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Monetary policy transmission in emerging market economies: what is new?

M S Mohanty and Philip Turner[1]

Introduction

The emergence of a truly global market economy and the associated changes in monetary policy regimes worldwide have sharpened the debate about how monetary policy affects the economy. When the Deputy Governors met at the BIS to discuss this topic a decade ago, several economies were either recovering from a crisis or in the midst of one. Inflation rates were high and volatile, and fixed or semi-fixed exchange rates dominated monetary policy regimes in a number of countries. In addition, the domestic economies and financial systems of several countries were relatively closed to the outside world. Financial markets were comparatively underdeveloped. Hence transmission channels in emerging economies were different from those in industrial countries. Much uncertainty surrounded the impact of monetary policy on prices and output and the channels through which they occurred. The survey of monetary policy transmission by Kamin et al (1998) grew out of this meeting.

Substantial changes over the past decade have doubtless altered transmission channels. Most, if not all, countries now have an independent monetary policy regime, with strong emphasis on inflation control. The financial markets in many countries are much more developed; the structure of the economy has undergone significant changes, and there has been a steady increase in trade and financial openness of emerging market economies. What do these developments mean for the transmission mechanisms of monetary policy? Have they reduced the degree of uncertainty concerning the impact of monetary policy? How have they influenced the response of the monetary authorities to various shocks? This paper seeks to update Kamin et al (1998), and draws extensively on the earlier paper. It discusses some of the new challenges facing monetary authorities in understanding the ways in which their policy instruments work through the economy.

The rest of the paper is organised as follows. Section 1 analyses the macroeconomic environment subject to which monetary policy is now conducted. Section 2 briefly reviews the major transmission channels for monetary policy and the extent to which their importance may have changed in the recent years. Based on a sample of emerging market economies, Section 3 provides some preliminary econometric evidence on whether the response of output and inflation to monetary policy shocks has changed between the early 1990s and 2000s. Section 4 focuses on implications for the transmission mechanism of key changes in household, corporate and banking system balance sheets. The penultimate section looks at the issues concerning the impact of globalisation on monetary policy transmission. The final section concludes.

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[1] This paper is based on information provided by the central banks of emerging market economies. It has benefited from discussions with central bankers attending the December 2006 Deputy Governors' Meeting and their subsequent comments. In addition, we are particularly grateful to Steven Kamin (an author of the 1998 volume on transmission mechanisms) for extensive comments. Thanks are also due to Andrew Filardo, Már Gudmundsson, Serge Jeanneau, Dubravko Mihaljek, Ramon Moreno, Sweta Saxena, Agustin Villar, Bill White and Feng Zhu, for useful comments; to Magdalena Erdem, Clara García and Pablo García-Luna for excellent research assistance and to Marcela Valdez-Komatsudani for very competent secretarial help. However, the views expressed in this paper and any remaining errors are our own.

1. Monetary and macroeconomic environment: what has changed?

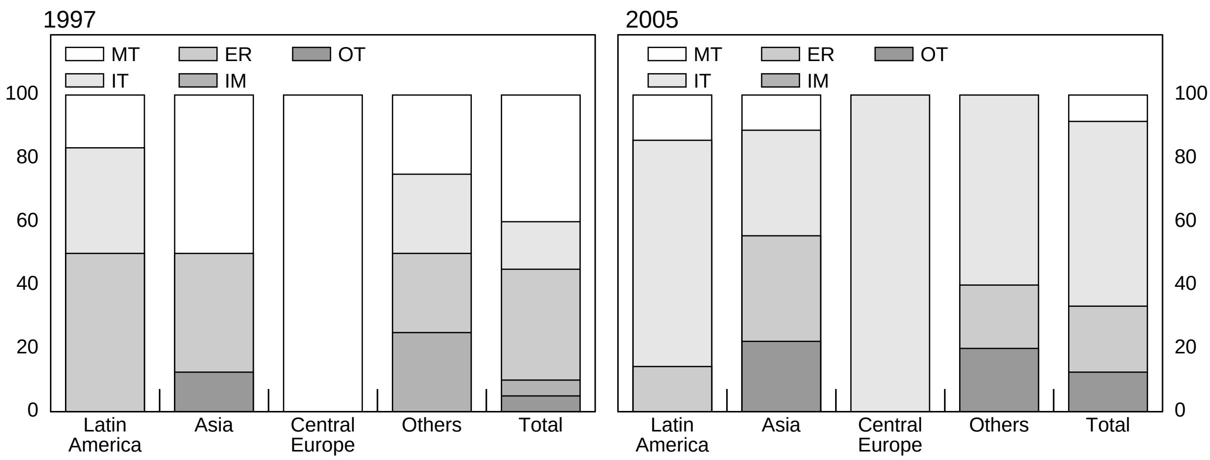
The monetary policy framework, the financial system in which the central bank operates and the real economy all condition monetary transmission mechanisms. The past decade has witnessed fundamental changes in each of these spheres. This section highlights some of the major policy changes with possible implications for the transmission mechanism.

More credible monetary policy regimes

One key change is in the growing focus of monetary policy on keeping inflation low, often (but not necessarily) in the context of formal inflation targeting. Targeting the exchange rate – often the alternative policy framework – fell out of favour after several crises from the mid-1990s demonstrated the increased vulnerabilities created by fixed exchange rate regimes. By 2005, some form of inflation targeting had become the most common monetary policy regime in emerging markets, with the number of fixed exchange rate and monetary targeting regimes falling sharply over the past decade (Graph 1).

Graph 1

Monetary regime
(percentage distribution)[1]



MT = monetary targeting; IT = inflation targeting; ER= exchange rate targeting; IM= IMF program; OT= others.

[1] Percentage of countries in the sample.

Sources: IMF; national data (questionnaire).

All major central banks in central Europe now conduct monetary policy through inflation targeting. Most do so in Latin America as well, although there are a few exceptions. Since the collapse of its dollar link in 2002, Argentina has been following monetary aggregates as an intermediate target for monetary policy. Since 2003, Venezuela has operated under a fixed exchange rate regime. In Asia, however, monetary policy regimes are much more mixed. Most crisis-hit economies switched to some sort of inflation targeting; but several nevertheless have a strongly managed exchange rate. China follows a quasi-fixed exchange rate regime and India has adopted a multiple indicator approach. Hong Kong SAR continues to operate under a currency board system and Singapore under an exchange rate (nominal effective rate) centred monetary policy regime. Among other countries, Israel, South Africa and Turkey have all adopted inflation targeting, while Saudi Arabia has a fixed exchange rate.

This focus on inflation has been accompanied by a further switch towards a market-oriented monetary policy operating system, and away from quantitative instruments of monetary control. Most countries now conduct monetary policy through indirect instruments such as open market operations, discount rates and foreign exchange swaps (Table 1). Credit ceilings as a primary instrument of monetary control have ceased to exist in many countries, while only a few countries rely on reserve requirements or moral suasion for carrying out monetary policy operations. The operating systems in many countries are converging to that observed in industrial countries: the central bank sets a key short-term interest rate (the policy rate) and allows the market to determine other interest rates in the economy.

Table 1

Primary instruments of monetary policy

	Credit ceilings	Reserve/ liquid asset require- ments	Discount rates	Open market operations	FX market operations	Moral suasion	Others
Latin America							
Argentina		Yes	Yes	Yes	Yes		
Chile			Yes	Yes	Yes		
Colombia				Yes	Yes		
Mexico							Yes[1]
Peru			Yes	Yes	Yes		
Venezuela		Yes		Yes			
Asia							
China		Yes		Yes		Yes	
Hong Kong SAR			Yes		Yes		
Indonesia		Yes		Yes	Yes	Yes	
Korea			Yes	Yes			
Malaysia				Yes[2]	Yes[3]		
Philippines		Yes		Yes			
Singapore					Yes[4]		Yes[5]
Thailand				Yes	Yes		
Central Europe							
Czech Republic				Yes			
Hungary				Yes[6]			
Poland		Yes		Yes			Yes[7]
Other EMEs							
Israel			Yes				
Saudi Arabia				Yes			
South Africa			Yes				
Turkey				Yes[8]			

For footnotes, see the end of the table.

Table 1 (cont)

Primary instruments of monetary policy

	Credit ceilings	Reserve/ liquid asset require-ments	Discount rates	Open market operations	FX market operations	Moral suasion	Others
Memo:							
United States		*Yes*	*Yes*	*Yes*			
Japan		*Yes*	*Yes*	*Yes*			
Euro area		*Yes*	*Yes*	*Yes*			
United Kingdom		*Yes*	*Yes*	*Yes*			

[1] Floor for short-term interbank interest rate and a target for daily settlement balances ("corto"). [2] Includes direct borrowing through open tender. [3] Mainly to smooth ringgit movements. [4] To target the S$ trade-weighted exchange rate. [5] Parameters: exchange rate bandwidth, slope of policy path. [6] The MNB also uses reserve requirement, interest rate corridor and FX market operations, but these are not the primary instruments of monetary policy. [7] Deposit facility; Lombard facility; and a corridor for o/n rates. [8] Overnight money market rate and other open market operations.

Source: National data (questionnaire).

One implication of these changes is that a flexible exchange rate opens up an additional channel of monetary policy transmission. Second, if monetary policy regimes have become more credible, there could be major implications for the transmission of monetary shocks. Several recent studies have confirmed the beneficial effects of inflation targeting for inflation expectations: see Mishkin and Schmidt-Hebbel (2001) and IMF (2006a).[2] Third, the shift to market-based monetary policy operations increases the role of the interest rate in the economy.

How visible has the impact of the monetary regime change been on the transmission mechanism? Graph 2, which reports the views of central banks on the relative importance of various factors in the transmission mechanism, suggests that it has been important in virtually every economy. In Mexico, studies show that a major break in the transmission mechanism was associated with the introduction of inflation targeting in 2001.[3] Since then, inflation has tended to become stationary, the degree of inflation persistence has fallen, and inflation forecasts of various private sector agents have converged to the central bank's inflation target. This appears to be true to varying degrees in several other countries as well (for instance, the Czech Republic, Colombia, Hungary and Poland). In Thailand, the switch from the fixed exchange rate regime to the managed float regime following the 1997–98 crises has had important effects on the transmission mechanism. In Turkey, the amendment of the Central Bank Law in 2001, providing a clear mandate to the central bank to maintain

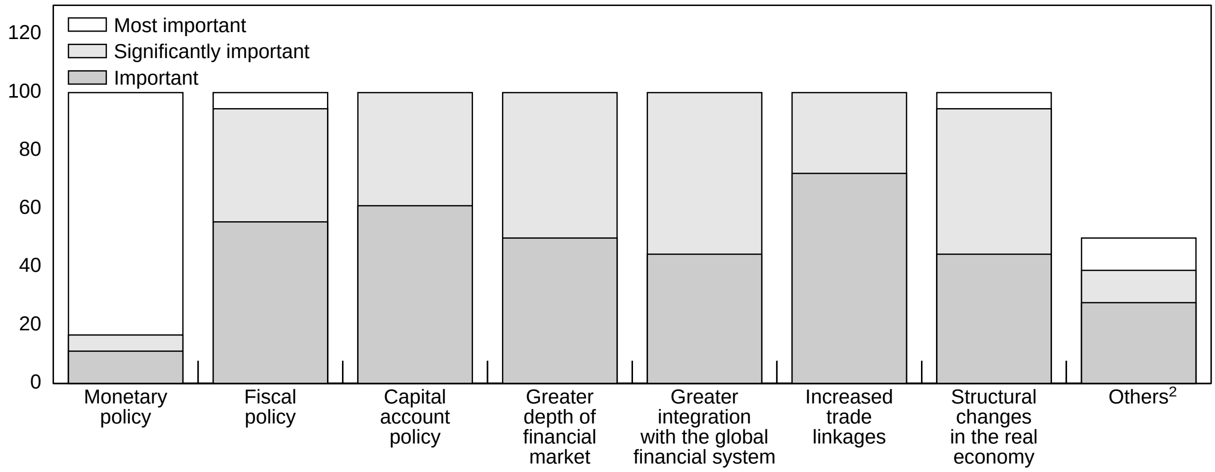
[2] Levin et al (2004) empirically confirm this hypothesis in the industrial country context. Although their findings do not provide such evidence for emerging markets they argue that this may be related to the fact that inflation was already falling in several countries when they introduced the IT regime and that the post-IT period is too short to conduct robust empirical tests for these countries.

[3] See, for instance, González and González-Garcia (2006).

price stability, and the recent disinflation have led to a significant reduction in the degree of inflation inertia and changes in firms' pricing behaviour.

Graph 2

Central banks' views on the importance of changes in the policy environment (percentage distribution)[1]



[1] Percentage of countries in the sample. Most important: score 1; significantly important: score 2 to 4; important: score 5 to 8. [2] "Others" refers to external shocks, trade credits and banking sector development.

Source: National data (questionnaire).

Experience in various countries indeed suggests that such effects are not confined to changes in the policy framework, but also extend to other areas of monetary policy. For instance, the introduction in India of a new liquidity management framework in 2004 (the so-called liquidity adjustment facility or LAF), setting a corridor for the movement of the daily interbank rate, has had significant implications for the transmission mechanism by improving the Reserve Bank of India's control over the interest rate. In Chile, such a change is associated with the removal of the unremunerated reserve requirement on short-term capital inflows (the "encaje"), the switch to a nominal interest rate as the operating target for monetary policy, and a greater degree of monetary policy transparency in the context of inflation targeting. In Malaysia, the transition to an interest rate-oriented monetary operating system in 2004 has strengthened the response of financial market prices to monetary policy changes. In Singapore, improved public communication of the monetary authority's exchange rate stance has affected the transmission mechanism by better stabilising private wage and price expectations.

Changed macroeconomic environment

The macroeconomic environment conditioning the conduct of monetary policy has also changed substantially over the past five years. As Table 2 shows, growth and inflation volatility has fallen in all regions (see Annex Table A1 for country details). The switch to a flexible exchange rate regime in many countries has limited the real overvaluations that often resulted when the exchange rate was used to stabilise inflation. Sudden currency crises have therefore become rare. Nevertheless, not all emerging market currencies have been fully flexible – several countries have witnessed an unprecedented and prolonged build-up of foreign currency reserves, particularly in Asia, during the past half decade. Indeed, the degree of exchange rate flexibility appears to have been much greater in Latin America and central Europe than in Asia (Annex Table A1).

Table 2

Volatility[1]

	Growth[2]		Inflation[3]	
	1990–99	**2000–Q206**	**1990–99**	**2000–Q206**
Latin America[4]	6.1	4.4	847.4	4.1
Asia[5]	4.3	2.5	5.0	1.7
China	1.8	1.3	8.2	1.6
India	1.2	2.3	3.6	0.9
Other Asia[6]	5.0	2.7	4.8	1.8
Central Europe[7]	1.7	1.5	14.1	2.5
Other emerging economies[8]	4.5	3.1	64.2	6.8
Total	**4.5**	**3.0**	**264.2**	**3.5**
Memo:				
United States	*1.5*	*1.3*	*1.1*	*0.8*
Euro area	*1.2*	*1.1*	*1.1*	*0.2*
Japan	*2.1*	*1.5*	*1.3*	*0.4*

[1] Measured as standard deviation using quarterly data; regional aggregation as simple averages of national volatilities. [2] Annual changes in real GDP. [3] Annual changes in consumer prices. [4] Argentina, Chile, Colombia, Mexico, Peru and Venezuela. [5] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [6] Asia as defined above but excluding China and India. [7] The Czech Republic, Hungary and Poland. [8] Israel, Russia, Saudi Arabia, South Africa and Turkey.

Source: National data.

A second major constraint on monetary policy – fiscal dominance – also appears to have eased. Since the ratio of the fiscal deficit to GDP has fallen (or stabilised) in many countries over the past five years, the public debt ratio has stopped growing rapidly (Annex Table A2). Substantial progress in lowering deficits has been achieved in Peru, Mexico, Saudi Arabia, South Africa, Russia and Venezuela during this period (partly because of higher commodity prices, however). In contrast, several countries in central Europe have seen a re-emergence of significant fiscal problems. In a number of countries, fiscal reforms have reduced direct borrowing by the government from the central bank. In India, the end to automatic monetisation of the central government fiscal deficit has ushered in a new era of monetary policy since 1997. In Chile, the introduction of the structural budget surplus rule (1% of GDP) since 2001 has reduced fiscal policy-related output volatility, enhancing the role of monetary policy in demand management. Several other countries (Brazil, India and Peru to name a few) have introduced similar budgetary laws to limit fiscal dominance.

Changes in the debt structure also affect transmission mechanisms. The reduced reliance on forex-denominated or forex-linked government debt has lowered the fiscal consequence of exchange rate changes. This has allowed governments to be more tolerant of such changes. Aktas et al (2007) point out that the fragile public debt structure of Turkey (dominated by short-term and inflation-indexed debt) in the past made the fiscal system very vulnerable to any tightening of monetary policy. The recent improvement in the fiscal situation has reversed much of this dynamic.

Table 3

Degree of openness[1]

	Trade openness[2]			Financial openness[3]		
	1990	**2000**	**2005**	**1990**	**2000**	**2005**[4]
Latin America[5]	24.4	32.2	39.7	67.6	95.7	103.8
Asia[6]	40.9	61.9	80.7	72.1	111.4	126.2
China	26.8	44.2	69.3	38.9	84.7	96.2
India	16.4	28.8	44.3	30.2	42.3	57.8
Other Asia[7]	90.3	126.2	136.2	174.1	226.9	247.1
Central Europe[8]	49.4	93.2	101.4		113.5	134.2
Other emerging economies[9]	36.2	64.8	64.2		138.2	128.8
Total	**44.5**	**67.1**	**79.8**		**128.1**	**139.6**
Memo:						
United States	*19.8*	*25.7*	*26.2*	*80.1*	*166.2*	*198.3*
Euro area	*55.3*	*72.6*	*74.1*		*212.5*	*261.5*
Japan	*20.5*	*21.3*	*28.1*	*111.4*	*100.4*	*154.4*
United Kingdom	*50.5*	*58.2*	*56.2*	*351.2*	*618.2*	*759.6*

[1] Indicators shown expressed as a percentage of GDP; aggregated using 2000 GDP and PPP weights. [2] Defined as the sum of imports and exports as a ratio to GDP. [3] Measured as the sum of gross stocks of foreign assets and liabilities as a ratio to GDP. [4] Data refer to 2004 for Mexico, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Poland, Saudi Arabia, South Africa and Turkey. [5] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [6] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [7] Asia as defined above but excluding China and India. [8] The Czech Republic, Hungary and Poland. [9] Algeria, Israel, Russia, Saudi Arabia, South Africa and Turkey.

Sources: Lane and Milesi-Ferretti (2006); IMF.

These reforms have been accompanied by far-reaching changes to trade and capital account policies in many countries. Table 3 underlines the greater integration of emerging market economies with the global economy since the beginning of 2000 (see Annex Table A3 for country details). As discussed in a following section, such integration has several potential implications for monetary transmission.[4]

Reduced government intervention in the financial system

Another important change has been the gradual reduction of government intervention in the financial system over the past decade. As discussed by Kamin et al (1998), government intervention in the past affected the monetary transmission process in at least three major ways: by imposing interest rate controls or other limits on financial market prices; by

[4] In Israel, for instance, a major break point in the transmission mechanism for monetary policy has been associated with the liberalisation of capital flows in 1997, which sharply increased the response of the exchange rate to the interest rate and significantly shortened monetary policy lags; see Barnea and Djivre (2004). See also Eckstein and Soffer (2008).

imposing direct limits on bank lending; or by providing government-financed credit to selected areas.

By 2005 *interest rate controls* had, by and large, been abolished in many countries. As Tables A4 and A5 in the Annex suggest, bank deposit and lending rates in most countries are now linked either directly to the policy rate or to a short-term market rate. In most countries, these rates are also negotiated with customers, implying some differentiation according to the latter's size and creditworthiness. Nevertheless, some countries still control interest rates for certain categories of borrowers and amounts of transactions. For instance, Colombia and Poland maintain a ceiling on interest rates for all categories of loans; Malaysia and Thailand have a maximum rate for consumer loans; and India imposes a minimum interest rate for saving deposits and small loans. It is unclear how far these controls affect the transmission of monetary shocks. For instance, a maximum rate for bank lending may not be binding if it is set at a fairly high level. But, as the experience of the United States with "Regulation Q" demonstrated, a sharp tightening of monetary policy can aggravate output and inflation volatility by leading to significant disintermediation of the banking system, thus squeezing credit supply. A floor rate for deposits implies that the nominal interest rate cannot fall beyond a limit, reducing both the flexibility of monetary policy to address deflationary pressures and the transmission of policy shocks through interest rates.

At the same time, several countries have significantly lowered *cash reserve requirements* for banks, which adversely affected their functioning and interfered with the development of financial markets. As Table A6 in the Annex shows, the typical cash reserve requirement in emerging markets is between 2 and 6%, which is still high relative to that seen in some industrial countries. Several countries (Argentina, Chile, China, Indonesia, the Philippines and Venezuela) impose reserve requirements in excess of 8%, although in some cases they may apply only to certain selected types of liabilities. Central banks in a number of countries do not pay interest on cash reserve requirements, and many pay interest at below market rates.

The picture varies with regard to *liquidity requirements*, which prescribe mandatory bank holdings of part of their liabilities in government securities or other such liquid assets. There is some evidence that such requirements have not fallen (and have even gone up in some countries) over the past decade (Annex Table A7). How far these requirements may be binding on banks' investment activities remains unclear. Given their attractive returns, banks in some countries (for instance, India) have invested in government securities beyond the prescribed minimum ratio. In other countries (for instance, Singapore), such a requirement is essentially a prudential, rather than a monetary regulation. To the extent that interest rates on government securities are market-determined, such requirements may not adversely affect banks' profitability but may have significant implications for trading volumes and market liquidity.

With the exception of a few countries, aggregate *credit controls* on banks have been abolished. China maintains monetary controls through the "window guidance" route, requiring banks to restrict credit expansion in certain sectors (for instance, real estate) and support development programmes. However, reliance on such controls is declining with the recent measures to liberalise interest rates in the economy (particularly the removal of a ceiling for the lending rate and a floor for the deposit rate). India has a minimum lending requirement for certain priority sectors. Prudential guidelines that would effectively restrict credit to certain sectors have been set in several countries. However, these are not explicitly used for monetary policy purposes.

Growth of financial markets

The past decade has also seen considerable development of financial markets in emerging market economies. The health of the banking system has improved substantially in all regions (Annex Table A8), and this has meant that the transmission of lower policy rates has improved (in the late 1990s, by contrast, weak banking systems compromised the transmission of easier policies). Apart from enhancing its resilience to monetary policy shocks, there is evidence that a healthy and competitive banking system reduces intermediation spreads. It also leads to a more symmetrical (and arguably more predictable) response of bank interest rates to higher and lower policy rates.[5]

More importantly, and in contrast to the experience of the 1990s, money and bond markets in several countries have deepened. One indicator of increasing money market depth is the growing daily turnover in relation to the banking system's total assets (Annex Table A9). In a number of countries, this has been led by growing use of repurchase operations in central banks' monetary operations. In Argentina, the central bank has been developing a market for its notes and bonds in order to develop a benchmark interest rate in the interbank market. In India, such a trend has been led by a substantial migration of money market activity from the uncollateralised call market to the collateralised repo market, paving the way for the development of a short-term money market. However, the interbank repo market continues to be underdeveloped in a number of countries, limiting the development of a robust term money market. Similarly, money market derivatives such as interest rate swaps, an important component of market liquidity, are absent in a number of countries.

Table A10 in the Annex provides indicators of liquidity in the domestic bond market. This influences the monetary transmission mechanism because it makes the yield curve more sensitive to changes in the policy rate and reduces sharp, unwarranted volatility in financial asset prices. In several countries, there is evidence to suggest that bond markets have grown in size and that maturities have lengthened over the past five years. Typical bid-ask spreads have fallen, and attempts have been made to increase maturity at issue to develop long-term benchmarks. Nevertheless, turnover ratios in many countries continue to be low compared to those in mature markets. In countries where turnover ratios are relatively large, they tend to reflect low outstanding stocks, rather than a significant increase in transaction volumes.

Reflecting financial market growth, the sources of financing of the private non-financial sector have broadened over the past decade (Annex Table A11). The share of commercial bank lending in total financing has fallen in many countries – in some cases (for instance, Hungary, Malaysia, Mexico and Thailand) quite sharply – between 1993 and 2005. This also remains true of the state-owned development financial institutions, which in the past played an important role in the financing of long-term capital projects. By 2005, the share of equity and bond financing was tending to rise. Another development has been a strong increase in financing through international capital markets, which constituted 20–40% of total private non-financial sector financing in many countries in 2005.

2. Major transmission channels

Among the various channels through which monetary policy can affect demand, five have been generally highlighted in the literature: short-term interest rates; long-term interest rates and asset prices; the exchange rate; the credit channel; and the expectations channel: see Mishkin (1995). This section extends and updates the analysis prepared by Kamin et al (1998) and examines whether the relative importance of various channels has changed over the past decade.

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[5] See, for instance, Archer (2006) and Mohanty et al (2006) and the studies reviewed therein.

The interest rate channel

In most conventional models of monetary transmission, a change in the policy rate under the central bank's control spreads to bank lending and deposit interest rates, which directly affects business and household spending decisions.

As the marginal interest rate (ie that on new borrowing) changes, business and household spending decisions are affected. For this, the *real* rate is important: a rise in the nominal interest rate that reflects higher inflation expectations – so that the real rate remains constant – will not change the perceived marginal cost of borrowing. The impact on existing loan contracts (ie "old" borrowing) will depend on the terms of the contracts. With floating rate contracts, average rates will change in line with marginal rates. With fixed rate contracts, average rates change more slowly over time as old contracts come up for renegotiation. Such an effect is important because it will alter the cash flow and balance sheet positions of borrowers as it changes the average interest rate. Hence household and business spending responses to a given change in policy rate will depend on the nature of loan contracts and the degree of indebtedness (Section 4 expands this analysis further).

In industrial countries the interest rate channel generally plays an important role in the transmission of monetary shocks. For instance, according to research done by the European Central Bank (2002), direct and indirect effects of interest rate changes (including wealth and exchange rate effects) on investment explain about 80% of the total response of output to monetary shocks after a lag of three years. In emerging markets, during the 1980s and 1990s there were several impediments to the operation of the interest rate channel. The lack of well developed money and bond markets and frequent shifts in the risk premium are examples of such impediments. In some cases, binding interest rate controls combined with non-price mechanisms for allocating credit reduced the pass-through of the policy rate to other interest rates. This may have also reduced the macroeconomic effects of policy rate changes. A greater dependence of firms on the internal cash surplus for financing capital projects lowered the response of investment to interest rate changes. Limited possibilities for household borrowing restricted the impact of interest rate changes on households as well. As noted above, several of these constraints have eased over the past decade.

Has interest rate pass-through changed recently? While this issue is examined in detail by Moreno (2008), Table 4 summarises central banks' views about the relative strength of the pass-through of policy rates based on internal research. Several findings emerge from the table. First, in a majority of countries, pass-through is generally found to be stronger and longer-lasting for bank deposit and lending rates than for the bond rate. Second, long-term bond rates now react significantly to the policy rate, although the impact is seen as temporary in several cases (discussed below). Third, in economies with large external financing requirements – in particular Latin America – monetary policy easing may influence the inflation risk premium on local currency debt and even perhaps the country risk premium. If a lower policy rate is regarded as unsustainable or raises future inflation expectations, then market-determined rates further along the maturity spectrum may not fall and could even rise, sometimes sharply if the currency comes under pressure. As noted above, this has been a major dynamic in countries with weak fiscal positions and a history of high inflation. Because the credibility of fiscal and monetary policy has now improved in many crisis-prone countries and because of current account surpluses, this "perverse" dynamic has changed: an easier monetary policy may no longer warrant any rise in risk premia.

Table 4

Response of long-term interest rates to policy rates

	Bond rate			Bank lending rate			Country risk spreads		
	Most significant	**Significant**	**Insignificant**	**Most significant**	**Significant**	**Insignificant**	**Most significant**	**Significant**	**Insignificant**
Latin America									
Argentina			Yes			Yes		Yes	
Chile		L		L					Yes
Colombia		T			L			T	L
Mexico		Yes			Yes				Yes
Peru		L		L					Yes
Venezuela			Yes		Yes				Yes
Asia									
Hong Kong SAR[1]		L			L				T
India		Yes			Yes				
Indonesia	Yes					Yes		Yes	
Korea		Yes		Yes					Yes
Malaysia	L			L				T	
Philippines		Yes							
Thailand		T			L				
Central Europe									
Czech Republic		T[2]		L[3]					Yes
Hungary	Yes[4]			L[5]					Yes
Poland			T						T
Other EMEs									
Israel	L[6]				Yes				Yes[7]
Saudi Arabia			Yes		Yes				Yes
South Africa		Yes		L					Yes
Turkey	Yes				Yes			Yes	

L = Long-lasting; T = Temporary.

[1] Policy rate movements refer to changes in US federal funds target rate. [2] Depends on market expectations. [3] Stronger on short-term rates, depends on market expectations. [4] Immediate. [5] Takes a few months but persistent. [6] Impact occurs during the following one-two months and remains persistent. [7] Generally insignificant, depends on the size of the policy rate change.

Source: National data (questionnaire).

Table 5 shows that most central banks see interest rates as the dominant channel of transmission. For instance, in Mexico, while shocks to the exchange rate explained over 60% of changes in inflation during the 1990s, the share had fallen to 16% by early 2000. In contrast, interest rates now explain a large part of the short- and long-run variation in output and inflation.[6] In Argentina, during the high inflation years of the 1980s, nominal interest rates were largely determined by inflation expectations. Higher interest rates were often associated with a rise rather than a decline in inflation and the rate of nominal currency depreciation. In contrast, with inflation becoming more moderate since the early 1990s (aside from the spike when the exchange rate collapsed), interest rates now have a strong and predictable negative effect on inflation and output.[7]

Table 5

Most dominant channels of monetary policy transmission: central bank views

Latin America	
Argentina	Interest rates, money growth and nominal exchange rate innovations (under an environment of low inflation).
Chile	Direct interest rate, exchange rate, credit and expectations channel.
Colombia	Expectations, cost push, aggregate demand and exchange rate channel.
Mexico	Nominal interest rate.
Asia	
China	Mainly credit channel.
Hong Kong SAR	Direct cost of capital effect.
India	Money growth, interest rate and credit channel.
Malaysia	Credit, interest rate, exchange rate and asset price channel.
Philippines	Base money, interest rate and exchange rate channel.
Singapore	Exchange rate channel.
Thailand	Interest rate, exchange rate and asset price channel.
Central Europe	
Czech Republic	Interest rate and exchange rate channel.
Hungary	Exchange rate channel.
Poland	Interest rate and exchange rate channel.
Other emerging economies	
Israel	Exchange rate channel.
South Africa	Interest rate and exchange rate channel.
Turkey	Exchange rate, interest rate, expectations and risk premium channel.

Source: National data (questionnaire).

[6] See González and González-García (2006).

[7] See Basco et al (2006).

There is also evidence of the interest rate channel in several Asian economies having gained importance. This is particularly true of Thailand in the aftermath of the 1997–98 crises.[8] In Hong Kong SAR, as the Hong Kong Monetary Authority (2008) discusses in this volume, given its strong impact on consumption and fixed investment, the direct cost channel constitutes the most important channel for the transmission of monetary shocks from the United States (given the currency's link with the US dollar). In the Philippines, although monetary policy has a direct impact on inflation in the short run through base money, in the long run, it is the central bank borrowing rate which dominates the transmission channel.

The role of the interest rate channel has also increased in central and eastern Europe, although its relative importance varies across countries. For instance, in the Czech Republic and Poland, this rise has been accompanied by an increase in pass-through of the central bank policy rate to bank deposit and lending rates, and in Hungary by larger and more rapid changes in bond rates. The future adoption of the euro would presumably strengthen this trend. To the extent that a single currency will contribute to reducing money market volatility and further deepening the domestic bond market in the region, it will help increase the role of the interest rate in the transmission of euro area monetary policy shocks.

Long-term interest rates or the asset price channel

A major change since the mid-1990s is the development of market-determined long-term interest rates in many countries as bond markets have developed. This is discussed further by Moreno (2008) in this volume. Changes in growth and inflation expectations determine the long-term rate of interest. Monetary policy reactions to shocks that keep such expectations constant (eg higher policy rates to counter an incipient rise in inflation expectations) may thus have no visible impact on long-term rates. Unanticipated changes in monetary policy, however, will lead to changes in long-term rates. One important complication is the behaviour of term premia. It is difficult to interpret the sensitivity of long-term interest rates to monetary policy changes when term premia are also changing. This has important implications for the interpretation of changes in the shape of the yield curve.

The present value of any asset or durable good is inversely related to the real long-term interest rate and positively related to the earnings of the asset. Hence, for example, equity prices can be interpreted as reflecting the discounted present value of expected future enterprise earnings. It follows from this that the causality between asset prices and macroeconomic performance runs in both directions. Expectations of stronger growth raise expectations of future earnings and, possibly, equity prices. This two-way causality makes it difficult in practice to discern the true impact of asset prices on aggregate demand.

There are two major routes through which higher asset prices can increase demand. First, higher asset prices boost household wealth; if this is regarded as permanent, desired consumption will increase.[9] In addition, increased wealth can be used as collateral to allow intertemporal substitution. Second, higher asset prices raise the market value of firms in relation to the replacement cost of capital (the so-called Tobin's q), increasing the attractiveness of new residential and non-residential investment projects.

There is some evidence to suggest that private consumption has been positively associated with asset prices (Graph 3). House prices tend to be correlated with interest rates. In contrast, equity prices tend to be correlated with several variables only weakly related to monetary policy. Even so, there are still several mechanisms through which monetary policy

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8 See Disyatat and Vongsinsirikul (2002).

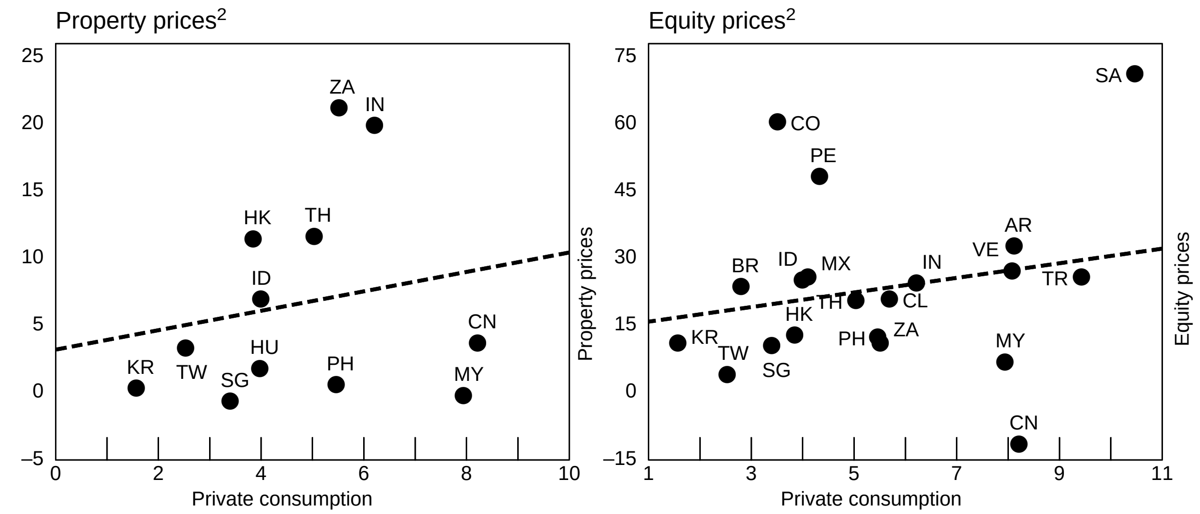
9 White (2006) argues that, in a closed economy, an increase in house prices may not imply an increase in wealth for the country as a whole, since they are likely to be offset by the expected future cost of living in a house.

could influence equity prices. First, lower interest rates reduce the discount factor for future dividend income, raising their present value. Second, to the extent that they raise expectations of future growth, lower interest rates may increase expected future cash flows and stock returns. Third, as pointed out by Bernanke and Kuttner (2003), an easy monetary policy may give rise to “expected excess return” by reducing the riskiness of stocks (for instance, by improving the balance sheet position of firms) as well as increasing investors' willingness to bear risk (for instance, by increasing expected future income).[10]

A major question is the extent to which the increased diversity of household wealth portfolios has enhanced the potential importance of asset prices for household consumption. Growing home ownership in many countries in recent years has been associated with a rise in the share of residential property in household wealth (for instance, over 60% in the Philippines and Colombia). This should, in principle, increase the sensitivity of consumption to policy-induced changes in property prices. In contrast, equities still constitute only a small part of household wealth in most emerging markets (for instance, between 1 and 2% in Colombia and India). In countries with a relatively diversified portfolio, such as Singapore, equities and residential property account for 18% and 48%, respectively, of total household wealth.

Graph 3

Asset prices and consumption[1]



AR = Argentina; BR = Brazil; CL = Chile; CN = China; CO = Colombia; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; SA = Saudi Arabia; SG = Singapore; TH = Thailand; TR = Turkey; TW = Taiwan (China); ZA = South Africa.

[1] Average of annual changes 2002-05, in per cent; in real terms. [2] Deflated by consumer prices.

Sources: OECD; Bloomberg; CEIC; Datastream; BIS.

Much depends on the degree of financial development and thus whether households are able to withdraw a part of their housing and equity wealth for consumption: see Mishkin (2007). This has been a major factor in many industrial countries in the current cycle, where households have borrowed against such collateral not only to finance higher consumption but also to invest in new residential property. In many emerging markets, however, banks might not be willing to lend even against collateral already in their possession. The

[10] In the context of the United States, Bernanke and Kuttner (2003) show that a 25 basis point surprise reduction in the Fed rate on average is associated with a 1 per cent increase in stock return (CRSP value-weighted index). This is similar to findings obtained in other studies; see, for instance, Rigobon and Sack (2002).

underdevelopment of the mortgage-backed securities market could also limit the financing of such expenditure via the market. In Mexico, for instance, the lack of a proper refinancing mechanism has been a major factor restricting households' ability to borrow against their assets. In the Philippines, the rental market provides partial compensation for a similar bottleneck as house owners are able to monetise part of their housing wealth by adjusting rents.

Has the role of the asset price channel changed in emerging market economies? This channel seems to have played a greater role in Asia than other regions in the current cycle. In China, for instance, strong property prices have been associated with higher bank lending since early 2005. House price inflation has in turn boosted household spending on a wider variety of durable consumption goods. The paper from Hong Kong SAR for this meeting draws attention to the differential impact of property prices on inflation and output: see Hong Kong Monetary Authority (2008). It shows that interest rate shocks operating through property prices have a much stronger impact on consumer prices than on household wealth and consumption. This is because rent is a much larger component in the overall price index in Hong Kong than it is in other economies. Nevertheless, a large decline in property prices over a short period can produce significant negative effects on consumption. This was demonstrated by a prolonged period of deflation in Hong Kong following the bursting of the property market bubble in 1997.

There is some evidence to suggest that the sensitivity of asset prices to interest rates may have changed, especially in South East Asia, following the 1997–98 crises. In Korea, while house prices are historically sensitive to changes in monetary conditions – in particular, bank lending – this relationship has strengthened further since the crises.[11] In Singapore, while interest rate induced property market cycles have played a significant role in the consumption cycle, the same does not hold for equity prices.[12] In contrast, in Thailand interest rates have had a much stronger influence on equity prices than on property prices in the post-Asian crisis period.[13] In Saudi Arabia a large increase in oil revenues over the past few years has been associated with a "liquidity boom" and a shift in investors' preference towards domestic assets: see Al-Jasser and Banafe (2008). This has led to sharp increases in equity and residential property prices and a consumption boom.

The exchange rate channel

In open economies, monetary policy operates to a considerable extent through the *exchange rate*. A key assumption underpinning this relationship is the uncovered interest rate parity condition (UIP): when the exchange rate is floating, a policy-led cut in the interest rate leads to capital outflows and a depreciation of the nominal exchange rate.[14] With sticky prices, this leads to a real depreciation and an increase in the price of tradables relative to non-tradables. The exchange rate channel plays an important role in emerging market economies for several reasons. First, the influence of the exchange rate on demand in small open economies tends to be large. Second, the exchange rate often constitutes a key variable for private sector expectations about inflation. Third, exchange rate changes produce large balance sheet effects in those economies where households and firms have foreign currency assets and liabilities.

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[11] See Park (2006).

[12] According to the internal estimates of the Monetary Authority of Singapore, a dollar decrease in the main equity price index leads to a fall of 2 cents in private consumption.

[13] See Sriphayak and Vongsinsirikul (2006).

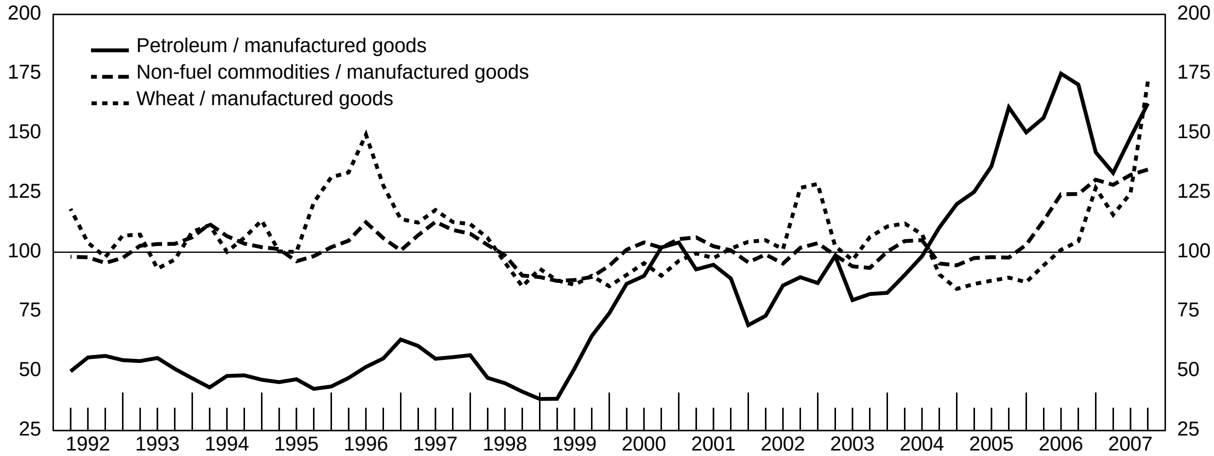
[14] More strictly, UIP implies that the exchange rate must fall enough to generate expectations of a subsequent appreciation equal to the new interest rate differential.

Singapore – an open economy par excellence – actually uses the nominal effective exchange rate as its intermediate target for monetary policy. In such an open economy, output and inflation are highly sensitive to changes in the exchange rate.[15] There is a similar adjustment mechanism in Israel, where the exchange rate appears to dominate other transmission channels.[16]

The importance of the exchange rate channel may also depend on the share of domestic value added (compared with imported goods/services) in tradables. If this is high, exchange rate changes have a large effect on output and on demand. But if import content is very high, then the exchange rate will have a more limited impact on domestic product, and a large direct impact on inflation instead.[17]

Graph 4

Relative prices of commodities and manufactured goods[1]



[1] 2000–05 = 100. Manufactured goods price is estimated as a weighted average of export prices of manufactures for industrial countries based on 2003 export values.

Sources: IMF; Datastream.

How far has the relationship between the interest rate and the exchange rate changed in recent years? Lower and more stable risk premia (eg as a result of the better macroeconomic environment) may have made the exchange rate response to domestic

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15 Research shows that the transmission of monetary shocks is relatively weak through the interest rate, which plays only a minor role in output and inflation development; see Chow (2005).

16 See Barnea and Djivre (2004). See Eckstein and Soffer (2008)

17 A special case in which devaluations can be contractionary has sometimes been put forward in the analyses of emerging market economies. This case arises when the debt of households, government or corporations is denominated in foreign currency and owed to non-residents: in such a case, a rise in the domestic currency value of debt following devaluation may offset the effect of expenditure-switching to domestically produced goods. This was frequently argued to be the case in Latin America during the 1980s – because of extreme currency mismatches in balance sheets.

Kim (2005) argues that in Korea a real depreciation has a negative impact on profitability and investment (through increased debt service payments as well as import costs). Sarikaya et al (2005) report a similar finding in Turkey. The 1997–98 Asian financial crises brought to light a similar problem for countries where firms and banks had borrowed heavily in foreign currency. As foreign currency debt declines, of course, these contractionary impulses are reduced. This devaluation-as-contractionary theory has often been used to resist necessary exchange rate adjustment ("fear of floating"); it is important to be clear on its limitations. Because bygones are bygones, inherited debt structures should not influence current production decisions: a devaluation therefore unambiguously makes domestically produced goods more competitive with foreign goods in an opportunity cost sense.

interest rates more predictable. In Hungary, for instance, volatile risk premia during the 1990s weakened the response of the exchange rate to monetary policy shocks. But studies covering a more recent period report that an unexpected 25 basis point increase in the policy rate results in an immediate exchange rate appreciation of 0.5–1%.[18]

In principle, the increased share of foreign goods and services in emerging markets should have made the exchange rate channel more potent. There is, however, econometric evidence that the pass-through for exchange rates to domestic prices appears to have declined in many emerging market economies: see Mihaljek and Klau (2008). One reason for this is that the "signal" value of the exchange rate for inflation has declined as confidence has grown in the efficacy of domestic policy frameworks in controlling inflation.

Finally, a new complication in exchange rate dynamics in many countries might be noted. This is the greater importance of medium-term changes in the terms of trade. During the 1990s, the terms of trade between raw material and manufactured goods showed no obvious trend (Graph 4). Beginning around mid-2003, however, oil prices rose. Then the prices of non-fuel commodities began to rise. Most recently, wheat prices have surged. At first, it was not clear whether these developments reflected market-specific factors and were purely temporary. However, it now appears that these relative price shifts are rather long-lasting.

Such shifts make it very hard for the central bank to "read" the exchange rate, and to decide how far (if at all) it would be wise to use monetary policy to offset or to spread over time the effects of exchange rate changes. The real long-term equilibrium exchange rate may well have risen in the commodity-exporting countries as commodity prices reach a new medium-term level. If so, this represents a real change that monetary policy should not seek to offset. Many would indeed argue that monetary policy cannot offset the real exchange rate in the long run – attempting to do so would eventually cause real appreciation via higher inflation. Exactly comparable arguments apply in the case of rapidly developing countries whose underlying capacity to produce tradables has expanded. In both cases, appreciation pressures are accentuated by capital inflows.

In practice, however, central banks have considerable room to manoeuvre in the short run. Policy decisions will be all the harder because it will not be clear *how far* the equilibrium exchange rate has risen. Nor will it be obvious how far a gradual – rather than abrupt – movement to a new equilibrium will reduce adjustment costs. Central banks will need to look very closely at the *determinants* as well as the size of exchange rate movements when setting interest rates.

The credit channel

A separate credit channel exists when banks ration credit through non-pricing mechanisms, so that the terms on which credit is available include variables additional to the interest rate. The credit channel has been particularly important in the emerging market context, where credit controls and directed credit programmes have limited firms' and households' access to the credit market. Such constraints have often been tightened during periods of monetary restriction.

Even in the absence of such restrictions, it has long been known that a tightening of monetary policy can generate a negative credit supply response (in addition to a demand-led contraction). Banks tend to respond to monetary tightening by cutting the supply of loans to small borrowers (the so-called bank lending channel) and raising the spread charged to them.[19] To the extent that banks hold limited equity, their lending capacity might be further

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[18] See, for instance, Vonnák (2006).

[19] Evidence in both developed and emerging markets shows that banks do face resource constraints (to the extent that they cannot replace lost deposits with market borrowing) because they might be subject to

impaired in the face of a binding capital-to-asset ratio due to a rise in non-performing loans.[20] In addition, banks' credit supply could be affected through a deterioration in borrowers' net worth and a decline in collateral values (the balance sheet channel).[21]

As noted above, the past decade has seen major developments in credit markets. Financial systems in most countries have been substantially deregulated and the health of the banking system and the regulatory environment has improved. How might these developments influence the credit channel?

Table 6

Investment response to bank credit from a panel regression: 2000–05

	Without control			**After controlling**[1]		
	Bank credit	**R^2**	**DW**	**Bank credit**	**R^2**	**DW**
Asia[2]	0.14	0.29	2.33	0.25**	0.63	1.94
	(0.90)			(2.20)		
Latin America[3]	0.70***	0.40	2.01	0.65***	0.60	2.42
	(2.96)			(2.69)		
Others[4]	0.44*	0.33	2.15	0.40	0.45	1.81
	(2.00)			(1.47)		
All emerging markets	0.49***	0.32	2.14	0.43***	0.48	2.03
	(3.82)			(3.72)		

*, **, *** denote coefficients significantly different from zero at the 10%, 5% and 1% level respectively; t-statistics are given in parentheses.

[1] The panel for the control specification is:

$$\Delta \log(inv) = \alpha_0 + \alpha_1 \Delta \log(bc) + \alpha_2 \Delta \log(y_{t-1}) + \alpha_3 \Delta(i-\pi) + \alpha_4 \Delta \log(xp) + \alpha_5 \Delta \log(inv_{t-1})$$

where "Δ" is the first difference operator, "bc" is real bank credit deflated by consumer prices, "π" is consumer price inflation, "inv" is gross fixed capital formation in real terms, "i" is the nominal bank lending rate, and "xp" is the volume of exports. All panels include cross-section fixed effects. [2] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan (China) and Thailand. [3] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [4] The Czech Republic, Hungary, Israel, Poland, Russia, Saudi Arabia, South Africa and Turkey.

Source: BIS estimates.

Table 6 shows the estimated response of fixed investment to bank credit from a panel regression focusing on the first half of this decade. A main finding emerging from the table is that bank credit appears to have a significant influence on investment in emerging market economies. This finding does not change even after controlling for several demand factors (such as output, exports and the real interest rate), suggesting that the supply of bank credit does play a role in influencing fluctuations in investment spending (nevertheless, it should be

asymmetric information problems, and tighter monetary policy reduces their profitability; see Kashyap and Stein (2000) and Bean et al (2002).

[20] See Van den Heuvel (2002) for the role of bank capital in monetary policy transmission.

[21] See Bernanke and Gertler (1995).

borne in mind that reverse causation – investing firms becoming keener to take out loans – could bias the coefficients in this regression). Another important finding is that the relative impact of bank credit on investment varies across regions: the impact is stronger in Latin America and central and eastern Europe than in Asia.

Country experiences of the importance of the credit channel are mixed. In several countries, a prolonged period of easy monetary policy over the past few years may have reduced the influence of this channel. In Poland, for instance, there appears to have been some weakening of the credit channel as banks have built up a large "liquidity buffer". Such a buffer can shield banks from a tightening of monetary policy.[22] While a credit channel was operative in the Czech Republic during 1996–98, evidence of its existence is weak during the early 2000s. Yet some studies show that there may be a distributive effect of monetary policy in the sense that banks with higher levels of non-performing loans respond less positively to a cut in the interest rate.[23]

In Asia, a sharp decline in bank credit in the aftermath of the 1997–98 financial crises has been followed by a revival since the early 2000s. In several countries the degree of credit market imperfection appears to be declining. In the Philippines, while the development of a commercial paper market and greater use of loan commitments (fixed credit lines for discretionary use by firms) have reduced some of the effects associated with a tighter monetary policy, a relatively high non-performing loan ratio in the banking system has had an opposite effect. In Thailand, studies show a significant decline in the output and inflation response to bank credit, particularly following the 1997–98 financial crises, which has led to increased financial diversification. This also remains true in Singapore, where small and medium-sized enterprises are increasingly accessing the equity and bond markets for their financing needs.

In the two large Asian economies, however, bank credit is still central. In China, given the quantitative orientation of its monetary policy and significant credit controls, monetary policy primarily affects demand by changing the supply of credit. In India, recent research has shown that small banks tend to curtail credit supply more sharply than big banks during monetary tightening.[24]

In Latin America, the recent surge in lending has relieved the earlier fears of credit constraints. Investment and credit have been positively related in most countries in the current cycle. In Colombia, although the credit channel remains important, its role has been reduced in recent years as firms have increasingly relied on internal revenue for financing capital projects. At the same time, credit flow to small firms and households has improved substantially. The 1995 financial crisis had a widespread impact on the credit market in Mexico, with banks actively rationing credit. However, during the past few years, bank credit to the private sector has grown at a rapid rate.

The expectations channel

Although not a stand-alone channel, expectations have considerable significance for the effectiveness of all other channels of transmission. To the extent that private sector wage and price expectations are forward-looking, they can speed up the adjustment of nominal demand to a change in central bank policy and affect the transmission lag to inflation. The expectations channel could influence transmission to the extent that central bank policy is anticipated by the market and priced into the yield curve.

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[22] See, for instance, Lyziak et al (2006).

[23] See Pruteanu (2004).

[24] See, for instance, Pandit et al (2006).

The operation of any expectations channel depends on several factors. One is the degree of *central bank credibility*: a higher degree of credibility leads to greater anticipated effects of monetary policy and vice versa. A second factor is the degree of *predictability* of central bank actions, which can be improved by increasing transparency and public communication of policy. As a third factor, some have argued that a higher degree of *commitment* by the central bank to vary its instrument consistently can enhance the role of the expectations channel.[25] One example was the quantitative easing policy followed by the Bank of Japan from 2001 to early 2006 to bring an end to deflation in Japan. Under this policy, the Bank of Japan announced that it would maintain its zero interest rate policy until inflation was sustained at a positive level. The policy was intended to anchor public inflation expectations but it also helped to stabilise the long-term interest rate. Inflation targeting may do this in much the same way in other countries.

A review of experience reveals the increasing importance of the expectations channel. One indicator is the growing convergence of private sector inflation expectations around the central bank's inflation target in many countries (including the Czech Republic, Colombia, Mexico and South Africa) in recent years. A second indicator in several countries is the stronger reaction of financial markets to central bank policy announcements. In Thailand, for example, the housing and bond market responded to the recent monetary tightening at an early stage. With the mortgage interest rate adjusting to an expected rate increase, the overall financing cost for homeowners moved up before monetary policy was tightened. In Singapore, the volatility of market rates around policy announcement dates has fallen significantly following increased communication of the central bank's monetary policy stance to the public.[26] In India, the opening-up of a two-way communication channel between the central bank and market participants has increased the signalling role of monetary policy.[27]

As financial markets come to better anticipate central bank policy, the size of policy rate adjustments can be reduced. As money market and bond rates move in anticipation of policy rate changes, central banks will need to factor in the impact of such movements on demand and on their actual policy rate adjustments. Careful monitoring of such feedback effects can be crucial. In a sense, market rate movements may often "do the central bank's work".

In a questionnaire response, most central banks said that the growing role of the expectations channel has implications for the magnitude of their interest rate response. For instance, in the Czech Republic, during the early years of the inflation targeting regime (1998 and 1999), the central bank changed its policy rate somewhat aggressively (usually by 50 basis points). But with inflation expectations becoming well anchored and monetary policy actions being better anticipated in recent years, the central bank has reduced the magnitude of the policy rate adjustment (usually 25 basis points). In Colombia, the volatility of the policy rate has fallen since 2000 following improved credibility of monetary policy.

Greater credibility of monetary policy allows a central bank to pursue a countercyclical policy that it could not safely pursue in the past when inflation was high or when its anti-inflation commitment was not trusted. In Israel, for instance, more stable nominal wage expectations have allowed the central bank to moderate interest rate moves.

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[25] The often quoted "Taylor rule" is one variant of such a commitment device. For a discussion on optimal policy commitment see, for instance, Clarida et al (1999) and Eggertsson and Woodford (2003).

[26] An empirical test conducted by the Monetary Authority of Singapore showed that during 2001–2005 about 50% of the policy change was priced in by market participants 10 days ahead of the actual policy announcement date; see MAS (2005).

[27] Mohan (2005) discusses the channels through which the Reserve Bank of India's communication policy may have helped to increase the effectiveness of monetary policy. See also Mohan (2008).

3. Has the output and inflation response to monetary policy shocks changed?

This section presents an analysis of output and inflation responses based on a monthly VAR model for a sample of countries.[28] The variables considered are industrial output, consumer price inflation, the real effective exchange rate, and the nominal short-term interest rate. The model was run for two sample periods: the first one covering the period 1990–96 and the second, 2000–06. The idea is to compare output and inflation responses in these two periods without considering whether a break actually occurred.[29] Following other studies, the variable orders are as indicated above, with output entering as the most exogenous and the interest rate as the least exogenous variable.[30] The assumption is that the interest rate responds to contemporaneous values of all three other variables; viz, output, inflation and the exchange rate.[31]

Graphs A1 and A2 in the Annex show impulse responses of output and inflation to one standard deviation shock in the interest rate. Such a model is of course a very simple representation of the monetary transmission mechanism: for instance, it does not include inflation expectations, credit aggregates or commodity prices, all of which have a high degree of significance for the inflation process in many countries. The following findings emerge from this analysis.

- In several countries, the short-run industrial output response to an interest rate shock appears to be subdued in both periods. In some countries (for instance India, Korea, Thailand and South Africa) the short-run output response seems to have increased during the first half of this decade compared with that in the first half of the 1990s. In most countries, industrial output recovers relatively rapidly following the monetary shock. In both periods, the long-run neutrality of monetary policy is validated given that output returns to the base level within a period of one to two years.
- In contrast, the response of inflation to monetary policy shocks appears stronger in the first half of the 2000s than in the first half of the 1990s. However, the response varies across countries. For some countries (for instance, Mexico and South Africa), the response is relatively strong. In a number of other countries (Chile, the Czech Republic and India), however, inflation rises for several months before falling in response to monetary tightening, suggesting something of a "price puzzle".[32] One explanation is that the assumption of a policy shock being purely exogenous may not be valid; in reality, the monetary authorities look at a much wider set of information about the economy. Consequently, both inflation and the interest rate may rise together for some time before the contractionary impact of monetary policy

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[28] The countries are India, Indonesia, Korea and Thailand from Asia; Chile and Mexico from Latin America; the Czech Republic and Poland from central Europe; and South Africa.

[29] The second half of the 1990s was excluded from the model to allow for the fact that many Asian economies went through a crisis during this period and that having different estimation periods for different countries might affect the comparability of results.

[30] See, for instance, Christiano et al (1999) and Castelnuovo and Surico (2006).

[31] The base model was run with three lags and with absolute values of inflation and the interest rate and changes in industrial output and the real exchange rate. In subsequent estimations, to check for model robustness, several alternative specifications were attempted. These included a longer lag length and first differencing of the interest rate and inflation as well as a measure of the industrial output gap instead of levels. Given that the results are not very different across specifications, the findings are based on the base model.

[32] See Sims (1992).

takes hold.[33] A second explanation is that a “cost channel” might be in operation whereby higher interest rates raise the costs of working capital and, in turn, prices before firms adjust supply in response to lower demand. Some have argued that the importance of the cost channel may rise as financial “frictions” decline, leading to increased pass-through of policy rate changes to working capital costs; see, for instance, Chowdhury et al (2006).

These results are supported by the variance decomposition analyses:

- The longer-run impact of monetary policy on inflation differs across countries. In a number of countries, the impact seems to have increased significantly between the first half of the 1990s and the first half of this decade. For instance, in Indonesia, Mexico and South Africa the variance in inflation explained by interest rates two years after the monetary policy shock appears to have increased from 2–5% during the first period to 10–30% in the second period.
- In contrast, in several other countries (India, Korea, Thailand, Chile, the Czech Republic and Poland), the variance in inflation explained by the interest rate appears to be small and to have fallen in the first half of this decade (from 1–14% following two years of shocks during 1990–96 to 2–3% during 2000–06).[34]
- As regards the variance in industrial output explained by the interest rate, the picture is similar. With the exception of South Africa, in several countries it varies from 1 to 8% after a gap of two years.

What could explain such a difference? One explanation could be that the model does not adequately capture the dynamics of the transmission mechanism in some countries because it omits several other channels and includes only partial estimates of output.[35] Another could be an experience similar to that of industrial economies where the decline in the share of output and inflation volatility explained by the interest rate is related to the relative stability of inflation and output.[36] The argument is that, to the extent that monetary policy may now systematically respond to various shocks with an objective of stabilising inflation and output, one would expect a reduction of inflation and output variability due to monetary policy innovations. The role of expectations is crucial in this context.

4. Balance sheet developments and transmission

This section discusses three major issues for the transmission mechanism related to changes in the balance sheet position of the private sector. It focuses on both current and possible future implications. One is the nature and the extent of changes in household

[33] Bernanke (2004) links such price puzzles to autonomous increases in inflation expectations, particularly in countries where such expectations are not sufficiently well anchored.

[34] But this does not necessarily mean that monetary policy measures have become less effective: as argued in the previous section, a more credible policy framework may well anchor inflation expectations without large changes in interest rates being necessary.

[35] One limitation of the model is its recursive ordering of the shocks. A structural VAR with a different ordering scheme may produce different results. However, implementing such a model for a large number of economies poses a difficult task.

[36] For instance, in the context of the United States, Boivin and Giannoni (2002) reported that the variance in output explained by monetary policy in the United States had fallen from 20% in a pre-1980s sample (1963–79) to 3% for the post-1984 sample (1984–97) and that of inflation from 14% to 6% during the same period. They attribute this finding to the greater success of monetary policy in stabilising inflation and output.

balance sheets implied by the recent rapid growth in household credit. The second is the ways in which recent corporate financial disintermediation might change the response of investment to monetary policy changes. A third issue is the impact of recent structural changes in the balance sheets of banks.

Implications of increased household lending

An important development since Kamin et al (1998) that has potential major implications for monetary transmission has been the greatly increased proportion of bank lending going to households (Table A12 in the Annex).[37] This has been accompanied by a rise in household debt as a percentage of disposable income in several countries, and growing household leverage ratio (debt as a percentage of household assets) in some countries (Table A13 in the Annex).

This in effect has relaxed household budget constraints, which could make the intertemporal substitution effects of monetary policy more powerful. In the past, in many countries, households were able to borrow relatively little from banks; during the past decade this has changed, increasing the substitution effects of monetary policy changes. At the same time, higher debt levels mean that changes in the policy rate can also generate substantial income effects as debt servicing payments amount to a greater share of household income. Such income effects could also be non-linear, rising substantially as the household debt levels rise beyond a certain threshold.

A second implication is that changes in the household balance sheet can lead to potential wealth effects from monetary policy, particularly through the housing market. Housing has become an important component of wealth in many countries, with possible implications for consumption. Such an effect could be reinforced by the use of housing as collateral.[38]

A third potential implication of changes in household balance sheets is linked to the cash flow effects of monetary policy on consumption and residential investment. Many factors influence the impact of policy on household cash flows: nominal interest rates; the size of gross financial liabilities and assets; and the nature of financial contracts. The argument is that high interest rates impose a cash flow constraint on prospective borrowers: the classic example is housing affordability indices, which have fallen in recent years following a large reduction in nominal interest rates. For existing borrowers, cash flow effects are substantial to the extent that they could refinance a previous loan at a lower rate. Households with a relatively high debt-to-income ratio tend to be relatively more cash constrained than others, exhibiting a higher degree of sensitivity to interest rate changes.[39]

Similarly, larger flows of financial liabilities produce stronger cash flow effects from a given change in the interest rate. With the exception of central Europe and Turkey, the ratio of gross financial liabilities flows of the personal sector to GDP has actually fallen in most countries over the past decade (Annex Table A14). In several cases, such a trend might reflect borrower prudence following a series of financial crises in the mid-1990s. If so,

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[37] For instance, as Table A12 shows, the share of mortgage credit in total bank credit in many emerging market economies (say between 20 and 40% in 2005) has recently exceeded that seen in the United States (25%). This is also the case for consumer credit (10–30% in several countries) led by a significant increase in credit card lending by banks.

[38] In addition, it is possible that greater borrowing opportunities allow younger households with little capital to "save" in the form of bigger houses, pushing up prices and stimulating demand. This would be dependent on the consumption response of those who do not own homes and whether they cut their spending in response to a rise in the cost of a future house purchase.

[39] See Grenville (1995) and Kneeshaw (1995) for a discussion on cash flow effects associated with monetary policy.

improved macroeconomic conditions and continued credit growth may reverse this trend. In contrast, in many countries the share of mortgage debt in the gross financial liabilities of the personal sector has increased.

As regards the nature of financial contracts, the shorter the duration of a loan contract, the more frequently it will be rolled over to reflect new interest rates, and hence the more quickly changes in policy rates will lead to changes in income and cash flows. The maturity structure of household loans is relatively short in many emerging market economies compared with industrial economies. Another important factor is the degree of indexation of financial contracts to inflation and the exchange rate which can aggravate cash flow effects of monetary policy. The rapid growth in foreign currency borrowing by households in central Europe over the past five years has increased their exposure to significant income and cash flow effects from changes in the exchange rate. In contrast, in those Asian and Latin American countries where a large proportion of debt had in the past been indexed to inflation and the exchange rate (a major vulnerability in earlier crises), indexation has generally been reduced.

What might be even more important is the extent to which households are borrowing at variable interest rates. Table A15 in the Annex shows that variable rate contracts dominate emerging mortgage markets. Fixed rate contracts are relatively important in Israel, the Czech Republic and Mexico. In addition, in most countries mortgage rates are either linked directly to the policy rate or indirectly through the banks' prime lending rate. Nevertheless, mortgage lending rates in a number of countries are subject to a maximum limit. Although similar information about consumer lending (particularly through credit cards) is not available, in most countries such loans tend to be at variable rates and of short-term duration.

In countries with primarily fixed rate lending, households will be insulated from movements in the policy rate. The burden of adjustment in this case shifts to lenders who might have funded themselves at adjustable interest rates.[40] Only new borrowers will be affected by such changes in interest rate. Much will also depend on how households view a particular change in the interest rate and on their forward-looking behaviour. If at the trough of the cycle, households expect the interest rate to go up, they might in effect raise precautionary saving by increasing repayments so as to maintain a constant debt repayment plus interest service rate. They may in short behave as if the interest rate is fixed over the cycle: see Debelle (2004).

Corporate balance sheets and the transmission mechanism

The impact of monetary policy on non-residential investment depends in part on the balance sheet position of corporations. As Kamin et al (1998) note, when initial balance sheet positions are strong – that is, assets far exceed debt repayment obligations – the probability of future financial distress may remain low even after a marked reduction in the value of asset holdings, and therefore expenditures may be little affected. But if balance sheet positions are weak, the same reduction in asset values may increase the probability of insolvency, and so lead to a sharp and sudden fall in borrowing and spending. Such effects may be more marked in the emerging market context because capital market imperfections limit borrowing possibilities severely. The impact of monetary tightening could therefore be accentuated by the so-called "financial accelerator" where weak corporate balance sheets may act to exaggerate the impact of a rise in the interest rate.[41]

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[40] Yet an easy monetary policy could still have an impact to the extent that households might choose to refinance their mortgages at lower interest rates.

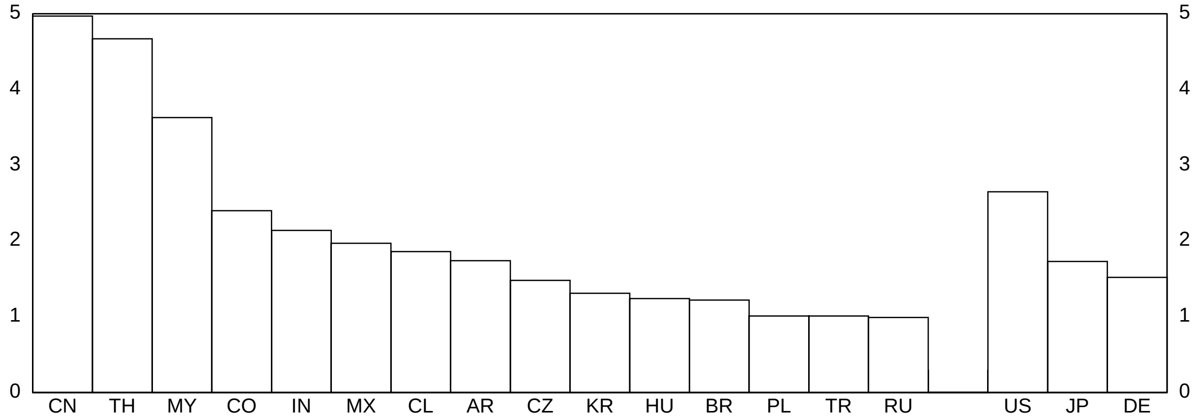
[41] See Bernanke et al (1999).

Trends in corporate balance sheet variables

Various indicators may capture the balance sheet vulnerability of firms to monetary policy shocks. One important measure is net worth, the ratio of net assets to income. Another is the ratio of debt to assets, which measures leveraging and may be better correlated with the probability that firms will have difficulty meeting scheduled debt service obligations. The degree of leveraging also indicates the prospective size of cash flow effects resulting from monetary policy measures as interest payments on debt rise. The latter effect could be captured by a third indicator, the ratio of net interest payments to income.

Graph 5

Internal resources[1]



AR = Argentina; BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; DE = Germany; HU = Hungary; IN = India; JP = Japan; KR = Korea; MX = Mexico; MY = Malaysia; PL = Poland; RU = Russia; TH = Thailand; TR = Turkey; US = United States.

[1] The internal resources index is defined as the ratio between the sum of cash flow from operations, plus decreases in inventories and receivables, plus increases in payables, over the sum of capital expenditures. This index is the complement to the Rajan and Zingales Index of External Finance, extracted from the Corporate Vulnerability Utility.

Source: IMF (2005).

Unfortunately, data on many of these indicators are not available consistently across countries. Nevertheless, what information there is suggests that the typical corporate leverage ratio in emerging markets has often been surprisingly higher than in industrial countries; see IMF (2005). For instance, the average corporate leverage ratio in Asia stood at 38% between 1993 and 2003, compared with 24% for the G3 countries. Latin America and emerging Europe have comparatively low ratios (26% and 28%, respectively). One factor often cited for a relatively high leverage ratio of emerging market firms is their comparatively low market-value-to-book-value ratio, which encourages firms to finance investment through debt rather than equity. On the other hand, in several emerging market economies firms tend to rely more heavily on internal funds than those in industrial countries, which may help constrain the leverage ratio (Graph 5).

One major indicator of how the balance sheet position of firms may have changed in more recent years is given by trends in gross financial liability flows of the non-financial corporate sector (Annex Table 16). In most countries, such liabilities as a percentage of GDP fell sharply – in some cases dramatically – between 1995–97 and 2003–05. There are a few exceptions, such as Thailand, where the appetite of firms to borrow did rise following the 1997–98 financial crisis. In a number of Asian economies (for instance, China and India) in recent years, firms have funded a larger part of their investment out of (growing) profits. This is also true, albeit to a lesser extent, in other regions, particularly in crisis-hit countries. In Argentina, firms have mostly relied on self-financing (to the extent of 80% of their new capital spending) for investment following the recent crisis. Similarly, in Turkey the corporate leverage ratio has fallen steadily since 2001 following a sharp rise in corporate profits.

There have also been significant changes in the composition of corporate debt. Three major trends are discernible from Table 7. First, the share of bank debt in total liabilities fell in a number of countries between 1995–97 and 2003–05. Second, with firms' increasing access to both local and international bond markets, the share of market debt in total liabilities has increased in several countries. Third, there has been a significant rise in equity financing by the corporate sector, particularly in Asia, where stock valuations have seen rapid growth over the past few years.

Table 7

Composition of outstanding financial liabilities of the non-financial corporate sector

In percentages

	Bank loans			**Commercial paper and bonds**			**Equities**		
	82–84	**95–97**	**03–05**	**82–84**	**95–97**	**03–05**	**82–84**	**95–97**	**03–05**
Latin America									
Argentina		24.0	21.9		41.7	33.5		34.3	44.6
Chile			20.9			34.7			[1]
Colombia[2]	20.7	36.3	32.2	13.2	35.7	40.0	66.1	28.0	28.0
Mexico		40.2[3]	26.4[3]		7.6[4]	11.1[4]			
Peru		95.0	80.0		5.0	20.0		0.0	0.0
Asia									
India[5]	27.0	17.2	34.2	8.1	14.4	–3.2	6.2	16.3	24.2
Korea	54.3	36.4	32.4	19.6	22.3	14.6	26.1	14.5	24.6
Malaysia[6]		73.6	55.0		24.1	43.6			
Philippines		5.3			16.4				
Singapore	68.8	40.4[7]	42.7[7]	5.3	8.5[8]	7.8[8]	25.9	10.4[9]	5.7[9]
Thailand		66.4	48.5		2.2	5.8		31.4	45.8
Central Europe									
Czech Republic[2]		28.9	19.7		1.9	2.7		38.4	43.7
Hungary		19.9[10]	23.7[10]		1.2	0.3		58.0	55.0
Poland[11]			17.9			2.5			57.9
South Africa		28.1	41.9		6.0	16.5		82.4	65.8
Memo:									
United States	*24.9*	*12.6*	*11.9*	*18.5*	*15.1*	*19.6*	*56.6*	*72.3*	*68.4*

Note: Data for 1982–84 refer to Table 9 in Kamin et al (1998).

[1] In terms of flows, equities represent a share of 15%. [2] Refers to 1996–97 and 2003–04. [3] Includes foreign and domestic bank financing. [4] Includes foreign and domestic debt issues. [5] Data are based on a sample of selected companies and refer to the financial years 1996–97 and 2004–05. [6] Refers to 1997 and 2005. For equities, only the share to total gross flow of financial liabilities can be provided: 20.3 (1997) and 35.3 (2003–05). [7] Including other loans. [8] Long-term loans and debentures. [9] Shareholders' equity. [10] Bank loans and credits from other sectors. Credits from non-financial corporate sector were excluded. [11] Refers to 2003 and 2004.

Sources: US Flow of Funds; national data (questionnaire); BIS statistics.

Will corporate deleveraging and financial diversification reduce the power of monetary policy?

The implications of recent changes in the corporate balance sheet for the monetary transmission process can go in several directions, and their relative importance is difficult to determine. On the one hand, lower corporate debt could ease cash flow constraints on firms, reducing the investment response to monetary tightening. Stronger corporate balance sheets could also weaken the role of the financial accelerator discussed above.

In addition, the reduced reliance of firms on bank loans could weaken the bank lending channel, particularly if firms can now more easily access commercial paper and bond markets as alternative funding sources. Similarly, the increased use of derivatives may protect firms from future interest rate and exchange rate shocks, reducing cash flows and debt servicing volatility and thereby balance sheet vulnerability.[42] The impact of financial market liberalisation, increasing the access of firms to the global capital market, may go in the same direction. In particular, large firms can increasingly switch from domestic to foreign financing when monetary policy is tightened.

On the other hand, better functioning capital markets could enhance the degree of pass-through of policy rates to the prices of a wider range of financial assets and so strengthen the direct cost impacts of monetary policy changes on investment. Similarly, to the extent that more liquid markets and actively traded securities increase the potential valuation effects of interest rate changes on the balance sheets of firms, investment spending might also become more responsive to changes in the policy rate. Changes in expectations about monetary policy could now play a more important role (than in the past) in firms' financial conditions.

Implications of changes in bank balance sheets

As already noted, the better health and greater productivity of the banking system in many emerging markets has been associated with several changes to the monetary transmission mechanism. On the one hand, it has probably led to a stronger direct cost channel. The paper from the central bank of Malaysia shows that the long-run pass-through from the overnight rate to the lending rate has increased steadily from 0.3 in 1989 to 0.6 in 2005 with associated increases in competition and efficiency in the banking system: see Ooi (2008). On the other hand, the decline in the balance sheet vulnerability of banks reduces non-price related distortions on credit supply and hence may reduce the importance of the bank lending channel in many countries. High capital levels and the increased access of banks to alternative sources of funding through certificates of deposit and long-term bonds (for instance, in Chile) will have similar effects by relaxing resource constraints on banks, particularly during monetary tightening.

Growing market risk exposure for banks

Yet some of these balance sheet changes and other changes may have altered the significance of some transmission channels. One question is the extent to which changes in banks' balance sheets might have affected their exposure to market risks and whether changes in monetary policy could aggravate such exposures.

Table A17 in the Annex provides information on the duration and maturity of banking system deposits and loans. In several countries, the share of lending at variable interest rates

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[42] On the other hand, the development of derivatives could also reduce market segmentation, reducing firms' ability to substitute alternative funding sources in response to monetary policy changes. On balance, evidence suggests that increased use of derivatives may have reduced investment response to monetary policy shocks in several countries; see Gomez et al (2005), who provide evidence in the context of Colombia.

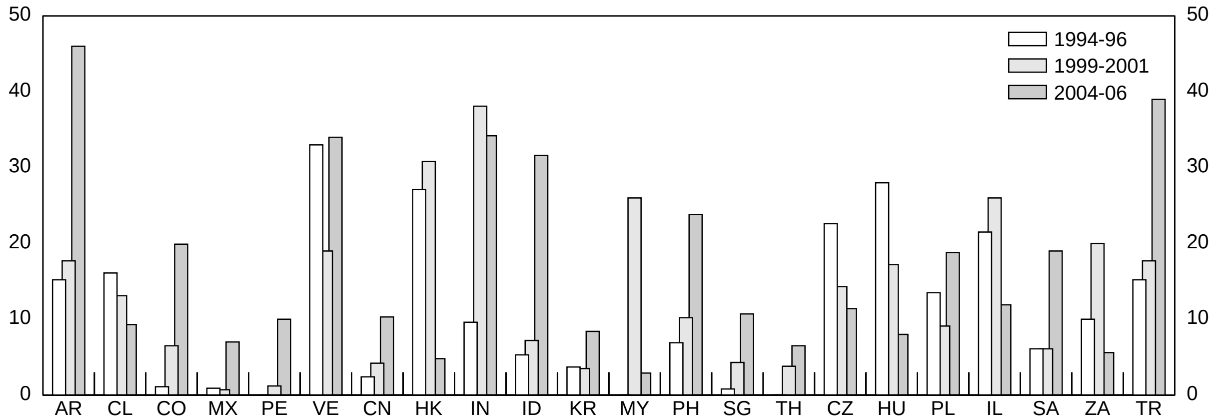
exceeds that of deposits. With increased pass-through of the policy rate, this could increase banks' interest rate exposure if their average funding cost does not vary sufficiently with monetary policy. Nevertheless, such exposures can be managed by a proper hedging strategy. In several other countries (for example, South Africa), banks have tended to pass on such risks to borrowers by mobilising more deposits at variable interest rates.

As regards maturity mismatches, the average maturity of deposits in most countries is shorter than loans, which makes the cash flow of banks vulnerable to refinancing risks. This is particularly true in Latin America (with the exception of Chile), where the average maturity of deposits is less than five months.

Graph 6

Commercial banks' holdings of government and central bank securities

Annual average as a percentage of total assets



AR = Argentina; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; HK = Hong Kong SAR; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; SA = Saudi Arabia; SG = Singapore; TH = Thailand; TR = Turkey; VE = Venezuela; ZA = South Africa.

Source: National data (questionnaire).

Another major source of exposure to monetary policy shocks could arise from the investment portfolios of banks. Over the past decade, commercial bank investment in government securities has increased, raising its share in total assets (Graph 6). In several countries, such a trend has recently been associated with large-scale intervention to resist exchange rate appreciation. Central banks have sold government or their own securities to commercial banks to sterilise excess liquidity.[43] The increased exposure of banks to bond markets increases the probability of large valuation changes for banks. This could well have financial accelerator effects. Banks might expand credit rapidly during an easing phase, as their capital gains and trading profits from bond holdings rise, while cutting back lending as losses mount during periods of monetary tightening. Such a reaction function would magnify the demand impact of monetary policy changes. Another potential, more insidious, implication is that it could influence central banks' interest rate response, to the extent that worries about the stability of the banking system might delay or attenuate needed monetary tightening.

Dollarisation

As regards banks' exposure to currency mismatches, Table 8 below shows the share of foreign currency in assets and liabilities in emerging economies' banking systems; see

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43 See Mohanty and Turner (2006) for a discussion on potential changes to bank lending behaviour associated with such sterilised intervention.

Table A18 for country details. Although the degree of "dollarisation" (or "euroisation" in the context of emerging Europe) of the banking system[44] has fallen over the past decade, it continues to be high in several cases. In most countries (outside of central Europe) the degree of asset-side dollarisation tends to be of roughly similar order to that on the liability side, suggesting that the direct exposure of the banking system to exchange rate risk is probably low. But banks' borrowers may have currency mismatches – and so they remain exposed through the credit risk channel.

Table 8

Currency denomination of bank balance sheets[1]

Percentage denominated in foreign currency

	Assets		Liabilities	
	2000	**2005**	**2000**	**2005**
Latin America[2]	30.1	15.7	29.6	14.5
Asia[3]	13.4	11.0	14.6	12.3
Hong Kong SAR	57.8	58.0	54.3	54.5
Singapore	75.4[4]	74.6[4]	75.1[5]	73.3[5]
Other Asia[6]	10.5	8.0	11.9	9.6
Central Europe[7]	23.1	25.0	21.1	18.7
Other emerging economies[8]	25.8	22.6	27.6	22.5
Total	**16.4**	**12.4**	**17.3**	**12.9**
Memo:				
United States	*0.7*	*0.8*	*0.8*	*0.7*
Japan	*12.7*	*21.3*	*9.1*	*12.9*

[1] Indicators shown are expressed as a percentage of GDP; aggregated using 2000 GDP and PPP weights. [2] Argentina, Chile, Colombia, Mexico, Peru and Venezuela. [3] Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [4] Refers to Asian Currency Unit (ACU) assets and foreign notes and coins, net amount due from banks, negotiable certificates of deposit (NCDs) held, loans to non-bank customers and bills discounted/purchased in the Domestic Banking Unit (DBU). Items that do not have breakdowns by S$ and FC in the DBU are excluded. [5] Refers to ACU liabilities and non-bank deposits, NCDs issued, amount due to banks, bills payable in the DBU. Items in the DBU that do not have breakdowns by S$ and FC are excluded. [6] Asia as defined above but excluding Hong Kong SAR and Singapore. [7] The Czech Republic, Hungary and Poland. [8] Israel, Saudi Arabia, South Africa and Turkey.

Sources: IMF; national data (questionnaire); BIS statistics.

As Kamin et al (1998) note, the transmission of monetary policy in a dollarised system will depend not only on the substitutability between domestic currency assets and dollar assets, but also on the substitutability between domestic dollar assets and international dollar assets. Because of the presence of default and convertibility risk, domestic dollar and international dollar)

[44] Using the definition in Kamin et al (1998) the term dollarisation is defined here as the provision of dollar-denominated loans and deposits by the domestic banking system, an activity which embraces both the store-of-value and, to a lesser extent, the transaction function of money.

assets are likely to be regarded as less than perfect substitutes. This is why dollar interest rates in dollarised financial systems have generally exceeded international levels.

Consideration of cases where markets regard domestic currency assets and dollar assets as close substitutes but view domestic and foreign assets as being non-substitutable serves to illustrate this point. Assuming limited exchange rate changes, policy-induced increases in domestic currency interest rates will induce borrowers to switch to domestic dollar loans and savers to shift their assets into domestic currency deposits leading to increases in domestic dollar deposit and lending rates. Therefore, monetary policy is effective in this case. Conversely, where domestic and foreign dollar assets are highly substitutable, the monetary transmission channel will more closely resemble that of a non-dollarised system with perfect capital mobility, where the exchange rate channel might play a more important role. Inflation and output developments will more likely depend on public expectations of the exchange rate.

The paper from the central bank of Peru illustrates the dilemma facing the central bank in a highly dollarised economy: see Rossini and Vega (2008). It shows that monetary policy needs to take into consideration currency mismatches and the risk of a run on dollar deposits in the banking system.[45] While the central bank has introduced prudential measures to control some of the risks, it has combined these with exchange rate intervention to smooth currency fluctuations. The paper shows that tighter monetary policy on its own will tend to accelerate the short-run impact on inflation and could generate perverse output effects through the exchange rate channel. But when combined with exchange market intervention, the inflation and output effects of monetary tightening are longer-lasting and more effective. Yet excessive foreign exchange intervention runs the risk that people do not internalise risks of denominating their debts in foreign currencies.

Banking sector consolidation and monetary policy transmission

Another question is how far the trend towards bank consolidation (increased mergers and amalgamations of banks and foreign ownership) might affect the transmission mechanism. On the one hand, a few large banks may dominate the banking market, which could reduce and lower the pass-through of the policy rate to bank deposit and lending rates. On the other hand, bank consolidation could increase the effectiveness of the interest rate channel if it increased efficiency, reduced transaction costs, and speeded up information processing. This would imply a faster transmission of interest rate changes across various segments of financial markets.

The balance of these factors is uncertain since separating the impact of other changes in the financial system from bank consolidation is often difficult. However, both research and experience in the context of industrial economies have demonstrated that financial consolidation has not significantly altered the transmission mechanism for monetary policy: see OECD (2001). In some countries, net efficiency gains from financial system consolidation have been large, strengthening the pass-through of the policy rate to other interest rates. Given the early stage of the development of financial markets in emerging market economies, it is more likely that the efficiency aspects dominate other factors, increasing the overall effectiveness of monetary policy.

[45] See also several papers on the policy implications of dollarisation in Armas et al (2006).

5. Globalisation and monetary transmission

The greater financial openness of emerging market economies is evident from a large build-up of gross foreign asset and liability positions and growing correlation between the prices of emerging market and industrial country assets. Two issues have received increasing attention in recent discussions about how these developments might affect the monetary transmission mechanism.

Internationalisation and inflation dynamics

The first issue relates to the implications of globalisation for the dynamics of domestic inflation. Trade integration affects the inflation process through the prices of tradable goods and through greater labour and product market competition with implications for the degree of pass-through of wage and cost increases to inflation.

There is little new in the debate about the impact of global influences as compared to domestic policies on inflation. An OECD study in 1973 noted that increasing integration was leading to a greater "internationalisation of the problem of inflation … and this was undermining the effectiveness of national stabilisation policies". But this conclusion, largely dependent on the fixed exchange rate regimes prevailing under Bretton Woods, was reversed by a 1982 OECD study which concluded that "with more flexible exchange rates, changes in policy (and particularly monetary policy) are likely to affect exchange rates and thus inflation".[46] Not all accepted this view: Beckerman and Jenkinson (1986) attributed the deceleration in OECD inflation from 1980 to 1982 to the fall in primary product prices, and not to the direct impact of higher unemployment.

Despite various challenges, however, the consensus view is still that domestic monetary policies dominate inflation outcomes – especially under flexible exchange rates.[47] A recent study by the OECD reported a significant impact of import prices on inflation in most industrialised economies since the mid-1990s: see Pain et al (2006). But it added that globalisation merely changed the price level of imported goods and services, with a one-time effect on inflation. Ihrig et al (2007) showed that while the sensitivity of inflation to the domestic output gap has fallen in industrial countries in recent years, there is only weak evidence of this being caused by either changes in import prices or global demand. Instead, they attributed the reduced sensitivity of inflation to the stabilising impact of increased trade openness on domestic output. In short, they found that domestic monetary policy determined inflation. The IMF reached a similar conclusion in its recent analysis of inflation in industrial economies.[48]

Global demand and supply developments, however, do have a major impact on *relative* prices. The greater effective use of labour in populous low-wage countries has compressed the prices of many manufactured goods in recent years. Real oil prices began to rise in 2003 and have remained high. Partly because higher energy prices have diverted crops to ethanol around the world and partly because higher incomes in poor countries have increased the

[46] See OECD (1973) and Turner (1982).

[47] See Yellen (2006), IMF (2006b), and Ball (2006). Borio and Filardo (2007) put the contrary case.

[48] In the context of industrial economies, IMF (2006b) estimates that about 50% of the reduction in the sensitivity of inflation to domestic output stems from increased openness, while the other 50% is due to improved monetary policy credibility. It argues that while the impact of import prices on inflation tends to be large in the first two years it falls significantly in the subsequent years, suggesting that import prices only change relative prices and not overall inflation over a long-term horizon. See also Ball (2006) who argues that relative price changes generated by import prices have no major impact on long-term inflation or inflation expectations and hence on the central bank's response to them.

demand for food, wholesale food prices have risen substantially. Because food and energy represent a comparatively high proportion of the average household's spending in emerging markets, the impact of such price changes on real incomes can be substantial. The measurement of inflation then becomes more dependent on the weight of different goods in the index basket.

An additional complexity arises with respect to capital flows. A worldwide rise in food prices, for instance, will have a larger impact on the CPI in a low-income country than in a high-income country. If because of this policy rates are increased more in low-income than in high-income countries, then capital flows could induce unwanted exchange rate appreciation in low-income countries. All such factors inevitably complicate monetary policy decisions in emerging markets.

Reduced monetary policy independence?

The question of monetary policy independence and capital flows is examined in an accompanying background paper: see Saxena (2008). The famous trilemma from the Mundell-Fleming model states that countries cannot simultaneously fix their exchange rate, have an open capital account, and pursue an independent monetary policy. Only two out of these three objectives are mutually consistent. Since 2000, emerging markets have seen an increase in the flexibility of exchange rates and also more open capital accounts. While an open capital account would imply a stronger link between domestic and foreign interest rates, this link can be weakened given a willingness to allow the exchange rate to fluctuate.

Saxena (2008) finds that the response of domestic interest rates to changes in the US interest rate (a proxy used for world interest rates) is higher for countries with flexible exchange rates and higher capital mobility than in countries with fixed exchange rates and mobile capital (especially during 2000–06). The results suggest that high capital mobility may be leading to a greater co-movement of domestic and foreign interest rates. [49] However, the response of domestic interest rates to changes in foreign interest rates has decreased since 2000 (compared with 1990–99), implying that as emerging market economies gain credibility with their newer forms of monetary policies, a further delinking between these interest rates might be expected.

6. Conclusion

The papers in this volume throw some new light on the old question of how monetary policy affects the economy in the emerging market economies. Policy transmission channels have changed in several important ways since the publication of Kamin et al (1998). Although the experiences of EMEs differ in many respects, some general conclusions are possible. Fiscal dominance has been largely overcome, and attempts to suppress inflation by currency overvaluation (sometimes at the price of non-convertibility) have been abandoned. Monetary policy frameworks have become more credible, and central banks more flexible in their operations. These shifts and the associated balance sheet changes have strengthened the interest rate channel. It is because of better monetary policies that inflation in most EMEs has become lower and less volatile.

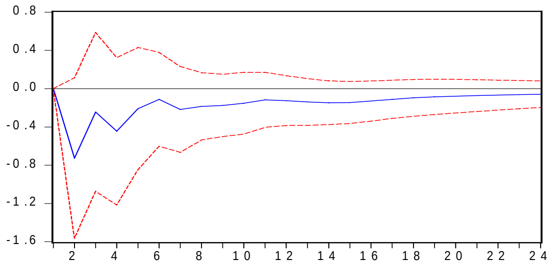
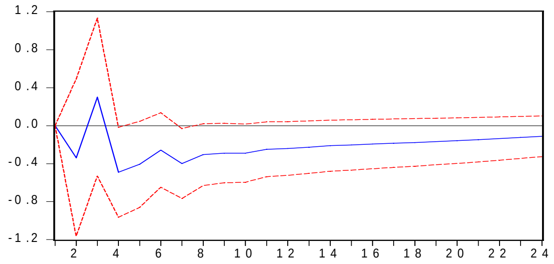
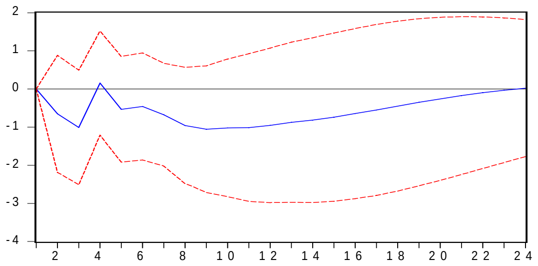
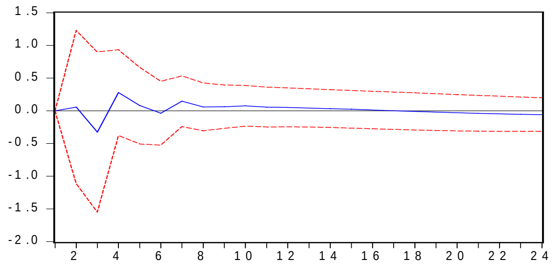
[49] This result could also reflect the fact that exchange rates have not been sufficiently flexible in practice, as many central banks have intervened in the foreign exchange market to stabilise them.

As the channels of transmission will continue to change as economies evolve, central banks need to remain alert to the implications of such changes as they calibrate their policy responses to macroeconomic developments.

Annex

Graph A1

Impulse response of output to interest rate shocks

1990–96	2000–06
Chile	
	
Czech Republic	
	
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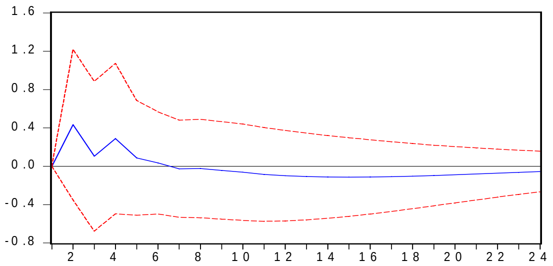	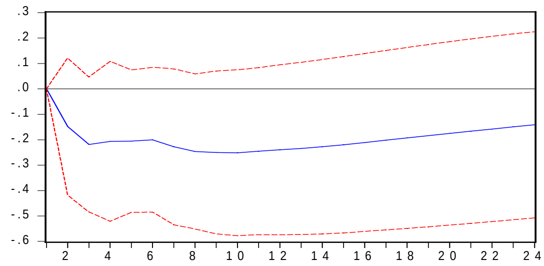
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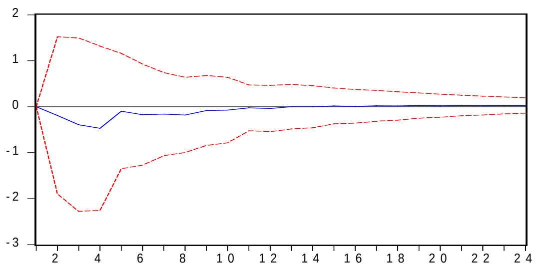
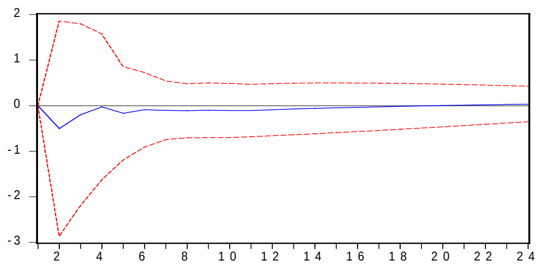
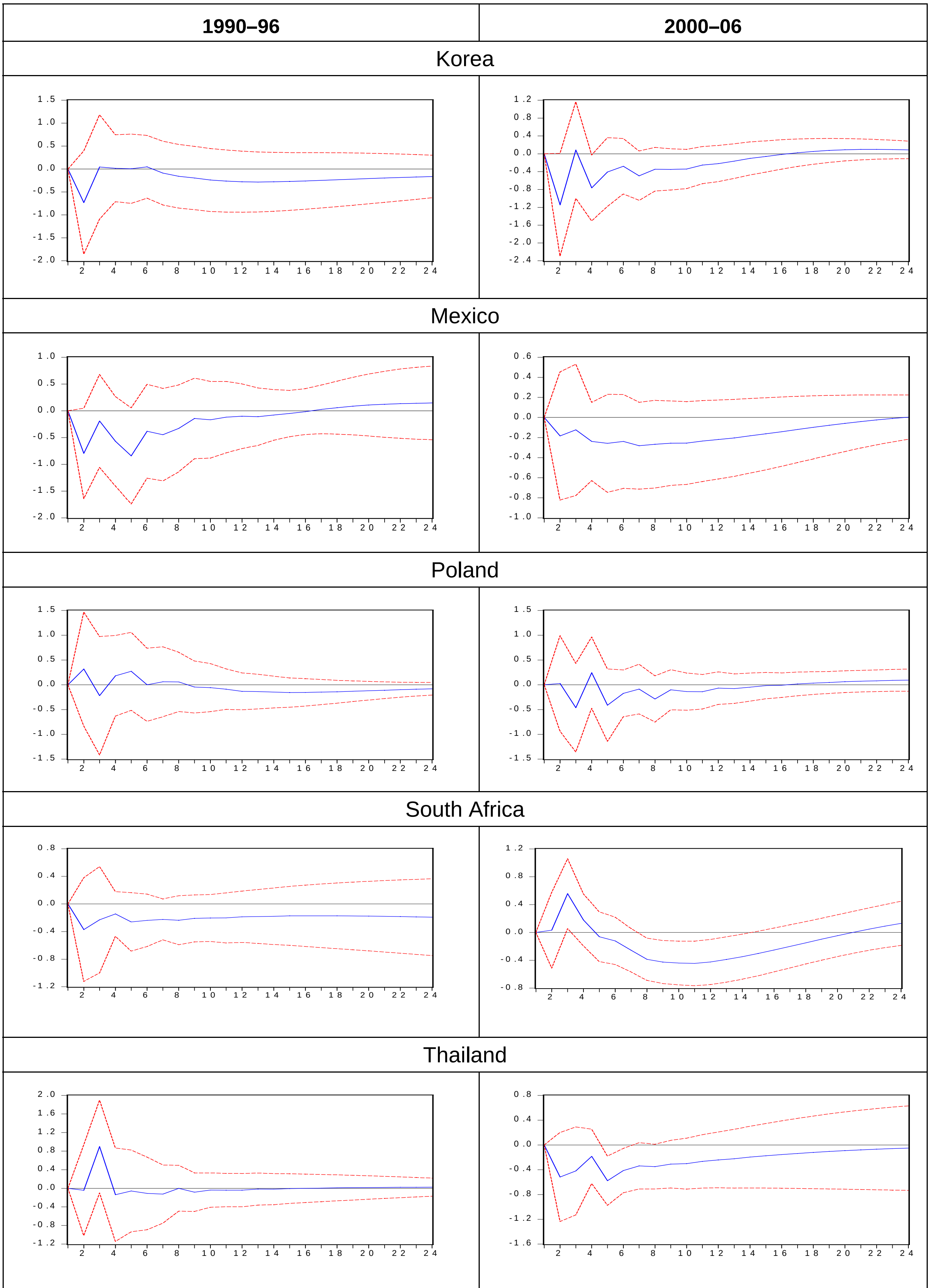
	

Impulse response of output to interest rate shocks



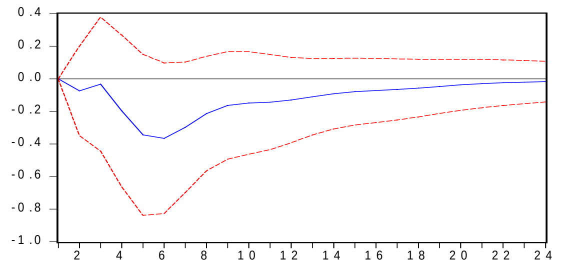
Source: National data; BIS calculations.

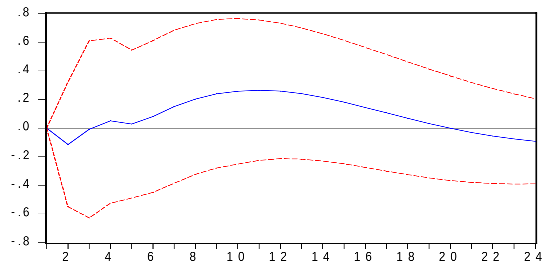
Graph A2

Impulse response of inflation to interest rate shocks

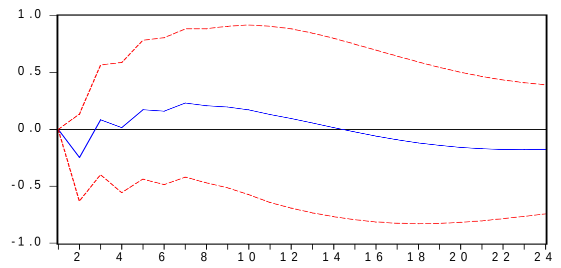
1990–96	**2000–06**

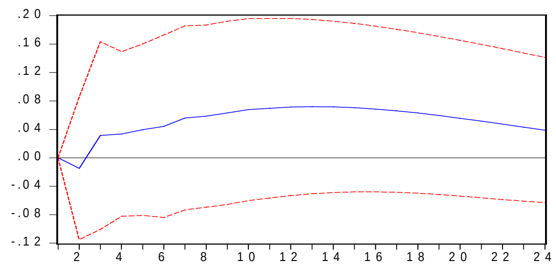
Chile



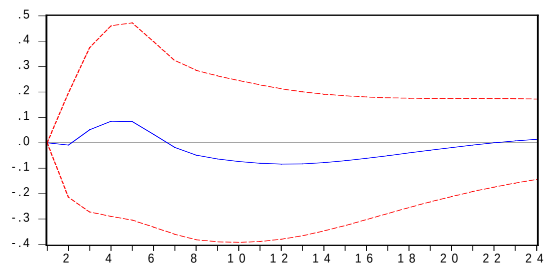


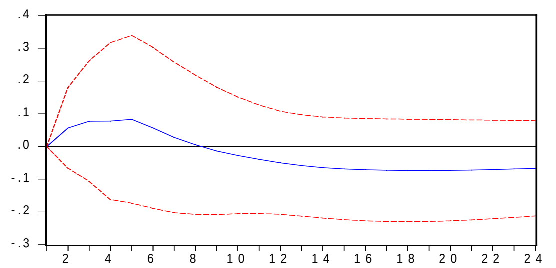
Czech Republic



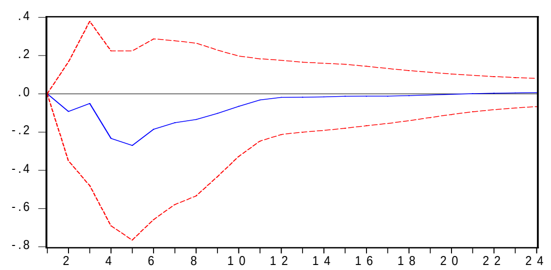


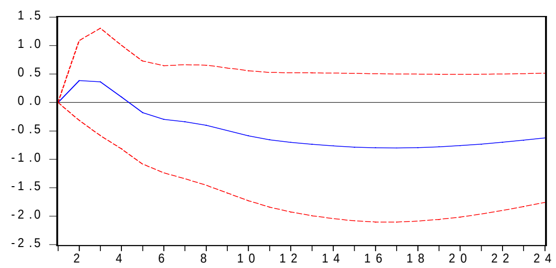
India



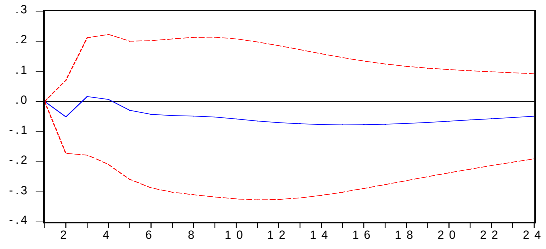
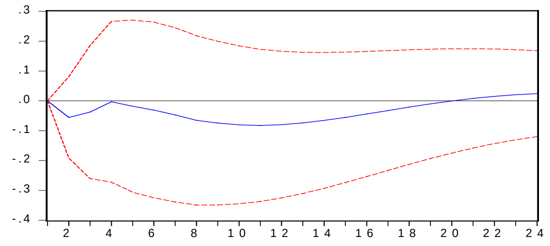
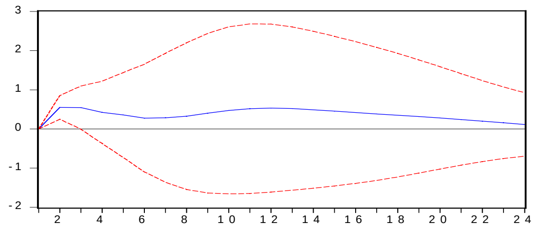
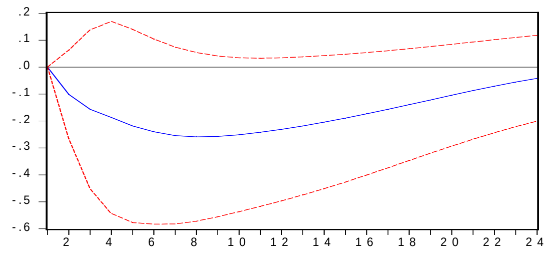
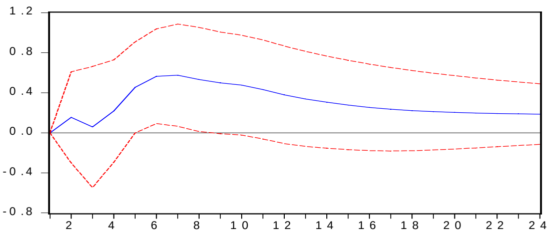
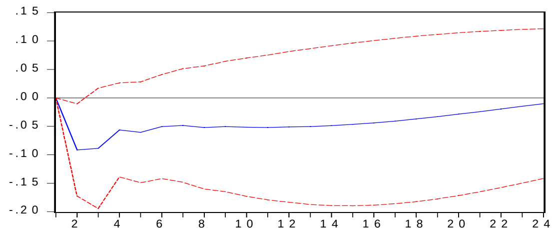
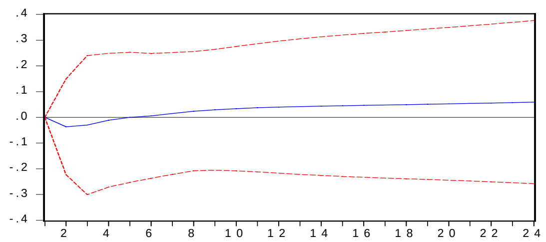
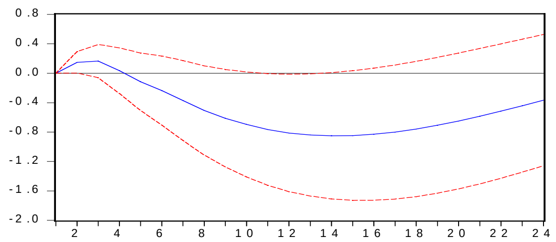
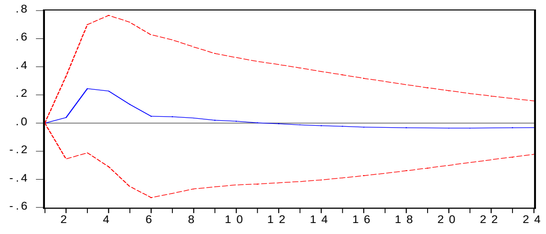
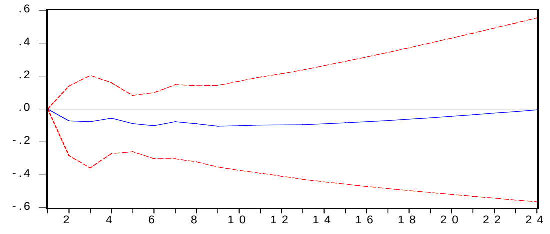


Indonesia





Impulse response of inflation to interest rate shocks

	1990–96	2000–06
Korea		
Mexico		
Poland		
South Africa		
Thailand		

Source: National data; BIS calculations.

Table A1

Volatility[1]

	Output[2]		**Prices**[3]		**Exchange rate**[4]	
	1990–99	**2000–Q206**	**1990–99**	**2000–Q206**	**1990–99**	**2000–Q206**
Latin America						
Argentina	5.9	8.3	2,584.3	12.1	3,712.5	81.6
Brazil	8.7	2.0	1,138.3	3.2	1,211.9	20.8
Chile	9.1	1.7	7.3	1.1	6.7	11.5
Colombia	4.0	1.8	5.6	1.6	11.3	13.3
Mexico	3.9	2.6	10.5	2.0	26.0	6.4
Peru	6.8	3.0	2,162.9	1.4	2,280.5	3.1
Venezuela	4.3	11.3	23.1	7.1	41.7	26.3
Asia						
China	1.8	1.3	8.2	1.6	16.1	0.9
Hong Kong SAR	3.8	4.0	4.4	2.0	0.2	0.3
India	1.2	2.3	3.6	0.9	11.5	4.2
Indonesia	7.0	1.1	18.1	4.4	85.9	14.0
Korea	4.9	2.4	2.3	0.8	19.0	8.1
Malaysia	5.6	2.9	1.0	0.9	16.0	0.9
Philippines	2.6	1.6	4.0	2.0	16.0	7.8
Singapore	4.0	5.0	1.3	0.8	6.9	3.1
Thailand	7.5	1.7	2.2	1.7	19.3	6.6
Central Europe						
Czech Republic	1.4	1.6	15.8	1.6	11.7	9.8
Hungary	1.8	1.0	7.2	2.6	6.7	12.3
Poland	1.8	1.9	19.2	3.3	7.2	7.8
Other emerging economies						
Israel	5.8	3.9	4.6	2.5	5.3	6.2
Russia	5.0	1.5	293.9	4.5	137.2	7.6
Saudi Arabia	3.4	3.1	2.5	1.0	0.0	0.0
South Africa	2.3	1.0	3.6	3.1	9.1	21.2
Turkey	6.1	6.1	16.5	22.7	41.4	40.2
Memo:						
United States	*1.5*	*1.3*	*1.1*	*0.8*	*1.0*	*1.0*
Euro area	*1.2*	*1.1*	*1.1*	*0.2*	*9.6*	*11.3*
Japan	*2.1*	*1.5*	*1.3*	*0.4*	*11.6*	*8.6*

[1] Measured as the standard deviation of annual changes of quarterly averages; in per cent. [2] Real GDP. [3] Consumer prices. [4] National currency per US dollar.

Source: National data.

Table A2

Fiscal indicators[1]

	Fiscal balance		Central bank credit to government		Public debt	
	1990–99	2000–06	1990–99	2000–05	2000	2006
Latin America						
Argentina	–1.9	–5.6	4.0	11.7	51.0	70.9
Brazil	–3.7	–3.7	26.8	16.6	48.8	50.1
Chile	1.5	1.4	16.9	8.5	14.0	5.9
Colombia	–1.8	–2.4	1.3	1.1	47.7	46.3
Mexico	–4.1	–2.7	1.4	0.0	49.3	43.1
Peru	–2.8	–1.6	0.3	0.1	45.5	35.3
Venezuela	–2.8	–0.3	6.0	1.1	27.3	35.8
Asia						
China	–2.2	–2.2	3.2	2.0	16.4	17.2
Hong Kong SAR	1.7	–1.8	…	…	0.0	1.7
India	–7.7	–8.6	11.8	4.4	75.0	80.9
Indonesia	–0.3	–1.6	3.7	14.3	52.1	25.0
Korea	–1.0	1.9	0.9	0.8	16.3	28.1
Malaysia	0.6	–4.5	1.3	0.2	36.7	43.5
Philippines	–1.7	–3.4	9.3	3.0	64.6	71.8
Singapore	10.0	5.5	0.0	3.7	84.1	97.8
Thailand	1.2	–0.1	1.5	1.9	56.9	43.9
Central Europe						
Czech Republic	–0.7	–3.4	1.2	0.3	15.2	26.6
Hungary	–5.1	–6.7	49.2	7.3	55.0	67.2
Poland	–3.4	–4.9	5.0	0.9	37.7	48.4
Other emerging economies						
Israel	–4.3	–4.0	4.8	2.0	87.0	95.3
Russia	–9.3	4.3	12.4	4.1	62.5	13.9
Saudi Arabia	–8.2	5.1	…	…	87.2	15.2
South Africa	–4.3	–1.1	1.7	2.2	42.9	32.8
Turkey	–8.5	–12.3	3.9	12.3	68.8	71.1
Memo:						
United States	*–2.8*	*–2.7*	*4.9*	*5.8*	*57.2*	*62.5*
Euro area	*–4.1*	*–2.2*	*1.7*	*1.9*	*69.6*	*69.8*
Japan	*–2.8*	*–6.8*	*6.5*	*17.6*	*142.5*	*181.8*

[1] Indicators shown are expressed as a percentage of GDP.

Sources: IMF, *World Economic Outlook*; JP Morgan, *Emerging markets debt and fiscal indicators*, October 2006; ECLAC; national data.

Table A3

Degree of openness

	Trade openness[1]			Financial openness[2]		
	1990	**2000**	**2005**	**1990**	**2000**	**2005[3]**
Latin America						
Argentina	15.6	22.7	45.0	67.8	124.0	167.3
Brazil	13.2	22.8	29.2	44.0	89.5	82.7
Chile	61.4	60.1	74.5	134.1	181.7	186.2
Colombia	33.6	36.0	40.3	77.9	88.1	96.4
Mexico	30.3	42.5	41.8	70.3	72.9	83.5
Peru	28.3	33.9	43.6	102.9	113.2	92.0
Asia						
China	26.8	44.2	69.3	38.9	84.7	96.2
Hong Kong SAR	254.2	283.7	383.4	1,462.9	1,246.5	1,439.5
India	16.4	28.8	44.3	30.2	42.3	57.8
Indonesia	48.4	76.0	66.4	80.6	136.8	100.7
Korea	56.7	78.0	82.3	35.4	82.7	109.2
Malaysia	147.2	228.9	222.5	141.3	211.4	254.4
Philippines	57.5	117.6	100.0	95.0	143.3	137.3
Singapore	359.5	377.7	456.1	361.3	809.5	1,023.2
Thailand	81.8	125.0	152.2	68.8	142.7	125.0
Central Europe						
Czech Republic	39.8	129.4	141.2		146.4	147.4
Hungary	69.7	151.6	137.2	63.7	157.7	173.5
Poland	46.8	60.4	74.1	117.1	86.5	116.6
Other emerging economies						
Algeria	54.7	62.6	71.3	74.2	87.1	96.1
Israel	68.2	76.4	88.9	112.6	167.4	207.4
Russia	16.9	67.6	56.7		168.5	135.6
Saudi Arabia	79.3	73.3	89.1	162.6	100.8	114.4
South Africa	43.0	52.8	55.7	51.3	139.7	135.3
Turkey	34.2	61.8	65.5	45.4	96.3	103.9
Memo:						
United States	*19.8*	*25.7*	*26.2*	*80.1*	*166.2*	*198.3*
Euro area	*55.3*	*72.6*	*74.1*		*212.5*	*261.5*
Japan	*20.5*	*21.3*	*28.1*	*111.4*	*100.4*	*154.4*
United Kingdom	*50.5*	*58.2*	*56.2*	*351.2*	*618.2*	*759.6*

[1] Defined as the sum of imports and exports as a ratio to GDP. [2] Measured as the sum of gross stocks of foreign assets and liabilities as a ratio to GDP. [3] Data refer to 2004 for Mexico, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Poland, Saudi Arabia, South Africa and Turkey.

Source: Lane and Milesi-Ferretti (2006).

Table A4

Determinants of bank deposit rates

	Linked to policy rate		Linked to interbank rate		Agreed within bank associations		Negotiated with customers		Subject to regulation	
	1997	**2006**	**1997**	**2006**	**1997**	**2006**	**1997**	**2006**	**1997**	**2006**
Latin America										
Argentina		Yes		Yes				Yes		
Brazil			Yes						Yes	
Chile	No	Yes	(Yes)	Yes	No	No	Yes	Yes	No	No
Colombia	(Yes)	Yes	(Yes)	Yes	(Yes)		(Yes)	Yes	No	
Mexico	No		Yes		No		Yes	Yes	No	
Peru				Yes[1]	No	No		No	No	No
Venezuela	No		No		No		Yes		No	Yes
Asia										
China								Yes	Yes	
Hong Kong SAR	No		Yes	Yes	(No)		Yes	Yes	No	
India	No	[2]	No	[2]	No		No	Yes[3]	No	Yes[4]
Indonesia	No	Yes	Yes		No		Yes		No	
Korea	No	Yes	No	Yes	No		No		No	
Malaysia	No		No		No		Yes	Yes	No	Yes[5]
Philippines		Yes		Yes		No		Yes		No[6]
Singapore			Yes	Yes			Yes		No	
Thailand[7]		Yes	Yes	Yes	No		Yes		No	
Central Europe										
Czech Republic		No		No[8]		No		No		No
Hungary				Yes						
Poland				Yes				Yes		
Other emerging economies										
Israel	Yes	Yes		–		No	Yes	Yes	No	No
Russia					No		Yes		No	
Saudi Arabia	No		Yes	Yes	No		Yes		No	
South Africa		Largely		No		No		Partly		No
Turkey				Yes						

Note: Data for 1997 refer to Table 6 in Kamin et al (1998).

[1] This interest rate is a main component in banking funding. [2] Interest rates on deposits (except as indicated in the last column) have been deregulated and are decided by the banks themselves. The deposit rates are influenced by the Reserve Bank's policy rates. [3] Bulk deposits. [4] Saving deposits and foreign currency deposits. [5] Minimum rates were prescribed for fixed deposit balances of RM1 million and below (with the exception of deposits placed by non-SME corporations and non-residents) for tenures between one and 12 months. [6] Refers to a typical domestic commercial bank. [7] Others: competition from other saving alternatives and competition among banks. [8] Little short-run link, but there is an effect in the long run.

Source: National data (questionnaire).

Table A5

Determinants of bank lending rates

	Linked to policy rate		Linked to interbank rate		Agreed within bank associations		Negotiated with customers		Subject to regulation	
	1997	2006	1997	2006	1997	2006	1997	2006	1997	2006
Latin America										
Argentina		Yes		Yes				Yes		
Brazil										
Chile		Yes		Yes		No	Yes	Yes	Yes	No
Colombia	(Yes)	Yes	(Yes)	Yes	(Yes)		(Yes)	Yes	No	Yes
Mexico			Yes	Yes			Yes	Yes		
Peru				Yes[1]	No	No		No	No	No
Venezuela	No	Yes	No		No		Yes	Yes	No	Yes
Asia										
China									Yes	Yes
Hong Kong SAR	No		(Yes)	Yes	No		Yes	Yes	No	
India	No	[2]	No	[2]	No		Yes	Yes	No	Yes[3]
Indonesia	No		Yes		No		Yes		No	Yes[4]
Korea[5]	(Yes)		(Yes)		No		Yes		No	
Malaysia	Yes		Yes		No		Yes	Yes	Yes	Yes[6]
Philippines		Yes		Yes		No		Yes		No[7]
Singapore			Yes	Yes			Yes		No	
Thailand		Yes	Yes	Yes	No		Yes		No	Yes[8]
Central Europe										
Czech Republic		No		Yes		No		No		No
Hungary				Yes				Yes		
Poland				Yes				Yes		
Other emerging economies										
Israel	Yes	Yes		–		No		Yes	No	No
Saudi Arabia	No		Yes	Yes	No		Yes		No	
South Africa		Yes		No		No		Partly		No
Turkey				Yes						

Note: Data for 1997 refer to Table 7 in Kamin et al (1998).

[1] This interest rate is a main component in banking funding. [2] Interest rates on loans (except as indicated in the last column) have been deregulated and are decided by the banks themselves. The lending rates are influenced by the Reserve Bank's policy rates. [3] Export credit rate. [4] Blanket Guarantee Rate. [5] An additional item is the market interest rate (CD, etc.). [6] Applicable to prescribed rate for loans extended through special funds administered by Bank Negara Malaysia and the ceiling on lending rates for housing loans extended to low-income groups. In addition, rates on hire purchase loans are subject to the Hire Purchase Act 1967, while rates on credit card loans are subject to the Credit Card Guideline issued by Bank Negara Malaysia. [7] Refers to a typical domestic commercial bank. [8] Only for credit card and personal loans.

Source: National data (questionnaire).

Table A6

Reserve requirements

In percentages

	Reserve requirement ratio				
	1990	**1998**	**2000**	**2006**	**Remuneration (latest)**
Latin America					
Argentina	5.0–88.0		15.0–22.0	14.0–35.0	BM
Chile	4.0–10.0	9.0	3.6–9.0	3.6–9.0	No
Colombia	18.2	31.0	4.8	5.7	BM
Mexico	0.0	0.0	0.0	0.0	
Peru	52.5	7.0	7.0	6.0	No
Venezuela	15.0	17.0	17.0	15.0	No
Asia					
China			6.0	8.5	BM
Hong Kong SAR	No	No	No	No	No
India	15.0	10.0	8.0	5.0	No
Indonesia	2.0	3.0–5.0	5.0	5.0–13.0	BM
Korea	1.0–11.5	3.1	1.0–11.5	1.0–5.0	
Malaysia	6.5	13.5	4.0	4.0	No
Philippines	25.0		9.7	10.1	Yes
Singapore	6.0	6.0	3.0	3.0	No
Thailand	2.0	No	1.0	1.0	No
Central Europe					
Czech Republic	8.0		2.0	2.0	Yes
Hungary	11.0	12.0	11	5.0	MR
Poland	9.9–20.8		5.0	0.0–3.5	BM
Other emerging economies					
Israel	0.0–10.0	8.0	0.0–6.0	0.0–6.0	No
Saudi Arabia	2.0–7.0	7.0	2.0–7.0	2.0–7.0	No
South Africa	2.0–5.0		2.5	2.5	No
Turkey	9.0–19.0		6.0	6.0	BM
Memo:					
United States	*3.0–12.0*	*0.0–10.0*	*0.0–10.0*	*0.0–10.0*	*No*
Japan	*0.125–2.5*	*0.05–1.3*	*0.05–1.3*	*0.05–1.3*	*No*
Euro area			*0.0–2.0*	*0.0–2.0*	*No*
United Kingdom		*0.4*	*0.0*	*0.0*	*No*

MR = Market rate. BM = Below market rate.

Note: Data for 1998 refer to Table 2 in Kamin et al (1998). Reserve requirements vary for some countries depending on the nature of the liabilities.

Source: National data (questionnaire).

Table A7

Liquidity requirements

In percentages

	1990	1998	2000	2006
Latin America				
Mexico	30.0	0.0	0.0	0.0
Peru			8.0	8.0
Asia				
India	38.5	25.0	25.0	25.0
Indonesia	4.5		11.6	19.4
Malaysia	10.0–17.0	17.0	3.0–7.0	3.0–7.0
Philippines			30.0	30.0
Singapore	18.0	18.0	8.0	18.0
Thailand	5.0	6.0	5.0	5.0
Other emerging economies				
Saudi Arabia	20.0	20.0	20.0	20.0
South Africa	5.0–20.0		5.0	5.0
Turkey			8.0–14.0	

Note: Data for 1998 refer to Table 2 in Kamin et al (1998).

Source: National data (questionnaire).

Table A8

Structural bank indicators

	Non-performing loans[1]		Capital asset ratio[2]		Operating costs[3]		Return on assets[4]	
	2000	**2005**	**2000**	**2005**	**2000**	**2005**	**2000**	**2005**
Latin America								
Argentina	16.0	5.2	10.6		4.6	4.6	0.0	0.9
Brazil	8.3	4.4	13.8	17.4	6.9	5.8	1.1	2.1
Chile	1.7	0.9	13.3	13.0	3.0	3.0	1.0	1.3
Colombia	11.0	2.7	13.2	13.5	11.0	5.3		2.8
Mexico	5.8	1.8	13.8	14.3	5.6	4.7	0.9	2.4
Peru		2.1	12.9	12.0	5.3	4.7	0.3	2.2
Venezuela	6.6	1.2		15.5	8.7	6.2	2.8	3.7
Asia								
China	22.4	10.5			1.4	1.1	0.1	0.8
Hong Kong SAR	7.3	1.5	17.8	14.9	1.2	1.0		1.7
India	12.8	5.2	11.1	12.8	2.6	2.4	0.7	0.9
Indonesia	34.4	15.6	21.6	19.6	2.5	3.6	0.3	1.7
Korea	8.9	1.2	10.5	12.8	1.8	1.7	–0.6	1.2
Malaysia	15.4	9.9	12.5	13.1	1.6	1.5	1.4	1.3
Philippines	24.0	20.0	16.2	18.1	3.4	3.4	0.4	1.1
Singapore	3.4	3.8	19.6	15.8	2.4	1.0	1.3	1.2
Thailand	17.7	11.1	11.3	13.3	1.9	2.0	–0.2	1.5
Central Europe								
Czech Republic	29.3	4.3	17.4	11.9	3.3	2.1	0.7	1.4
Hungary	3.0	2.1	13.7	12.0	4.9	3.6	1.3	2.0
Poland	15.5	7.7	12.9	14.5	4.8	3.7	1.1	1.6
Other emerging economies								
Israel	6.9	10.3	9.2	10.9	2.4	2.5	0.5	0.8
Russia	7.7	3.2	19.0	16.0	6.3	3.8	0.9	3.2
Saudi Arabia	10.4	10.6	21.0	17.1	1.6	1.6	2.0	3.5
South Africa		1.5	14.5	12.3	4.9	3.1		1.1
Turkey	9.2	4.8	17.3	24.2	5.7	6.0		1.7
Memo:								
United States	*1.1*	*0.7*	*12.4*	*13.0*	*2.9*	*2.3*	*1.1*	*1.3*
Germany	*4.7*	*4.8*	*11.7*	*13.4*	*1.5*	*1.2*	*0.2*	*0.2*
Japan	*5.3*	*1.8*	*11.7*		*1.2*	*1.1*	*0.0*	*0.5*

[1] As a percentage of total loans. [2] As a percentage of risk-weighted assets. [3] As a percentage of total assets. [4] In per cent.

Sources: IMF, *Global Financial Stability Report*; Bankscope; BIS calculations.

Table A9

Average daily money market turnover

As a percentage of outstanding banking assets

	Total money market		Interbank repo market		Interest rate swaps		Others	
	2000	2005	2000	2005	2000	2005	2000	2005
Latin America								
Argentina				0.1			0.6[1]	0.2[1]
Chile		0.2						0.2[2]
Colombia	1.2	2.4	0.6	0.9			0.6[3]	1.6
Mexico	7.3	5.9					0.0[4]	1.7[5]
Peru	0.3	0.3	0.3	0.3				
Venezuela	0.7	0.6	0.7	0.6				
Asia								
China	15.6	62.2	10.6	41.9				
Hong Kong SAR	7.0	8.0			3.8	4.1		
India	2.4	2.6	0.0	0.9	0.1	0.1	2.4	1.6
Indonesia	0.2	0.4						
Korea					2.5	3.5	0.2[6]	0.2[6]
Malaysia[7]	0.2	0.1	...	0.1	1.6	2.4	...[8]	...[8]
Philippines	0.5	0.3				0.0		
Singapore								
Thailand	1.4	2.1	0.0	0.0			1.4[9]	2.1[9]
Central Europe								
Czech Republic	1.9	1.6	0.0	0.0				
Hungary	0.8	3.8	0.0	0.2			0.8[10]	3.5[11]
Poland		5.1		0.2		0.9		4.0
Other emerging economies								
Israel	0.2	0.3						
Saudi Arabia			0.6	0.8				
Turkey	2.2	2.8	2.0[12]	1.9[12]			0.2[13]	0.9[13]

Note: Money turnover data include various instruments that are not uniformly classified across countries. In some countries they include the central bank's own repo (and reverse repo) transactions with counterparties.

[1] Call market (interbank loans). [2] Interbank short-term loans. [3] Includes repo and buy/sell-backs. 4 Includes reverse repos. [5] Mexican Derivatives Exchange. Daily average volume for TIIE (Interbank Interest Rate) 28-day futures contracts traded in Mexder. [6] Monetary Stabilization Bonds issued by the Bank of Korea. [7] "…" denotes negligible. [8] Includes negotiable certificates of deposit and bankers' acceptances. [9] BOT Repo, interbank deposits and FX swaps. [10] FX swaps: 0.1 and unsecured market: 0.7. [11] FX swaps: 2.9 and unsecured market: 0.6. [12] Data cover the transactions of banks, intermediary institutions and the Central Bank of the Republic of Turkey (CBRT) in the Istanbul Stock Exchange Repo Market and open market operations and repo transactions at the CBRT. [13] Interbank repo transactions in the money market at the CBRT.

Source: National data (questionnaire).

Table A10

Depth of government bond market

	Outstanding stocks (as a percentage of GDP)		Typical bid-ask spreads ("on the run" bonds; in bp)		Ratio of annual turnover to average outstanding stocks		Average contractual maturity (in years)	
	2000	2005	2000	2005	2000	2005	2000	2005
Latin America								
Argentina	35	50						
Chile	36	25		3.0–5.0	0.8[1]	1.1	3.3	3.1
Colombia	14	25	15.0[2]	10.0[2]	0.6	15.0	3.5	3.8
Mexico	10	13	14.0	5.0		5.2	1.5	3.2
Peru		4		30.0		1.3		12.0
Venezuela	7.3	9.8	28.0	52.0			2.5	3.7
Asia								
China	9	15			4.7	40.2		
Hong Kong SAR	8	9			52.6	55.2		
India	19	26	1.0–3.0	1.0–2.0			12.6[3]	14.1[3]
Indonesia	31	15			0.1	0.7		
Korea	2	11			8.6	9.2	3.5	5.9
Malaysia	71	80	2.0	4.0	1.4	0.9	5.1	5.1
Philippines	31[4]	39[4]		17.3	0.1	0.0		
Singapore	77[5]	103[5]	…[6]	S$0.1–0.2[7]	…[6]	15.0	4.1[8]	5.7[8]
Thailand	15	22	2.0–5.0	2.0–5.0			6.7	9.9
Central Europe								
Czech Republic	5	16	9.0[9]	7.0[9]	2.2	1.0	4.1[10]	7.9
Hungary[11]	31	40		5.0–18.0	5.0	3.2	1.6	3.6
Poland[12]	17	31	9.0	2.5	10.5	36.8	3.9	5.8
Other emerging economies								
Israel	31	45			0.5	1.1		
Saudi Arabia	104	59	10.0–15.0	10.0	0.0	0.0	7	5
Turkey	29[13]	50		20.0	19.7[14]	9.4	1.3	3.2

[1] Refers to 2001. [2] Denominated in domestic currency. [3] New loans issued during the year. [4] Central government local currency issuances. [5] Includes marketable and non-marketable securities. [6] Trading of marketable securities not active. [7] The market convention in terms of prices. [8] Marketable securities only. [9] Excluding bonds with shorter times to maturity than one year. [10] Average residual maturity weighted with the annual turnover. Maturity of each bond is median maturity of the year. [11] Data for local currency denominated marketable government securities. [12] Market bonds and bills together. [13] Total of cash and non-cash stocks. [14] Daily transaction volumes in the Bonds and Bills Market in the Istanbul Stock Exchange.

Sources: The US Federal Reserve Board; Bloomberg; national data (questionnaire); BIS statistics.

Table A11

Sources of financing for the private non-financial sector

As a percentage of total financing

	Commercial banks		**Other institutions**		**Foreign sources**		**Others**	
	1993	**2005**	**1993**	**2005**	**1993**	**2005**	**1993**	**2005**
Latin America								
Argentina		54.0						46.0[1]
Chile		22.6						77.4[1]
Colombia		25.0				23.0		52.0[1]
Mexico	91.5	36.9	8.5	31.6		24.4		7.1[2]
Peru		67.0		20.0[3]		12.0		1.0[4]
Asia								
India[5]	21.7	51.7	34.4	16.6	4.6	2.2	39.3	29.5[6]
Indonesia		13.3		10.0		37.0		39.7[1]
Korea	24.5	32.1[7]	35.0	23.5	3.7	7.2	36.8	37.3
Malaysia	54.9	38.9	45.1	3.7		22.5		34.9[1]
Philippines								
Singapore	87.2	75.2[8]	12.8	9.2[9]				15.6[2]
Thailand	84.1	58.4		0.3	7.5	16.8	1.0	24.5
Central Europe								
Czech Republic[10]		13.8[11]		3.2		5.2		77.8[1]
Hungary	22.5	12.2[12]	0.3	1.5[12]	49.2	37.2[13]	28.0	49.0[1]
Poland[14]		13.4				1.1		85.5
Other emerging economies								
Israel	51.6	61.0		18.0	6.6	18.0	41.8	3.0[2]
Turkey		75.6		3.3[15]		21.1		
Memo:								
Japan	*42.7*	*63.5*	*27.9*	*17.3*	*0.0*	*0.0*	*18.0*	*19.1*
United States	*25.8*	*20.6*	*26.9*	*27.0*	*2.9*	*5.7*	*44.5*	*46.8*

Note: Data for 1993 refer to Table 5 in Kamin et al (1998).

[1] Includes equity. [2] Equity excluded. [3] Mainly pension and mutual funds. [4] Other residents. [5] Financial year 2004–05. [6] Includes non-bank borrowings, trade dues and other current liabilities. [7] Commercial banks and specialised banks. [8] Includes domestic banking units and Asian Currency Units of commercial banks. [9] Includes finance companies and merchant banks. [10] Data cover loans to NFCs and HHs. [11] Commercial banks, money market funds and credit unions. [12] Credit. [13] Credit and equity. [14] Operating activity, excluding investment. [14] Equity included in 1993. [15] Investment and Development Banks.

Sources: Central banks; IMF; national data (questionnaire); BIS.

Table A12

Composition of commercial bank credit

As a percentage of total credit

	Home mortgage			Consumer credit			Enterprise credit		
	1993	**2000**	**2005**	**1993**	**2000**	**2005**	**1993**	**2000**	**2005**
Latin America									
Argentina		5.9	4.3		33.3	26.4		37.8	39.8
Chile[1]	11.2	16.8	20.6	4.0	8.0	12.2	44.5	68.3	65.1
Colombia		32.8	10.7		14.4	26.1		41.2	5.3
Mexico	13.0	26.7	18.4	7.2	5.9	27.8	36.3	60.9	43.0
Peru		7.0	13.0		9.0	13.0		68.0	62.0
Venezuela		3.0	0.0		12.0	10.0		51.0	56.0
Asia									
China					3.8	10.5		96.0	89.5
Hong Kong SAR	9.4	33.7	31.4	3.6	7.1	8.3	87.0	59.2	60.3
India[2]		2.5	6.8		4.5	6.9	56.5	55.3	47.9
Indonesia	4.1	5.9	8.1	6.9	14.9	29.9	70.7	63.1	48.7
Korea[3]	12.7			11.7	31.5[4]	48.9[4]	74.5	63.0	48.8
Malaysia[5]	13.9	15.7	27.7	11.2	12.4	26.1	30.1	61.6	40.9
Philippines[6]		1.7	1.6		1.8	4.1		91.2	84.1
Singapore	14.9	25.0	33.8		16.0	16.4		58.9	49.8
Thailand[7]	8.3	7.9	11.0	4.1	3.3	7.0	58.8	62.5	61.4
Central Europe									
Czech Republic		8.6[8,9]	18.5[9]		5.3[8]	8.9		41.7	42.5
Hungary	6.2	4.3	23.0	3.5	8.4	14.4	52.4	86.0	60.0
Poland[10]			11.1		21.7	19.5		57.9	43.5
Other emerging economies									
Israel		11.0	14.0		7.0	8.0		74.0	66.0
Saudi Arabia					14.3	39.9		78.0	52.8
South Africa		33.9	46.4		9.2	10.7		28.6	24.5
Turkey					13.7	17.3		50.4	32.2
Memo:									
United States	*17.4*	*19.2*	*24.6*	*14.9*	*13.5*	*12.6*	*40.2*	*47.0*	*44.2*
Japan	*8.0*	*13.7*	*20.6*	*3.5*	*2.4*	*2.1*	*80.2*	*63.2*	*47.4*

Note: Data for 1993 refer to Table 14 in Kamin et al (1998).

[1] Interbank loans excluded. [2] End of March of the respective year. [3] Interbank loans excluded. They represent 1.6% in 2000 and 0.8% in 2005. [4] Total loans to the HH sector. [5] The residual categories are loans to financial institutions, foreign entities and other domestic entities. [6] Accounts lodged under foreign offices excluded. [7] Other household credit: 14.5% in 2000; 10.3% in 2005. [8] Refers to 2002. [9] Includes mortgages and loans from building societies. [10] Annual average; government securities and securities issued by other sectors held by commercial banks are excluded.

Sources: US Flow of Funds; BoJ Flow of Funds; national data (questionnaire).

Table A13

Structure of household balance sheet

	Household debt as a percentage of household disposable income			Household debt as a percentage of household assets		
	1995	**2000**	**2005**	**1995**	**2000**	**2005**
Latin America						
Chile		34.0	56.0			
Colombia	27.6	25.7	23.7			
Mexico	17.3	10.5	14.9[1]		18.3[2]	18.7[2]
Peru		17.0	12.0			
Asia						
China	0.9	5.2		4.0	27.3	10.4
India				2.5[3]		2.8[3]
Korea	85.1	93.9	139.6	46.0	41.2	52.9
Philippines	3.5[4]	2.8	4.1			
Singapore		218.1	218.7		20.2	19.5
Thailand	46.9[5,6]	46.7[5]	59.3[5]			
Central Europe						
Czech Republic	11.9[7]	14.1	25.3[1]	3.6[7]	4.1	7.5[1]
Hungary	6.4	7.0	28.9	8.4	7.1	26.0
Poland[8]	7.0[6]	13.5	21.1	20.1[6]	27.0	34.7
Other emerging economies						
Algeria						
Israel	70.0	76.0	64.0	20.4	17.4	15.6
South Africa	58.3	53.3	62.4	20.6	18.2	18.8
Turkey	1.2	5.5	9.3			
Memo:						
United States	*93.5*	*102.8*	*135.1*	*15.5*	*15.2*	*19.1*
Japan	*130.2*	*131.0*	*127.9*	*15.0*	*14.6*	*14.7*
Euro area	*70.9*	*83.0*	*89.2*	*11.8*	*12.4*	*12.3*

[1] Refers to 2004. [2] Refers to households' financial assets: M2 and equity holdings. Without equity holdings the ratios are 31.2% in 2000 and 34.1% in 2005. [3] Refers to urban HHs. For rural HHs: 1.8% and 2.8%. Data pertain to 1991–92 and 2002–03. [4] Refers to 1999. [5] HH debt as a percentage of HH income. [6] Refers to 1996. [7] Refers to 1998. [8] Refers to HH debt (without interest) to financial institutions and HH assets (currency in circulation, gross deposits (without interest), assets outside banking system).

Sources: OECD; US Flow of Funds; national data (questionnaire).

Table A14

Gross flow of financial liabilities of the personal sector

In percentages

	Annual flow of gross financial liabilities as a percentage of GDP		Composition of outstanding financial liabilities			
			Mortgage debt		Other debt	
	1995–97	2003–05	1995–97	2003–05	1995–97	2003–05
Latin America						
Chile		17.5[1]		54.3		45.7
Colombia	5.0	1.1	49.1	25.7	50.9	74.3
Mexico	2.8	1.7	87.9	74.6	12.1	25.4
Peru	0.3	1.5	2.5	14.0	97.5	86.0
Asia						
Indonesia	20.9	9.9				
Korea	8.5	4.8				
Malaysia[2]	16.3	13.4	36.0	48.2	64.0	51.9
Singapore		2.0		73.5		26.5
Thailand[3]	3.0	2.1	34.6	53.4	65.4	46.6
Central Europe						
Czech Republic[4]	2.5	4.2	3.0	13.5	97.0	86.5
Hungary[5]	0.5	5.3	56.0[6]	38.0[6]	44.0	62.0
Poland	1.3[7]	1.6		28.7		71.3
Other emerging economies						
South Africa	8.6	6.9	36.7	58.0	63.3	42.0
Turkey[5,8]	2.2	6.6			100.0	100.0
Memo:						
United States	*6.0*	*11.9*	*64.2*	*67.9*	*35.8*	*32.2*

[1] As a percentage of disposable private income. [2] Refers to 1997. [3] Liabilities with commercial banks. [4] 1997 and 2004. [5] Household sector. [6] Housing loans. [7] Refers to 1997. [8] Consumer credits, credit card claims and credit to personnel.

Sources: US Flow of Funds; national data (questionnaire); BIS.

Table A15

Structure of the mortgage loan market

	Percentage share in total outstanding mortgage loans		Determinants of mortgage lending rate				Use of mortgage-backed securities
	Fixed rate	Variable rate	Linked to policy rate	Linked to prime lending rate	Subject to regulation	Others	
Latin America							
Argentina				Yes			Limited
Chile			No[1]	No	No[2]	No	Limited
Colombia					Yes	Yes[3]	Limited
Mexico	41.0[4]	59.0[5]		Yes	Yes	Yes[6]	Limited
Peru				Yes	No		Limited
Venezuela	0.0	100.0		22.0	78.0		No
Asia							
Hong Kong SAR	0.3	99.7		Yes			Yes[7]
India	[8]	[8]				Yes	
Indonesia	1st year	2nd year	Yes				No
Korea						Yes[9]	
Malaysia	23.4	76.6		Yes	Yes[10]		Limited
Philippines[11]		100.0	Yes	Yes	Yes		Limited
Singapore				Yes		Yes[12]	Limited
Thailand		Majority		Yes			No
Central Europe							
Czech Republic	Majority					Yes[13]	
Poland	1.8	98.2		Yes		Yes[14]	Very limited
Other emerging economies							
Israel	68.0	32.0	Yes	Yes	No		No
Saudi Arabia							No
South Africa		Majority		Majority[15]			Yes[16]

[1] Positive correlation between both variables, but they are not linked. [2] Ceiling interest rate, but not binding. [3] 93% of mortgage loans are indexed to inflation (UVR). However, recently half of the new disbursements have been made at a fixed rate. [4] Mortgage loans originated by banks and sofoles. [5] Credits originated by public sector government agency indexed to inflation. [6] Negotiated with customers. [7] Exists but limited usage. [8] Interest rates on housing loans are deregulated and decided by the banks. Borrowers have the option of both fixed and variable rate loans. [9] Linked to market interest rates (CD, etc.). [10] Ceiling rate on housing loans extended to low-income groups under the Lending Guidelines to Priority Sectors. [11] Local commercial bank. [12] S$ interbank rates. [13] Mostly 5Y. [14] Also negotiated with customers. [15] Mostly linked to prime lending rate which is in turn linked to policy rate. [16] Started in 1989 and accelerated in 2002.

Source: National data (questionnaire).

Table A16

Annual gross flow of financial liabilities of the non-financial corporate sector

	As a percentage of GDP		
	1982–84	**1995–97**	**2003–05**
Latin America			
Argentina		6.6	6.6
Chile	11.6		11.2
Colombia	10.7	22.4[1]	5.8[2]
Asia			
China		19.4	19.1
Korea	21.8	25.2	10.4
Malaysia		46.1	7.8
Singapore	9.6	59.6	14.9[2]
Thailand		4.0	21.0
Central Europe			
Czech Republic[2,3]		22.7	8.2
Hungary		26.8	18.6
Other emerging economies			
South Africa		9.1	5.5
Turkey		16.8	12.0

Note: Data for 1982–84 refer to Table 9 in Kamin et al (1998).

[1] Refers to 1997. [2] Refers to 2003–04. [3] Refers to 1996–97.

Source: National data (questionnaire).

Table A17

Structure of outstanding bank deposits and loans

As a percentage of total

	Deposits			Loans		
	At fixed interest rate	**At variable interest rate**	**Average contractual maturity (months)**	**At fixed rate**	**At variable rate**	**Average contractual maturity (months)**
Latin America						
Argentina	94.4	5.6		...	...	
Chile	99.4	0.6	13.0	74.0	26.0	17.0[1]
Colombia	…	…	2.1	42.0	58.0	4.5
Mexico	94.9	5.1	1.1			
Peru	48.0[2]	52.0	4.2			
Venezuela	13.0	87.0	1.0	0.0	100.0[3]	60%<12.0
Asia						
India	Majority		2.0			4.4
Indonesia	50.2	49.8		0.7	99.3	–
Korea				[4]	[4]	
Malaysia	48.7	51.3		40.9	59.1	…
Philippines	36.4[5]		3.5[5]	93.2		15.5
Singapore[6]	70.7	29.3	6.0			36.0–60.0
Thailand	Majority		8.4[7]	20.0	80.0	75.6[8]
Central Europe						
Czech Republic		Majority of deposits of households and corporate sector	48% o/n deposits 25% deposits with agreed maturity up to 2Y	Majority of loans to households[9]	Majority of loans to corporate sector	Above 60.0[10]
Hungary	54.0	46.0	3.0	15.0	85.0	15.0
Poland[11]	55.0	45.0	3.2[12]	12.0[13]	88.0	84.2[2]
Other emerging economies						
Israel			14.2			15.2
Saudi Arabia[15]	46.8	9.4	Short-term			…
South Africa	23.0	77.0	0.0–1.0	Minority	Majority	24.0–240.0
Turkey	99.9	0.1	2.8	78.3	21.7	...

[1] Estimated. [2] Term deposits. [3] In Venezuela the CB regulates interest rates for loans to a top rate of 28% per year. Loans can have variable rates below that. [4] Corporations: 46.1% at fixed rate; 53.9% at variable rate; households: 13.8% at fixed rate; 86.2% at variable rate. [5] Time deposits. [6] Deposits refer to non-bank customers' deposits; loans refer to non-bank loans and advances including bills discounted/purchased. [7] Excluding current and saving deposits (41% of total deposits). [8] Excluding call loans (11% of total loans). [9] Specially housing loans. [10] 57% of loans to private sector. [11] Information on deposits is unavailable; figures reflect the interest rate structure of the sum of all interest bearing liabilities. [12] Of liabilities to non-financial sector. [13] Share in total loans to financial sector (excluding banks), non-financial sector, general government sector. [14] Of loans to non-financial sector. [15] Non-interest bearing deposits are excluded.

Source: National data (questionnaire).

Table A18

Currency denomination of bank balance sheets

Percentage denominated in foreign currency

	Assets			Liabilities		
	1993	2000	2005	1993	2000	2005
Latin America						
Argentina		69.8	20.6		69.1	17.6
Chile	19.7	14.4	18.9	20.6	12.9	17.8
Colombia	13.0	8.1	6.5	11.1	10.0	5.4
Mexico	26.7	16.1	9.8	28.2	15.6	9.8
Peru		74.0	66.0		76.0[1]	66.0[1]
Venezuela	12.2	8.1	5.7	3.5	2.2	1.2
Asia						
Hong Kong SAR	74.5	57.8	58.0	75.5	54.3	54.5
India		2.9	1.1		5.0	4.3
Indonesia	35.1	25.1	19.6	36.4	30.3	19.3
Korea	4.1	13.4	9.9	3.9	12.2	9.9
Malaysia		6.2	6.4		4.2	7.5
Philippines		32.4	31.0		40.8	37.8
Singapore		75.4[2]	74.6[2]		75.1[3]	73.3[3]
Thailand		14.0	11.8		6.8	5.4
Central Europe						
Czech Republic		18.6	18.5		17.1	14.7
Hungary	28.8	35.6	38.4	30.9	35.9	31.6
Poland[4]		21.0	23.3		18.0	16.2
Other emerging economies						
Israel	36.1	39.0	42.0	36.9	38.0	43.0
Saudi Arabia	25.6	34.5	19.3	29.1	31	22.8
South Africa		6.8	8.7		3.1	2.0
Turkey[5]		35.0	32.0		46.0	36.0
Memo:						
United States	*1.2*	*0.7*	*0.8*	*1.5*	*0.8*	*0.7*
Japan	*11.6*	*12.7*	*21.3*	*14.3*	*9.1*	*12.9*

[1] Excludes capital. [2] Refers to Asian Currency Unit (ACU) assets and foreign notes and coins, net amount due from banks, NCDs held, loans to non-bank customers and bills discounted/purchased in the Domestic Banking Unit (DBU); items that do not have breakdowns by S$ and FC in the DBU are excluded. [3] Refers to ACU liabilities and non-bank deposits, NCDs issued, amount due to banks, bills payable in DBU. Items in the DBU that do not have breakdowns by S$ and FC are excluded. [4] Annual average. [5] Year-end figures.

Sources: IMF; national data (questionnaire); BIS statistics.

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Monetary policy transmission and the long-term interest rate in emerging markets

Ramon Moreno[1]

I. Introduction and summary

Since the early 1990s, the progressive shift towards inflation targeting in emerging market economies (EMEs) and the growing use of short-term interest rates as operating instruments has underscored the need to better understand the channels of monetary policy transmission in EMEs.

A question of particular interest is how changes in short-term rates – which are either set by monetary authorities or influenced strongly by them – are related to long-term ones. This paper seeks to shed light on this relationship by first discussing the various factors that influence long-term rates, including expectations of future policy and inflation, risk premia and foreign interest rates. Reductions in the level and volatility of inflation, improvements in liquidity and reductions in credit risk may have all contributed to a distinct reduction in the level and volatility of term spreads (the difference between long- and short-term rates) in emerging market economies. Central bank questionnaire responses indicate that inflation expectations are now better anchored, and the influence of external factors on domestic long-term rates has in some cases increased.

The relative importance of domestic policy and foreign factors in influencing long-term rates is also examined by estimating a vector autoregression model for a group of emerging market economies. This analysis indicates that: (i) the domestic long-term interest rate in our set of emerging markets is most affected by its own innovations, which suggests that changes in long-term interest rates largely reflect variation in the term spread due to changes in expected inflation or risk premia; (ii) the magnitude of these innovations has fallen in recent years, which is broadly in line with the reduction in the level and volatility of term spreads; and (iii) while their contribution to explaining the behaviour[2] of long-term interest rates in emerging markets is still small, foreign long-term rates sometimes have a larger impact on domestic long-term rates than does the domestic policy rate. This impact in some cases has also increased over time. A number of issues of interest to policymakers may be highlighted.

First, the reduction in inflation and inflation volatility has anchored inflation expectations in a number of emerging market economies, reducing the need for policymakers to respond aggressively to shocks. A question this raises is what set of interest rate and communications policies will ensure that such credibility is maintained.

Second, reductions in risk premia have had an expansionary influence on emerging market economies by reducing financing constraints. This raises the question of whether policy rates need to rise (other things being equal) to offset the stimulus from reduced financing constraints. Another question is whether reductions in risk premia might have gone too far, such that long-term interest rates are now “too low”, exposing emerging financial markets to a possible sudden reversal in investor sentiment.

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[2] More precisely, the variance of the forecast error.

Third, what are the implications of an increased role for external factors in determining domestic long-term rates for policy setting? Should the information content of the foreign yield curve or foreign news be taken into account in assessing monetary conditions? As above, does this imply that policy rates (other things being equal) should be set differently?

The rest of the paper is organised as follows. Section II discusses the determination of long-term interest rates in a closed economy, and some factors that may account for the reduction in term spreads. Section III summarises interest rate determination in an open economy, the conditions under which domestic long-term rates will be anchored by external interest rates, and the extent to which it appears these conditions are being met. Section IV highlights what is known about the relationship between policy rates and long-term interest rate prices in emerging markets based on both central bank responses to a questionnaire and existing research. Section V describes the dynamics of the relationship between short-term rates, foreign interest rates and long-term rates based on empirical estimates of the VAR model.

II. Determinants of long-term interest rates and the term spread in a closed economy

As financial markets develop, the relationship between short-term and long-term interest rates becomes an increasingly important issue for central bankers. One reason is that policymakers typically influence very short-term rates (eg overnight rates), but spending, and consequently inflation, is usually related to interest rates at longer maturities. Another reason is that, as discussed below, long-term interest rates contain information about expected future paths of inflation and risk premia; the behaviour of long-term rates thus reveals how markets perceive policy and economic conditions.

Table 1

Level and volatility of daily spread[1]

	One-year rate						Five-year rate[2]					
	Average			Standard deviation			Average			Standard deviation		
	2001	2005	change	2001	2005	% change	2001	2005	change	2001	2005	% change
India	0.3	0.7	0.4	1.0	0.4	–65	0.6	1.5	0.9	1.1	0.5	–60
Korea	0.7	0.6	–0.1	0.4	0.3	–12	1.4	1.2	–0.2	0.6	0.4	–31
Malaysia	...	0.2	...	...	0.2	...	0.7	0.8	0.1	0.3	0.1	–58
Philippines	4.2	2.2	–2.0	1.3	0.6	–57	5.3	3.5	–1.8	1.4	0.8	–46
Thailand	0.6	0.6	0.0	0.4	0.1	–61	2.1	1.8	–0.3	0.6	0.4	–39
Brazil	4.4	–0.7	–5.1	2.5	0.8	–67	6.0	–1.7	–7.7	3.3	0.8	–76
Mexico[3]	1.9	–0.3	–2.2	0.8	0.4	–44	3.9	–0.2	–4.1	1.1	0.6	–46
Czech Rep	0.3	0.1	–0.2	0.4	0.2	–36	0.8	1.0	0.2	0.5	0.2	–55
Hungary	–0.7	–0.3	0.4	1.0	0.8	–17	–2.5	–0.3	2.2	1.1	1.0	–2
Poland[4]	–0.8	–0.4	0.4	1.1	0.3	–68	–4.9	–0.2	–4.7	2.2	0.5	–75
Turkey	25.8	1.9	–23.9	23.4	0.9	–96	...	...	...	...	...	...

[1] Long-term minus short-term rate, in percentage points. [2] For Brazil, three-year rate. [3] 2001 column refers to 2003. [4] 2001 column refers to 2002 for one-year rate.

Sources: Bloomberg; Datastream; BIS calculations.

To illustrate, Table 1 shows that spreads between long-term and short-term rates have fallen significantly in a number of emerging market economies in the course of this decade. Volatility in these spreads has also fallen across the board.

What could explain the observed declines in the level of spreads and their volatility? In a deep and liquid government bond market where the central bank fully controls the nominal short rate, the nominal yield curve will be driven by market participants' views about the course of monetary policy. Participants will form their views based on the underlying macroeconomic conditions and the likely reaction of the monetary authority and how this will affect the outlook, notably inflation. These views give rise to expectations about the path of nominal short rates and to term premia associated with the uncertainty surrounding these expectations.

Expectations of inflation. In order to equalise returns across different maturities, long-term rates will depend on current short-term rates and market expectations of future short-term rates; this is known as the expectations theory of the term structure. As short-term rates are influenced directly by policy, in effect, long-term rates reflect expectations of future monetary policy. Furthermore, since the nominal rate is the sum of expected real returns and the nominal rate of inflation, the nominal rate on a long-term bond between today and the time the bond matures can be expressed as the sum of expected real returns and inflation over that period:

$$i_t^n = \frac{1}{n}\sum_{i=0}^{n} E_t r_{t+i} + \frac{1}{n} E_t \overline{\pi}_t^n + \rho = r_t^n + \pi_t^n + \rho \tag{1}$$

where i_t^n is the nominal interest rate on a bond maturing n periods from time t, $E_t r_{t+i}$ is the one-period real rate of interest rate (averaged over the term of the bond), $E_t \pi_t^n$ is the expected inflation over the period of the bond and ρ is the risk premium charged by domestic residents for holding a domestic bond. The second equality is to simplify the notation.

Thus, fluctuations in the long-term interest rate, and the corresponding spread with the short-term rate, will reflect changes in expected real rates and in expected inflation (the variance of inflation would influence term premia; see below). Some estimates suggest that changes in expectations of inflation can have a very large impact on long-term rates (accounting for nearly 80% of the fluctuations in long-term rates in the UK over the period 1985–1994; see Barr and Campbell (1997)).[3]

Due to the relatively recent (and in some cases still incipient; see below) development of bond markets in a number of emerging market economies,[4] analysing the impact of changes in expectations of inflation on the term structure over an extended period is not always possible. Nevertheless, Mehl (2006) has recently performed a related exercise. He studies 14 emerging market economies to see whether the slope of their yield curve predicts domestic inflation (and growth) over the past decade. Mehl finds that a yield curve does help predict inflation; after a 100 basis point steepening observed a year and a half earlier, inflation (and growth) is expected to accelerate by around 30 basis points a year ahead. Adding the yield curve also improves out-of-sample forecasts of inflation for about half of the countries in his sample.

Of particular interest is that inflation and its volatility have fallen considerably in a number of emerging markets in this decade. One explanation is that shocks have been smaller; in

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3 However, direct tests of the expectations theory of the term structure itself have in some cases rejected it.

4 For example, in Thailand long-term interest rates are not available over a full business cycle of expansion and contraction; see Bank of Thailand (2006). In Mexico, the issuance of longer-term securities began in earnest at the beginning of this decade.

particular, fiscal positions have stabilised or improved in a number of emerging market economies. Another explanation is that inflation is less sensitive to shocks because it is anchored by stable inflation expectations, particularly in inflation targeting countries. A body of recent research suggests that a credible inflation target has helped to anchor inflation expectations in developed and emerging market economies. Using a measure of compensation for expected inflation and inflation risk at long horizons in the US, the UK and Sweden, Gürkaynak, Levin and Swanson (2006) find that forward inflation compensation is insensitive to economic news when a country targets inflation. In a study of selected Latin American economies, De Mello and Mocerro (2006) find evidence suggesting that inflation targeting regimes have anchored inflation expectations in Brazil, Chile and Mexico.[5]

The yield curve slope out to one year might also react quite differently from the slope at longer horizons to changes in near-term inflationary expectations. The former could rise as the market expects monetary policy to resist, whereas the latter (assuming success) might stay relatively flat. Variations in the responses to policy changes at different maturities are reported by a number of central banks (see below).

Term premia. Long-term rates generally exceed the predictions of the expectation theory; for example, Poole (2006) observes that in the US over the past 50 years, the 10-year Treasury rate has averaged about 90 basis points above the federal funds rate. Two reasons can be offered for expecting even larger term premia in emerging financial markets. First, a history of high and volatile rates of inflation expose holders of longer-term (unindexed) securities to a higher risk of loss. As noted previously, inflation has become more stable and it is likely that this has reduced term premia in recent years. Second, emerging financial markets tend to be comparatively thin and illiquid compared to developed markets. In many cases, there is no active secondary market in long-term bonds so that investors needing to dispose of their holdings over a short period can experience significant capital losses. One rough proxy for potential bond market liquidity is market size, which has been associated with more market turnover and lower bid-ask spreads. McCauley and Remolona (2000) suggest that government bonds outstanding must exceed around $100–200 billion in order to sustain a liquid government bond market. Emerging bond markets still appear to be small by this criterion, with only few exceptions. As can be seen in Graph 1, by 2005, only China, Korea, Malaysia, Mexico and South Africa had reached a total (government and private) bond market size of about $100 billion or higher.[6] Brazil, Thailand and Argentina had markets in the $65–$85 billion range; while the remaining markets were all below $50 billion. However, there is also some evidence that emerging bond markets are growing quite rapidly. For example, using BIS data, Eichengreen, Borenzstein and Panizza (2006) estimate that between 1994 and 2004 domestic bonds as a share of GDP rose from nearly 30% to over 40% in East Asia and the Pacific and approximately doubled to almost 40% in Latin America, while rising from 100% to more than 120% in developed markets.

Central bank questionnaire responses also indicate that liquidity in a number of emerging bond markets has increased. Apart from bond market growth, bid and ask spreads have fallen, and maturities have in some cases lengthened. Nevertheless, turnover ratios in many countries are still low.[7]

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5 For falling trends and international convergence in inflation, see BIS (2006) Chapter 4; on volatility, see Mohanty and Turner (2008, this volume), Table 2.

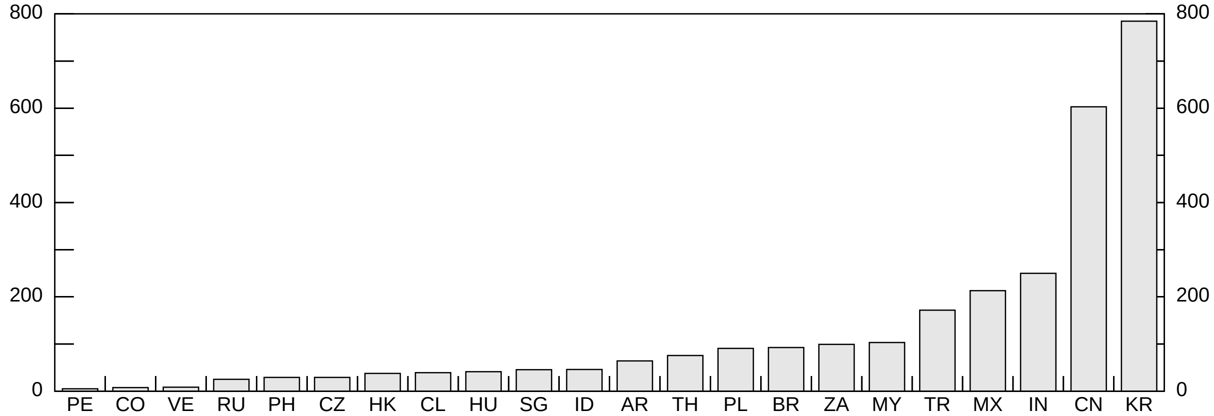
6 The presence of a large private sector bond market can add to liquidity if it does not lead to market segmentation.

7 See discussion of Table A10 in Mohanty and Turner (2008). For Asia, also see Gyntelberg, Ma and Remolona (2005). For Latin America, see Jeanneau and Tovar (2006). These papers note that liquidity remains an issue despite progress.

Graph 1

Bond market size[1]

End-2005, in billions of US dollars



[1] Amounts outstanding of domestic long-term debt securities plus local currency part of international long-term debt securities; for some countries, only domestic long-term debt securities. The corresponding figures for the US, Japan and the UK are 19, 7 and 1 trillion US dollars, respectively.

Source: BIS.

An example of greater financial market depth is Mexico: in 1995 the government could only borrow in the domestic market at less than one-year maturity. Maturities have risen significantly since 2000, when three-year and five-year bonds were first issued. In July 2001, 10-year government bonds were issued, while in October 2003 20-year bonds were auctioned for the first time. Another example is Poland, where the liquidity premium is negligible. All segments of the Polish treasury bond market at maturities of up to 10 years are liquid, allowing investors to execute trades quickly and without influencing market prices. Liquidity is concentrated in the five- and 10-year segment, where outstanding amounts of specific bond issues exceed PLN 20 billion (EUR 5 billion), fulfilling the requirement for benchmark status. In Thailand, according to the central bank, "the Thai bond market has already developed to a stage where information embedded in the term structure of interest rates reflecting market expectations of future short-term interest rates can be useful for monetary policy purposes."[8]

Positive term premia may also reflect the fact that investors need to be compensated for the risk of losses from default, and these risks generally rise with the time to maturity. This can be an important consideration in emerging market economies where sovereign debt in many cases is rated sub-investment grade. However, such risk premia appear to be declining. Converting ratings to a numerical scale reveals that the mean sovereign rating of the emerging markets in our sample rose in this decade, from below BBB+ at the end of 2001 to above BBB+ at the end of 2005 (the median rose from around A– to around A over this period) according to Standard & Poor's. The dispersion (standard deviation) in ratings fell much more dramatically, by about 29%.

Policy implications. The factors described previously can have important implications for the relationship between short-term rates and long-term rates and monetary policy transmission. If expected inflation is high and volatile, or equivalently, if inflation expectations are not well

[8] Bank of Thailand (2006, page 29, paragraph 1). This was before the introduction of capital controls on 18 December 2006, which appears to have affected the operation of the Thai bond market. However, restrictions have been reversed over time.

anchored, long-term rates will tend to be more volatile as expectations shift, and will be less responsive to policy rates. This will generally be associated with higher and more volatile term spreads, as was observed at the beginning of the decade in some of the countries included in Table 1. Policymakers may then need to respond more aggressively to shocks in order to influence long rates and achieve the desired path of output and inflation. On the other hand, if policy rate changes are credibly expected to respond to keep the economy on track (ie inflation within target and growth at potential), the long-term rate may change less than proportionately (or not at all) in response to shocks. An important point to bear in mind is that while reductions in inflation appear to reflect better policies, including the shift to inflation targeting, they also may reflect the effects of favourable global supply shocks or favourable market sentiment that could reverse in time. Under these conditions, the appropriate set of interest rate and communication policies that can help keep inflation expectations anchored warrant further examination.

Reductions in risk premia also have implications for policy as the associated reduction in financing constraints tends to stimulate the economy. One question of interest is whether policy rates need to rise to offset this stimulus. Another question is whether reductions in risk premia might have fallen too far. If long-term interest rates are now “too low”, emerging financial markets could be exposed to a possible sudden reversal in investor sentiment.

III. Long-term interest rates in an open economy

In economies that are highly integrated with the rest of the world, domestic yields or asset prices may be significantly influenced by developments in foreign markets.[9] Nominal interest rate determination in an open economy can be described by:

$$i_t^n = r_t^{n,W} + \pi_t^{n,W} + \Delta s_{t+n}^e + \rho^W \tag{2}$$

The first two right-hand terms are the expected world real rate of interest rate and world rate of inflation, Δs_{t+n}^e is the expected average rate of depreciation of the nominal exchange rate over the term of the bond and ρ^W is a risk premium that global markets apply to the domestic bond.

Financial integration of a small open economy implies that the determination of long-term interest rates satisfies equation (2). For the resulting long-term rate to also satisfy equation (1), the determinants of interest rates in a closed economy must converge to, or be anchored by, foreign determinants. To illustrate this we subtract equation (2) from equation (1) to obtain:

$$(r_t^n - r_t^{n,W}) + (\pi_t^n - \pi_t^{n,W}) - \Delta s_{t+n}^e + (\rho - \rho^W) = 0 \tag{3}$$

Equation (3) suggests that convergence of domestic nominal interest rates with foreign rates will generally imply: (i) real interest rate convergence; (ii) stable real exchange rates; and (iii) convergence in risk premia of domestic and foreign residents.

Real interest rate convergence. Real interest rate convergence appears to be occurring with the growing globalisation of saving and investment, which implies that real interest rates are increasingly determined globally. However, recent empirical evidence suggests that convergence still tends to be one-sided, with the real rate in the largest economy, the US, affecting real rates in smaller economies, but not necessarily vice versa. The creation of the

9 For a discussion in the context of developed markets, see Christiansen and Pigott (1997).

relatively large eurozone has altered, but not eliminated, this one-sided relationship (Chinn and Frankel (2005)).

Stable real exchange rates. Real exchange rate stability would imply that the relative inflation terms and the nominal exchange rate in equation (3) cancel out. One way to meet this condition is if purchasing power parity holds; however, the empirical evidence suggests that purchasing power parity does not hold at the horizons of interest to policymakers. Another way to achieve this is for inflation rates to converge and for nominal exchange rates to remain stable. As noted previously, inflation convergence is occurring, but the fact that many countries now maintain floating exchange rates implies a continuing wedge between domestic and foreign (nominal) interest rates. Having said that, the empirical evidence provided in Saxena (2008, this volume) that this wedge might not be very robust. She finds that as long as capital is highly mobile, the foreign interest rate effect on the domestic rate is larger *under regimes classified as floating* (de facto or de jure) than under those classified as pegging. One explanation is that those countries with floating exchange rates tend to have a higher degree of capital mobility. Another is that countries whose exchange rate regimes are classified as floating intervene actively in the foreign exchange market and do not fully sterilise, which would tend to link foreign to domestic rates. However, they are not as successful in stabilising the exchange rates as countries who are classified as pegging.[10]

Equalisation of risk premia of domestic and foreign investors. In open economy models, no distinction is usually made between domestic and foreign residents in describing risk premia. While risk premia of these two types of agents do share common elements (eg they are likely to reflect concerns about inflation, exchange rate volatility or default),[11] there are reasons to believe there may be important differences. For example, the risk tolerance of foreign investors – which would be reflected in risk premia – may differ from that of domestic residents because the former have more diversified portfolios or are exposed to conditions (eg investment opportunities or performance or liquidity in the rest of the world) that do not directly affect domestic investors. The equalisation of risk premia between the closed and open economy is more likely to happen if: (i) financial integration significantly increases the pool of foreign investors relative to domestic; or (ii) portfolios of domestic and foreign investors become more diversified and thus more "similar".

The equalisation of risk premia thus depends on the degree of integration with global financial markets. As reported in Saxena (2008), such integration has increased, as the share of external assets and liabilities as a percentage of GDP has grown significantly. Another indicator is the degree of foreign participation in emerging bond markets. Although this is still relatively small, in some cases it is large enough to have an impact. According to a recent report of the Committee on the Global Financial System (2007), the foreign share in local currency bond markets has grown rapidly in some emerging market economies, and is respectively 22% and 27% of the total in Poland and Hungary, 9% and 11% in Mexico and Turkey, and 3% to 6% in Thailand, Malaysia and South Africa.[12]

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[10] Christiansen and Pigott (1997) also suggest that floating does not completely insulate domestic interest rates from foreign interest rates.

[11] This risk premium would contain components related to currency risk as well as country risk (covered interest differential). For an explicit decomposition, see, for example, Chinn and Frankel (2005).

[12] According to the same report, the estimates provided by market participants are usually higher: by way of comparison, partly relying on BIS data, Eichengreen, Borensztein and Panizza (2006, Figure 17) estimate that the share is nearly 30% in Hungary, over 20% in Poland, below 10% in Mexico and Turkey, around 5% in Argentina and Malaysia, and well below 5% in Thailand, Peru, Indonesia and Korea. This compares to over 50% in the US. Based on information on US holdings, foreign participation in some other markets also appears to be small. See Burger and Warnock (2004), whose methodology is used in part by Eichengreen, Borensztein and Panizza (2006).

To sum up, we may highlight two points from the preceding discussion. First, inflation expectations and risk premia have fallen and are more stable than they have been in the past; this may explain the significant reduction that has occurred in the course of this decade in the level and volatility of long-term rates and term spreads in emerging market economies. Second, globalisation introduces another channel that can influence the long-term interest rate and the effectiveness of monetary policy. However, it is not entirely clear how important it is because some factors (eg floating exchange rates, differences in risk preferences) may introduce a wedge between domestic and foreign nominal long-term rates. We attempt to shed further light on this last point in the next two sections.

IV. Effects of policy rates and external factors on long-term rates: central bank views

Given the preceding, what is the relative importance of short-term rates, risk premia and external factors in influencing long-term interest rates in emerging market economies? Based on their responses to the questionnaire circulated for this meeting, central bank views can be summarised by three main points.

First, the policy rate influences long-term rates, but more stable inflation expectations have dampened the direct impact. Central banks generally reported that the effect of the policy rate on long-term rates is significant, although in some cases the effect was temporary (Table 4 in Mohanty and Turner (2008)). In Malaysia, the pass-through from policy rates to short-term and long-term rates has reportedly risen over time, perhaps due to more bank competition and the development of more liquid bond markets following the move to a more market-based interest rate framework in April 2004. In Chile, Larraín (2005) finds that policy rate surprises affect longer-term rates. In Hungary, a monetary policy surprise affects the entire yield curve of government bonds, although the effect is temporary (see the contributions in this volume of Vonnák (2008) and Mohanty and Turner (Table 4, 2008)).

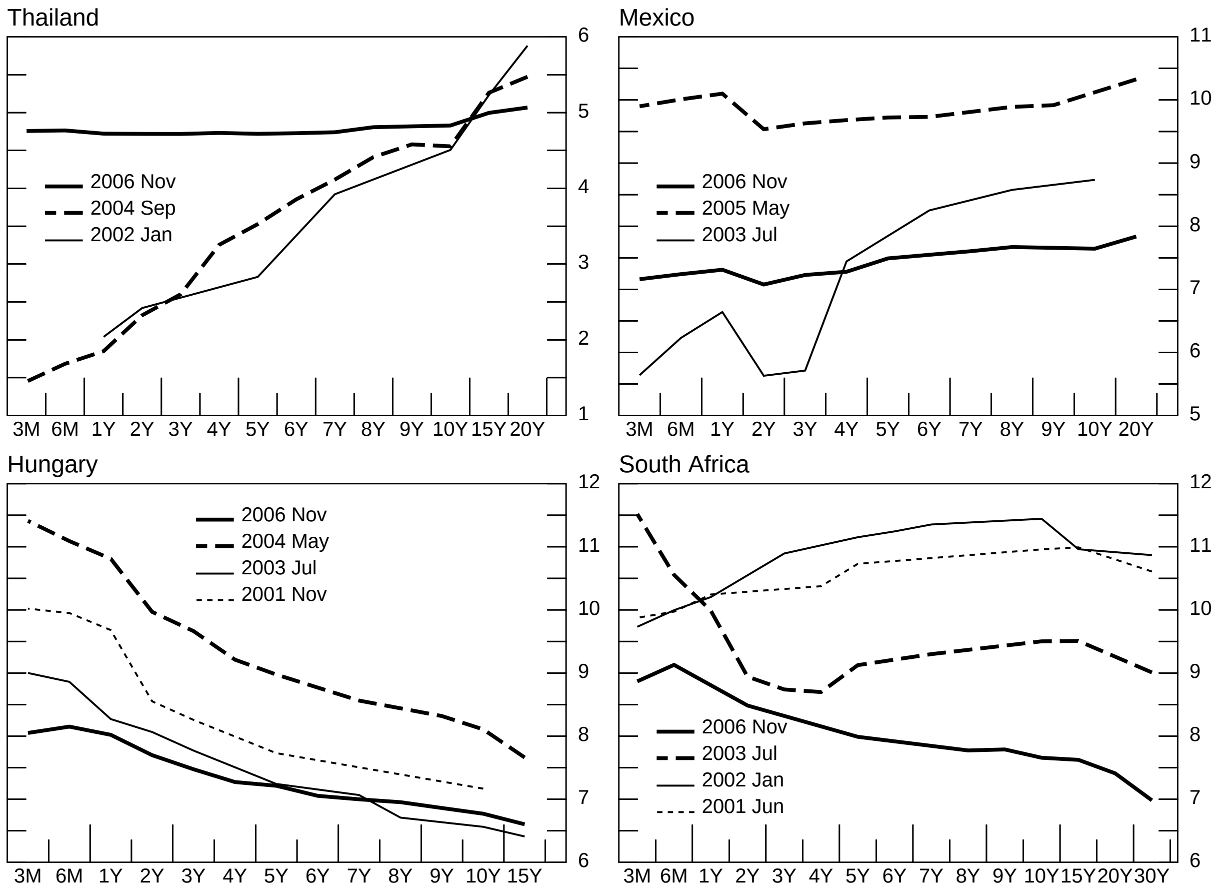
A number of central banks (eg those of Chile, the Czech Republic, Mexico and Colombia) have said that the credibility of monetary policy and inflation targets has increased and have highlighted two implications. One is that long-term rates are now less sensitive to a variety of shocks including changes in the policy rate, but this is seen as a desirable. For example, in Mexico, inflation targeting has implied more anchoring of expectations, as the dispersion of expectations among market forecasters has fallen. While in the past monetary policy appeared to generate parallel movements in the yield curve without changes in slope, monetary policy actions since 2001 have changed the slope of the curve; that is, monetary policy tightening implies a flatter yield curve.

To illustrate, Graph 2 shows the pattern in yield curves in a number of emerging market economies as policy tightened or eased. As can be seen, the Mexican yield curve was initially upward sloping but there was a significant flattening as interest rates rose between July 2003 and May 2005. Rates subsequently fell, but the yield curve was still flat in November 2006. In effect, the tightening helped stabilise inflationary expectations, allowing the whole yield curve to drop subsequently. (For further discussion of bond markets and yield curves in Latin America, see Jeanneau and Tovar (2006)). Thailand's upward sloping yield curve also flattened in the course of this decade (note the difference in scale). In Hungary and South Africa, inverted yield curves also flattened as rates fell.

It is worth noting that a flattening yield curve is not always seen as a sign of greater credibility. For example, Bevilaqua, Mesquita and Minella (2008, this volume) note that as monetary policy was tightened in Brazil in 2004, longer-term yields increased little, resulting in a flattening yield curve and a comparatively small increase in the real interest rate at a one-year horizon. They interpret this as reflecting the small impact of tightening on inflation expectations, due to a lack of policy credibility. However, more recently, long-term rates have fallen in anticipation of disinflation, and a flattening yield curve has reflected monetary easing that is consistent with meeting the inflation target in the context of such disinflation. In this setting, the longer term-rate is seen as having become “more sensitive to actual and expected changes in the basic interest rate”, reflecting increased policy credibility.

Graph 2

Local currency sovereign yield curves



Source: Bloomberg.

Another implication is that there is less need for aggressive policy adjustment due to better anchored expectations. For example, since the adoption of inflation targeting in Colombia in 1999, the credibility of the central bank has risen as it has closed the gap between actual and target inflation. In 1999, only one third of people surveyed believed the central bank would meet its inflation target; seven years later the percentage had increased to 90%. As a result, the magnitude of interest rate policy shocks has fallen.[13] In the Czech Republic, the central bank has gradually gained greater credibility after the adoption of inflation targeting, reflecting good communication and successful disinflation. The result is that the typical policy

[13] The interest rate policy shock is based on Bayesian estimation of an interest rate policy rule in the context of a dynamic stochastic general equilibrium model of the Colombian central bank. The volatility of interest rate policy shocks has fallen since March 2000 from 54% to 8%. Higher credibility might reflect the central bank of Colombia’s success in steadily closing the gap between observed and target inflation. The mean absolute gap fell from 2% in 1997–99 to 0.65% for 2000–05.

rate change has fallen from 0.5 percentage points in 1998–99, at the beginning of inflation targeting, to 0.25 percentage points recently.

Second, risk premia still affect long-term rates, but their relative importance has declined. Even in cases where the effect of the policy rate was still thought significant, long-term rates could be influenced by fluctuations in risk premia. For example, in Turkey the debt service burden and the maturity structure of the debt stock are important determinants of market interest rates. The risk premium thus dominates the effect of the policy rate on long-term rates. Since the adoption of floating, and especially after 2002, however, the relationship between short- and long-term rates appears to have strengthened. Market rates and overnight rates follow a parallel pattern, while the risk premium has also come down with a fall in the debt burden. During certain periods, and especially when there is a heightened perception of risk, market rates still diverge from overnight rates. It is expected that the decline in the level and volatility of the risk premium will continue, particularly in the context of increased central bank transparency.

Third, in some countries, but not all, external factors are increasingly important. As noted earlier, shocks to foreign interest rates affect domestic rates in emerging markets, even under floating. In line with this, some central banks see external factors playing a major role in influencing interest rates, particularly at the long end.[14] For example, in Hungary, shocks to the risk premium and long-term expectations regarding eurozone entry contribute significantly to exchange rate and yield curve movements; monetary policy has to react often to shifts in the risk assessment of foreign investors. As noted earlier, research by Rezessy (2005) indicates that monetary policy decisions have immediate impact on the yield curve, but the impact is largest at the short end of the yield curve and smallest at the long end. Long-term interest rates are more sensitive to global risk appetite and expectations concerning Hungary's euro convergence.

In Mexico, the central bank is less able to influence rates in the long part of the yield curve. While the maintenance of a stable monetary policy would still have an impact by lowering the risk premium of domestic long-term rates, the long part of the Mexican yield curve is increasingly influenced by global conditions. For example, during the period of market volatility in 2006.Q2, yield curves steepened as investor risk appetite fell. The spread between the 20-year government bond interest rate and one-day funding rate moved from 61 bps during 2006.Q1 to 206 bps.

In Poland, the short end of the yield curve is mainly sensitive to changes in the key central bank interest rates. The rate on the two-year treasury bond is driven by the implications of the expectations theory of the term structure. Foreign influences are most important for the yields on 10-year bonds, which are shaped by the term risk premium and inflation expectations. Nonresidents are the most important holders of long-term bonds, and the risk premium reflects macroeconomic and political conditions and exchange rate risk.

With the issuance of 12-year inflation indexed bonds in 2004, the central bank of Poland can estimate inflation expectations embedded in long-term yields. For example, at the June 2006 CPI-linked bond auction, average inflation expectations were revealed to be stable over the next 10 years. Since the beginning of March 2006, rising long-term yields have reflected an increase in the term risk premium associated with a fall of global risk appetite for risky assets.

In contrast, some central banks did not emphasise external factors in their questionnaire responses, or said that these factors play a more limited role in influencing interest rates. For

[14] Research by Andritzky et al (2005) also suggests that external factors are relatively important; they indicate that emerging market bond spreads respond more to rating actions and changes in global rates than to domestic data and policy announcements.

example, Vargas (2008, this volume) reports that financial market interest rates generally follow the policy rate, although research shows that interest rate pass-through is incomplete and weakened in this decade because of a delinking of mortgage loans and short run interest rates. Malaysia reports that movements in the yield curve so far follow the general policy direction even if capital account liberalisation has led to an increase in short-term and long-term financial flows (see also Ooi (2008, this volume)). In Thailand, an increasing degree of capital account openness has not significantly affected the yield curve. The short end of the yield curve is largely influenced by the policy rate. The long end of the yield curve is more difficult to control, and is likely to be influenced by market inflation expectations and the economic outlook. In Turkey, the short end of the yield curve is also affected by central bank rates, while the middle segment (18–24 months) seems to respond to inflation expectations. At the long end, risk and term premia are embedded in expected future short-term rates.

In South Africa, short dated bonds influence the South African Reserve Bank's (SARB) repurchase rate, while longer dated bond yields reflect inflation expectations and other factors and are more difficult to control. However, the SARB does not aim to control such yields directly; bond yields are determined by supply and demand factors.

Additional perspective is provided by Mehl (2006). He finds that that the US yield curve helps predict inflation in half of the countries in his sample, while the slope of the euro area yield curve conveys information for future inflation in the new EU member states. (He reaches a similar conclusion for growth). On average, a 100 basis point steepening of the US or euro yield curves observed a year earlier implies an expected acceleration of inflation of around 60 basis points a year ahead. In half the countries in his sample, the US or euro area slope of the yield curve is a better predictor than emerging economies' own domestic slope for inflation (two thirds for growth). He finds that the ability of external slopes to predict economic outcomes is stronger in countries that pegged their exchange rate over part of the sample period (specifically Hong Kong, Poland, Saudi Arabia and Taiwan), after controlling for relative market liquidity and commonalities in economic shocks. This is broadly in line with the Hong Kong Monetary Authority's response to our questionnaire, which indicates that both short-term and long-term yields follow US rates under the linked exchange rate system. However, Mehl suggests that international yield curve spillovers are mainly channelled through the short end of the maturity spectrum.

V. Empirical analysis

To further clarify the relationship between short- and long-term rates, we estimate an econometric model that attempts to identify the direct impact of changes in short-term rates and foreign long-term rates on domestic long-term rates of similar maturity. Identifying this impact poses a number of challenges. One is that financial markets invest a great deal of resources in forecasting monetary policy decisions and, as noted previously, the resulting expectations are embedded in the term structure of interest rates. This implies that changes in policy are often anticipated, which can make it difficult to identify any direct relationship between changes in short-term rates and long-term interest rates. For this reason, some researchers have focused on identifying policy rate surprises and relating these to changes in long-term interest rates (Rigobon and Sack (2002) for the US, Rezessy (2005) for Hungary and Larraín (2005) for Chile). Others have instead focused on how economic news – which may include policy announcements and developments that influence the path of policy – affect long-term interest rates (Fleming and Remolona (1999)).

In this paper we implement a different empirical approach; we estimate a (near) vector autoregression model of interest rates. The model allows us to describe the dynamic interaction between domestic interest rates at various maturities and short-term interest rates or foreign interest rates. It also provides a method for identifying underlying shocks and assessing their relative importance in driving long-term interest rate behaviour.

1. The model and data

The relationship between long-term interest rates, the policy rate and foreign interest rates can be described by the following (near) vector autoregression system in first differences:

$$\Delta i_t^{f,m} = a_0 + \sum_{i=1}^{T} a_i \Delta i_{t-i}^{f,m} + u_{1t} \qquad \text{Foreign long-term rate} \quad (4)$$

$$\Delta i_t^{SR} = b_0 + \sum_{i=1}^{T} b_i \Delta i_{t-i}^{f,m} + \sum_{i=1}^{T} b_{i+T} \Delta i_{t-i}^{SR} + \sum_{i=1}^{T} b_{i+2*T} \Delta i_{t-i}^{m} + u_{2t} \qquad \text{Domestic short-term rate} \quad (5)$$

$$\Delta i_t^{m} = c_0 + \sum_{i=1}^{T} c_i \Delta i_{t-i}^{f,m} + \sum_{i=1}^{T} c_{i+T} \Delta i_{t-i}^{SR} + \sum_{i=1}^{T} c_{i+2*T} \Delta i_{t-i}^{m} + u_{3t} \qquad \text{Domestic long-term rate} \quad (6)$$

Equation (6) is the focus of the present discussion. It says that the domestic long-term rate depends on the lagged foreign rate of similar maturity, the lagged short-term rate, and its own lags.[15] The same set of predetermined variables influence the short-term interest rate (equation 5). However, by construction domestic variables have no influence on the foreign interest rate; they do not appear in the specification of equation (4).

The ordering of equations (4) to (6) is maintained in the computation of impulse responses to (orthogonalised) innovations in each of the variables. These innovations are identified by a Choleski decomposition of the variance covariance matrix of the residuals of the equations in this system. Our focus will be on responses by the domestic long-term interest rate to innovations in each variable. One identifying assumption implied by this ordering is that the foreign rate is exogenous (contemporaneously) to both domestic rates. Another identifying assumption is that the domestic short-term rate is exogenous to the long-term rate at a daily frequency. This assumption appears to be plausible, since the short-term rate is anchored by the policy decisions of the central bank, and changes in this policy occur relatively infrequently in daily data (typically on the occasions when the monetary board meets, which can occur once every several weeks or even once a quarter).

Estimation was implemented using daily data on short-term (overnight or interbank) rates and rates at one-, three-, five- and 10-year maturity. A US interest rate for a security of comparable maturity was used to represent the foreign rate.[16] Data for the period 2001:01:01 to 2006:09:30 were generally collected from Bloomberg. Five lags were selected (three in the case of Korea).

Two sets of questions were addressed:

1. *Which variables help forecast long-term interest rates*? This was done by testing which variables lead or Granger-cause long-term interest rates over the full sample period.

2. *What is the recent dynamic impact of the variables in the model on long-term interest rates*? Has this relationship changed? This was done by estimating the (accumulated) impulse response of long-term interest rates to shocks to each series. In order to verify the most recent responses, and bearing in mind that these might have changed with disinflation and possible significant reductions in risk premia, we estimate impulse responses over two periods: (1) 2001:01:01–2004:06:29, when the Federal Reserve was easing; (2) 2004:06:30–2006:09:30, when the Federal Reserve was tightening.

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[15] Plausible alternative specifications would include adding the foreign short-term interest rate and an error-correction model. These are left for future research. Some results on the impact of foreign short-term interest rates are provided by Saxena (2008).

[16] Although the US rate rather than a European rate was used as the foreign rate for central Europe, the estimated effect of a shock to the foreign rate on the domestic rate is still strong relative to the impact of the domestic policy rate. See Appendix A.

To conserve space, impulse responses were estimated only for longer-term rates at one-year and five-year maturity. A caveat is that we focus on point estimates, which are subject to a margin of uncertainty.

2. Results

Forecasting long-term rates

As reported in Table 2, tests of Granger causality suggest that, with some exceptions, external long rates are better predictors of longer-term yields in emerging market countries than are short-term interest rates. Changes in short-term rates generally do not lead rates at longer maturities in other countries in the group included in Table 1. However, changes in the short-term rate lead (Granger-cause) changes in rates at one-, three-, five- and 10-year maturities in Thailand and Mexico. They also lead changes at one-year maturity in Korea, at one- and three-year maturity in the Czech Republic and at five- and 10-year maturities in Poland. Whether the preceding results have anything to do with bond market size (Graph 1) is unclear; while Korea, Malaysia and Thailand have among the larger emerging bond markets, the Czech Republic does not.

Table 2

Tests of Granger causality

P-values on null hypothesis of no Granger causality, full sample

	India		**Korea**		**Malaysia**		**Philippines**		**Thailand**	
1-year										
Foreign rate	0.01	***	0.19		0.27		0.40		0.00	***
Short-term rate	0.06	*	0.04	**	0.42		0.80		0.03	**
3-year										
Foreign rate	0.48		0.99		0.00	***	0.51		0.00	***
Short-term rate	0.72		0.76		0.76		0.81		0.02	**
5-year										
Foreign rate	0.38		0.54		0.01	***	0.13		0.00	***
Short-term rate	0.13		0.79		0.89		0.41		0.00	***
10-year										
Foreign rate	0.07	*	0.01	***	0.00	***	0.39		0.00	***
Short-term rate	0.36		0.67		0.55		0.88		0.00	***
	Brazil		**Mexico**		**Czech Republic**		**Hungary**		**Poland**	
1-year										
Foreign rate	0.47		0.36		0.34	**	0.01	***	0.01	***
Short-term rate	0.02	**	0.02	**	0.01	***	0.41		0.65	
3-year										
Foreign rate	0.60		0.34		0.00	***	0.01	***	0.00	***
Short-term rate	0.00	***	0.07	*	0.00	***	0.44		0.25	
5-year										
Foreign rate			0.70		0.00	***	0.00	***	0.09	*
Short-term rate			0.08	*	0.13		0.93		0.02	**
10-year										
Foreign rate			0.95		0.00	***	0.01	**	0.25	***
Short-term rate			0.00	***	0.50		0.55		–0.04	***

***Reject null at 1%; **reject null at 5%; *reject null at 10%.

The regression results more consistently indicate a closer relationship between foreign and domestic long rates. In particular, changes in US rates lead changes in domestic rates at 10-year maturity in all countries except Mexico. In Thailand and central Europe (the Czech Republic, Hungary and Poland), this relationship generally holds for all other maturities as well. Remarkably, changes in the US rate do not lead changes in domestic rates in Mexico or Brazil.

Impact of shocks on long-term rates

The graphs in Appendix A report the impulse responses of domestic long-term rates to innovations in the foreign (US) rate, the policy rate and the own domestic long rate. We focus initially on the most recent period (the last two graphs on each row). The first point to note is that the largest impact is from a shock to the (own) domestic long-term rate. While it is tempting to conclude from this that domestic shocks are therefore the most important drivers of long-term interest rates, such an inference is probably not valid. A shock to the domestic long-term rate could reflect a shift in the term risk premium, due to less investor risk tolerance or greater investor uncertainty; this could well reflect foreign as well as domestic investor sentiment. A more fully specified model might be able to capture such nuances.

With this qualification in mind, the impulse responses (point estimates) once again convey the impression that foreign interest rate shocks in many cases have a larger impact on long-term rates. Focusing on the most recent period (2), the point estimates generally show larger responses of domestic long rates to the foreign long-term rate than the domestic short-term rate.

Has the transmission of shocks changed?

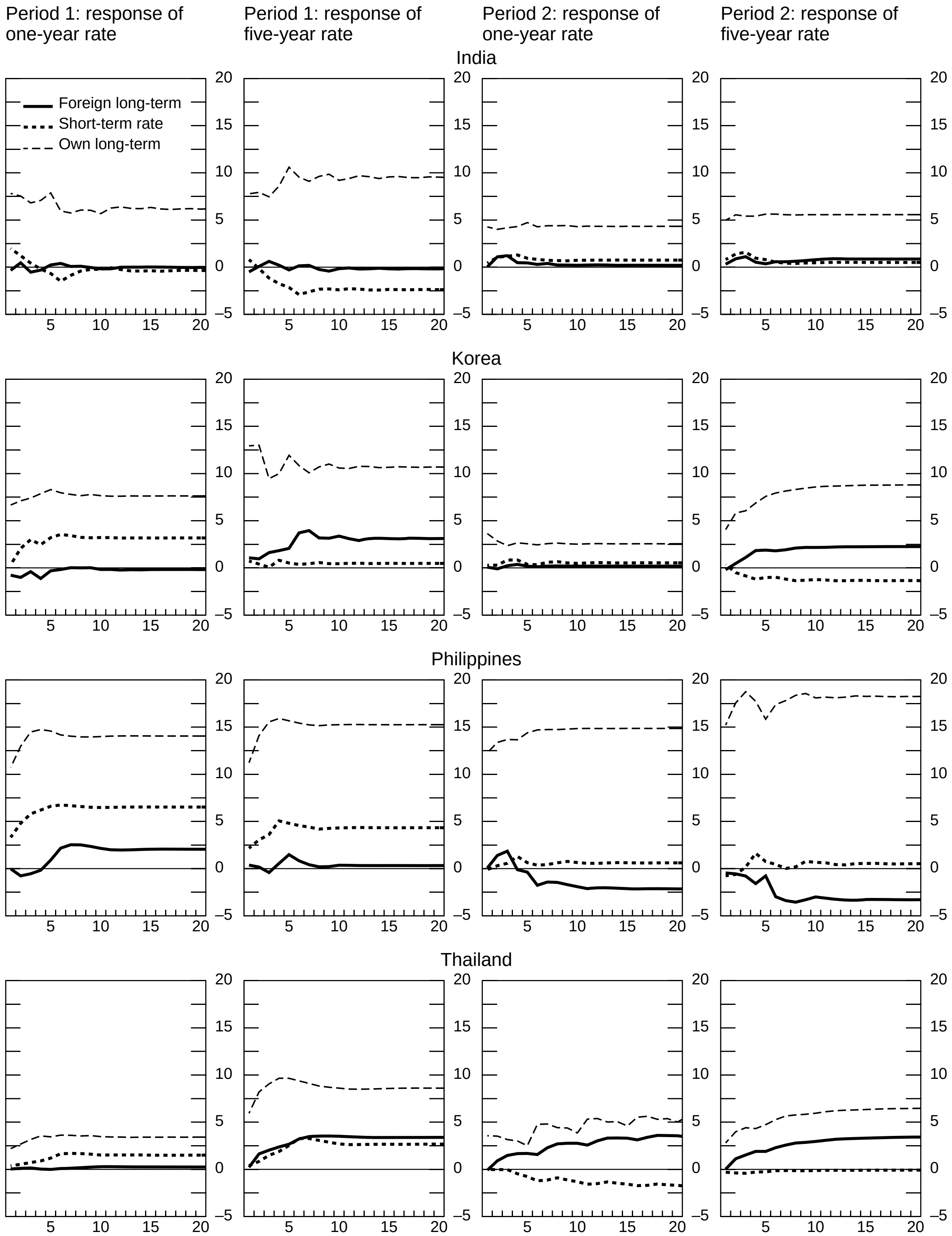
Two trends are apparent when comparing the responses in the two periods.

First, the magnitude of shocks to domestic long-term rates and the cumulative responses has in a number of cases declined, which is in line with the earlier discussion that expectations of inflation and risk premia have fallen. There are some exceptions; Hungary for both long-term rates, the Philippines for the five-year rate, and Thailand for the one-year rate.

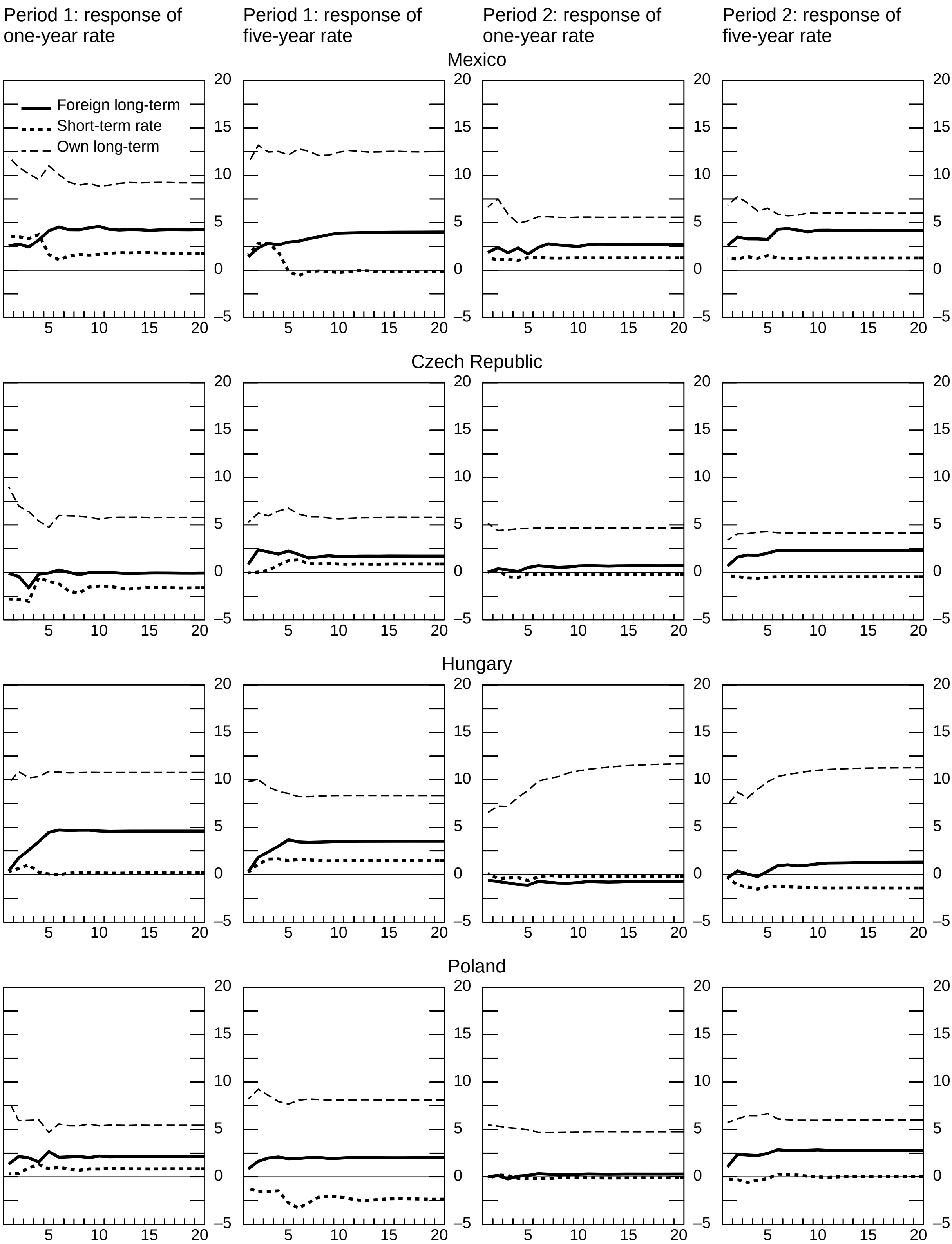
Second, there are some cases in the first period only in which shocks to the domestic short-term rate have a larger direct effect (in absolute value terms) than foreign shocks (Korea, the Philippines and Brazil). On balance, the relative impact of domestic short-term rates and foreign rates gives the impression that external influences were in some cases already apparent at the beginning of this decade. Furthermore, such influences have increased in some countries. Having said that, the importance of innovations in either policy rates or foreign long-term interest rates in the estimated model is small. Variance decomposition results consistently attribute most (around 90% or higher) of the variance of forecast errors in the domestic long-term rate to its own innovations. Research using alternative specifications may shed further insight on the evolution of the policy transmission mechanism and the factors that drive long-term interest behaviour in EMEs.

Appendix A

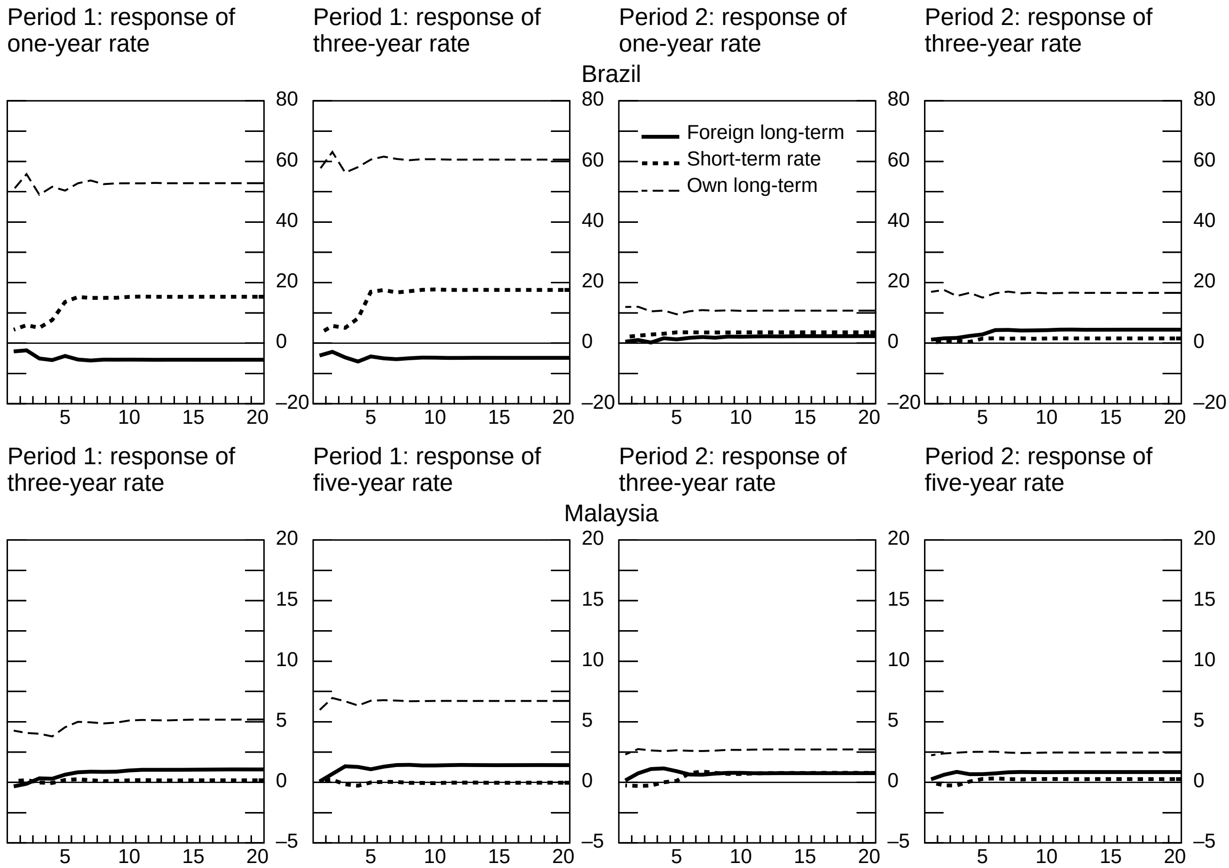
Response of long-term rates to shocks[17]



[17] Impulse responses: period 1 = 2001:01:01 to 2004:06:29; period 2 = 2004:06:30 to 2006:09:28.



Period 1: response of one-year rate
Period 1: response of five-year rate
Period 2: response of one-year rate
Period 2: response of five-year rate
Mexico
Czech Republic
Hungary
Poland
Foreign long-term
Short-term rate
Own long-term
20
15
10
5
0
–5
5
10
15
20



Period 1: response of one-year rate
Period 1: response of three-year rate
Period 2: response of one-year rate
Period 2: response of three-year rate
Brazil
Foreign long-term
Short-term rate
Own long-term
Period 1: response of three-year rate
Period 1: response of five-year rate
Period 2: response of three-year rate
Period 2: response of five-year rate
Malaysia

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Capital flows, exchange rate regime and monetary policy

Sweta C Saxena[1]

Introduction

Financial globalisation can provide significant benefits to developing countries but at the same time poses significant risks. There is strong evidence to suggest that developing economies could benefit from financial globalisation, given that certain framework conditions are fulfilled.[2] Hence, there is a trend towards open capital accounts, as illustrated by Malaysia, which recently shed controls that had been brought in 1998 in the aftermath of the Asian crisis. The move towards higher capital mobility confronts central banks with some difficult choices in implementing monetary policy:

1. *Control of exchange rate or interest rate?* If central banks want to stabilise exchange rates, they have to accept the consequences for domestic interest rates. If they wish to gain control over their domestic interest rates, then they have to accept higher volatility in their exchange rates. Hence, their independence to choose interest rates can be constrained under an open capital account.

2. *Exchange rate or inflation as the nominal anchor?* The move towards inflation targeting implies giving up the exchange rate as the nominal anchor for monetary policy, which means floating exchange rates with higher volatility. Does this mean that the central bank should not care about exchange rate stability as such? Conventional wisdom would have central banks pay attention to the exchange rate *if* it interferes with the price stability goal. But what happens when the economy is dollarised (Peru) or some contracts are denominated in foreign currency (Israel)? What should countries that are building net foreign liabilities (denominated in foreign currency) do when faced with the choice of exchange rate stability vis-à-vis price stability? This paper will address some of these issues.

To foreshadow the main results, the paper finds that the emerging markets have become more financially globalised, as can be seen in a build-up of gross foreign asset and liability positions, increased presence of foreign investors in local currency bond markets and increasing correlations of stock markets in the emerging markets with those of the industrial countries. In fact, some countries have been able to issue longer-term local currency bonds in the international markets, in spite of so-called "original sin". Such an integration is desirable as it increases international risk-sharing, but it can also increase the impact of foreign shocks on domestic economies. The recent May–June sell-off is a testimony to this. Although many emerging markets (mainly Asia) improved their net external positions between 1996 and 2004, the situation has worsened for others (mainly CEE countries due to deteriorating current account balances). In the light of significant external liabilities

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[2] See Kose et al (2006), for details.

(denominated in foreign currencies), CEE economies in particular are exposed to substantial exchange rate risk.

On the impact of capital flows and the exchange rate regime on monetary policy, the paper finds that domestic short-term interest rates are significantly affected by foreign interest rates, especially for countries with high capital mobility and less than fully floating exchange rates. The link between domestic and foreign interest rates is also in line with Moreno (2008) that finds that the foreign long-term interest rate affects the domestic long-term interest rate more than the domestic policy rate. The results also indicate that the credibility gained by central banks in keeping inflation low and maintaining a stable macroeconomic environment is helping to stabilise long rates more generally.

The rest of the paper is organised as follows. Section 1 discusses the constraints imposed by capital flows on macroeconomic policy (the so-called impossible trinity or trilemma). Section 2 investigates the impact of foreign interest rates on domestic interest rates under various exchange rate and capital mobility regimes. Section 3 analyses the indicators of financial globalisation and the issues related to exchange rate stability vis-à-vis price stability (especially in the light of balance sheet effects and dollarisation issues). Section 4 concludes.

1. The impossible trinity

The transmission of monetary policy depends on the openness of the capital account and the exchange rate regime. The famous trilemma from the Mundell-Fleming model states that countries cannot simultaneously fix their exchange rate, have an open capital account and pursue an independent monetary policy. Only two out of these three objectives are mutually consistent.[3] If the capital account is closed, then domestic interest rates would transmit to domestic demand, irrespective of the exchange rate regime. However, if the capital account is open, then domestic monetary policy will be determined by the exchange rate regime and the degree of substitutability between domestic and foreign financial assets. Under a floating regime, monetary policy can work either through the interest rate and liquidity channel or through the exchange rate channel. Under the latter channel, the impact of monetary policy on aggregate demand is larger if domestic and foreign assets are substitutable, as policy-induced changes in interest rates affect the exchange rate, which in turn affects output and inflation. However, the higher substitutability between domestic and foreign assets offsets the impact of monetary policy through capital flows in a fixed exchange rate regime. Hence, monetary authorities can move domestic interest rates independently of foreign rates only if there is a lesser degree of substitutability under a fixed exchange regime.

The foregoing analysis suggests that the exchange rate channel of monetary policy transmission is hampered if the exchange rate is not allowed to move freely. Indeed, nine out of 13 Asian and Latin American emerging economies actually use foreign exchange intervention to complement their conduct of monetary policy. Hence, the impact of capital flows on exchange rates may be offset through foreign exchange intervention. For instance, Malaysia intervenes in the foreign exchange market to prevent large changes in exchange rates that are not supported by fundamentals (Ooi (2008)).

[3] Obstfeld et al (2005) find that this trilemma has been largely borne out by history. They find considerable monetary autonomy for non-pegged regimes in the presence of capital mobility, but loss of this independence for countries with pegged regimes.

2. Do foreign interest rates influence domestic short-term interest rates?

The question of monetary policy independence is closely linked to the choice of exchange rate regime. If it is credible, a fixed exchange rate provides a nominal anchor for monetary policy; if not, monetary policy is dictated by the need to attract capital flows to finance the current account imbalances. If policymakers float their currency, then they gain control over their monetary policy. The central bank can use domestic interest rates to respond to shocks if the exchange rate is floating. Hence, domestic short-term interest rates in countries with floating exchange rates should be less sensitive to changes in international interest rates. But certain factors (eg foreign currency liabilities) prevent countries from following independent monetary policies despite adopting a flexible exchange rate regime.

The relationship between exchange rate regime and monetary policy independence has been tested in a few papers. For a large sample of industrial and developing countries, Frankel et al (2004) show that domestic short-term interest rates, even in countries with floating exchange rates, are linked with international interest rates in the long run. Only a couple of large industrial countries can choose their own interest rates over time. However, Frankel et al (2004) also find that the adjustment of floaters' interest rates to international interest rates is rather slow, implying some monetary independence in the short run. Unlike Frankel et al (2004), Shambaugh (2004) finds that domestic interest rate behaviour is different between pegged and non-pegged regimes: countries with pegged exchange rates follow the base country interest rate more than others.

There is little empirical research linking capital mobility to monetary independence. Shambaugh (2004) and Obstfeld et al (2005) do include a dummy variable for capital controls to study the link between domestic and foreign interest rates. But this measure cannot capture the intensity of capital controls or liberalisation. To address this, this paper introduces a measure of international capital mobility which gauges the intensity of capital liberalisation. A variable for interest rate liberalisation is also introduced.

These academic papers are an interesting line of research, but all of them are dated. The data go up to 2000, but much has changed since then. During the last five to six years, the emerging market economies have become more open on capital account and are following freer exchange rate policies. For example, on a scale of 3, the average index of capital mobility increased from 1.61 during 1975–99 to 2.59 between 2000 and 2006 for a group of 17 emerging economies in Asia and Latin America and including South Africa. The proportion of observations on exchange rate regimes classified as floating increased from 68% to 73% between 1975–99 and 2000–06. Against this background, it would be interesting to see if:

1. higher capital mobility has increased the impact of foreign interest rates on domestic rates; and
2. floating the exchange rate helps reduce the impact of foreign interest rates on domestic rates.

So what should we expect? Consider the following four scenarios and the expected domestic interest rate link with the foreign interest rate:

	Fixed exchange rate	**Flexible exchange rate**
Capital immobility	No link	No link
Capital mobility	Positive link	?

Under no capital mobility, monetary policy would be independent irrespective of the exchange rate regime, implying that domestic interest rates can move independently of foreign interest rates (and hence no link between the two). However, under full capital mobility, the link between the domestic interest rate and the foreign interest rate would be positive under a fixed exchange rate regime, as higher foreign interest rates would induce capital outflow and a depreciation of the domestic currency. In order to prevent depreciation, domestic interest rates should rise.

However, the link between domestic and foreign interest rates is not so clear when capital is mobile and exchange rates are floating. The difficulty in determining the effect arises because central banks often intervene in foreign exchange markets, even when their exchange rates float, to smooth exchange rate fluctuations or accumulate foreign reserves (see BIS Papers no 24). If the central bank does not allow *full* adjustment of the exchange rate by intervening in the foreign exchange market even when the exchange rate is floating, the reaction of the domestic interest rate to a foreign interest rate shock can be large. Hence, we would expect a significantly positive link between domestic and foreign interest rates.

More precisely, in order to answer these questions, I use two techniques. I estimate the following regression as well as the impulse response functions:[4]

$$\Delta r_{it} = \alpha + \beta_1 \Delta r_t^* + \beta_2 Capmob_{it} + \beta_3 \Delta r_t^* Capmob_{it} + \beta_4 Float_{it} + \beta_5 \Delta r_t^* Float_{it} + u_{it}$$ [5]

If coefficient $\beta_1 > 0$ (significantly greater than zero), domestic short-term interest rates are correlated with foreign interest rates. The correlation may arise because of common shocks that require a common interest rate response, because of high capital mobility that imposes an interest parity condition, or because of attempts to fix the exchange rate. For countries with floating exchange rate regimes, any linkage may also provide evidence that the country does not allow the exchange rate flexibility that it claims to (fear of floating) or intentionally follows the foreign country.

A1: If higher capital mobility increases the impact of foreign interest rates on domestic interest rates, the interaction of foreign interest rates and capital flows should be high and significant ($\beta_3 > 0$). So, I test:

H0: $\beta_3 = 0$ against H1: $\beta_3 > 0$

A2: If exchange rate flexibility has reduced the impact of foreign interest rates on domestic interest rates, then the relationship between local interest rates and foreign interest rates should be weaker than for countries that continue to fix their exchange rates ($\beta_5 < 0$). Therefore, I test the following hypothesis:

H0: $\beta_5 = 0$ against H1: $\beta_5 < 0$

In the light of the recent tightening of monetary policy in the United States, I also examine the asymmetry of the interest rate linkage when US monetary policy is tight.

In addition, I estimate impulse response functions from the following regression:[6]

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4 Following Frankel et al (2004) and Shambaugh (2004), r = ln(1 + i), where i of 10% is represented as 0.10. Also, the regression in changes is estimated as a pooled OLS (Shambaugh (2004) Obstfeld et al (2005)), unlike the regression in levels with fixed effects as done in Frankel et al (2004).

5 While other factors can influence domestic interest rates, Shambaugh (2004) controls for time, trade shares, debt exposure, capital controls and level of industrialisation, and finds that, during the post-Bretton Woods era, with the exception of capital controls, the exchange rate regime tends to be the major determinant of how closely domestic interest rates follow foreign interest rates.

6 This work is in the same spirit as Romer and Romer (1989), who identify the impact of monetary shocks on US output in the postwar period.

$$\Delta r_{it} = \alpha_i + \sum_{j=1}^{4} \beta_j \Delta r_{i,t-j} + \sum_{s=0}^{4} \Delta r_{t-s}^{*} + \varepsilon_{it}$$

The impulse response functions are shown with one standard error bands drawn from 1,000 Monte Carlo simulations.[7]

Results[8, 9, 10]

The regressions show a mostly significantly positive β_1 coefficient (Tables 1 and A1–A3), implying that changes in domestic interest rates in these emerging markets do move in line with the interest rate changes in the United States. This could be because of fear of floating (for flexible exchange rate regimes) or because of the interest rate parity condition (for fixed exchange rate regimes) or due to common shocks. The inclusion of world oil or food prices in these regressions does not change the sign or the significance on the change in US interest rates, implying that these common global shocks cannot be the reason for the positive sign. But this linkage with the United States is stronger for the entire sample and early part (1975–89) when the Fed tightens its monetary policy than when it eases it (Table 1). However, the relationship between domestic and US interest rates is stronger in the recent period when there is global tightening rather than easing[11] (Tables A1 and 2), ie interest rates in these emerging markets move with the US interest rates when there is a general global tightening which could occur due to common shocks requiring a common response. Perhaps the recent oil shock is one example.

For countries with high capital mobility, the coefficient β_3 is normally positive (when significant), which implies that higher capital mobility reduces these countries' ability to change their interest rates independently (Tables 2, A2 and A4).[12] Countries with more flexible exchange rates see a downward trend in their interest rates relative to countries with fixed exchange rates (Tables 2, A3 and A4). But the coefficient on β_5 is positive (when significant), implying that flexibility in the exchange rate has apparently not bought these countries any independence in setting their own domestic interest rates. Tables 2 and A4 show that β_1 is negative during the 2000–06 period, but β_3 and β_5 are positive, implying some delinking between the domestic and the US interest rate in general in recent times, except for countries with high capital mobility and a flexible exchange rate regime. This result is, however, counterintuitive as a flexible exchange rate regime in principle gives a central bank greater room to manoeuvre and so makes monetary policy more independent. But as discussed above, countries with flexible exchange rates can still have their domestic interest rates move with the foreign interest rate under a higher level of capital mobility. This point is brought out in Table 3.

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7 I use four lags for domestic and US interest rates as the lags beyond that were mostly insignificant and the DW stat shows no sign of serial correlation.

8 Data construction and some tables and graphs are provided in the Annex.

9 When I exclude periods of high inflation in Argentina, Brazil and Chile, capital mobility for the entire period (1975–2006) becomes insignificant. All other results hold.

10 The results remain qualitatively unchanged even when a variable is introduced to capture the business cycle.

11 Global tightening refers to the periods when interest rates increase in the United States, the United Kingdom and Japan simultaneously.

12 The results from interest rate liberalisation equations (not reported here) are similar. Countries with fully market-determined interest rates have their interest rates move with US interest rates during 1975–2006 and 2000–06.

Table 1

Impact of US monetary policy tightening[1]

	1975–2006	1975–1989	1990–99	2000–06
Δr*	**0.04**	0.02	**0.40**	**0.17**
	0.04	0.24	0.01	0.00
US tight MP * Δr*	**0.10**	**0.07**	0.06	0.01
	0.01	0.06	0.82	0.81
Rsq	0.00	0.00	0.00	0.03
DW statistic	1.80	1.87	1.73	1.51
Total observations	6,902	2,360	2,671	1,871
Cross sections	24	18	24	24

[1] P-values are below the coefficients.

Table 2

Impact of capital mobility, exchange rate regime and global tightening

	1975–2006	1975–1989	1990–99	2000–06
Δr*	–0.01	–0.01	0.10	**–0.36**
	0.82	0.61	0.81	0.08
Capmob	0.00	0.00	0.00	0.00
	0.56	0.74	0.90	0.19
Capmob * Δr*	**0.04**	0.03	0.12	**0.16**
	0.05	0.15	0.39	0.02
Float	**–0.0004**	0.00	**–0.001**	0.00
	0.03	0.36	0.01	0.30
Float * Δr*	0.00	0.01	0.12	**0.17**
	0.95	0.78	0.60	0.00
Global Tight * Δr*	0.04	0.05	–0.38	**0.24**
	0.52	0.42	0.31	0.02
Rsq	0.00	0.00	0.01	0.07
DW statistic	1.72	1.84	1.67	1.37
Total observations	5,398	2,069	2,003	1,326
Cross sections	17	16	17	17

[1] P-values are below the coefficients.

Table 3 illustrates the impact of foreign interest rates on domestic interest rates classified by exchange rate regime and level of capital mobility.[13] When capital mobility is low, there is no link between domestic and US interest rates, irrespective of the exchange rate regime. But, as expected, the link between domestic and US interest rates is significantly positive for countries with a fixed exchange rate and mobile capital. In addition, countries with flexible exchange rate regimes have their domestic interest rate linked to the US interest rate only when capital is mobile. Of the 6,273 observations on exchange rates and capital mobility between 1975 and 2006, 40% represent a flexible exchange rate and high capital mobility against 21% with a fixed exchange rate and high capital mobility. During 2000–06, the proportion of observations with floating exchange rates and mobile capital is 72% against 23% with a fixed regime and mobile capital. The implication is that the proportion of economies influenced by high capital mobility has risen sharply in recent years. Moreover, this has coincided with a greater reliance on floating and intervention in the foreign exchange markets.

Table 3

Impact of capital mobility and exchange rate regime

	1975–2006	**1975–1989**	**1990–99**	**2000–06**
Fix*No Capmob	0.0002	0.0002	0.0005	0.0021
	0.2954	0.3815	0.6640	0.8782
Fix*No Capmob* Δr*	0.0002	0.0002	0.0076	0.0190
	0.1794	0.2236	0.1529	0.3090
Fix*Capmob	0.0001	0.0003	0.0004	**–0.0001**
	0.5580	0.4248	0.1314	0.0137
Fix*Capmob * Δr*	**0.0017**	0.0012	**0.0028**	**0.0013**
	0.0220	0.1705	0.0756	0.0041
Float*No Capmob	0.0002	–0.0001	0.0011	–0.0049
	0.5320	0.8474	0.2391	0.5727
Float*No Capmob* Δr*	0.0003	0.0003	0.0043	0.0897
	0.3442	0.4696	0.4327	0.1037
Float*Capmob	–**0.0004**	0.0001	–**0.0008**	**–0.0002**
	0.0191	0.7162	0.0204	0.0002
Float*Capmob* Δr*	**0.0014**	**0.0012**	**0.0041**	**0.0029**
	0.0057	0.0173	0.0212	0.0000
Rsq	0.004	0.001	0.003	0.077
DW statistic	1.71	1.84	1.68	1.36
Total observations	5,414	2,069	2,003	1,342
Cross sections	17	16	17	17

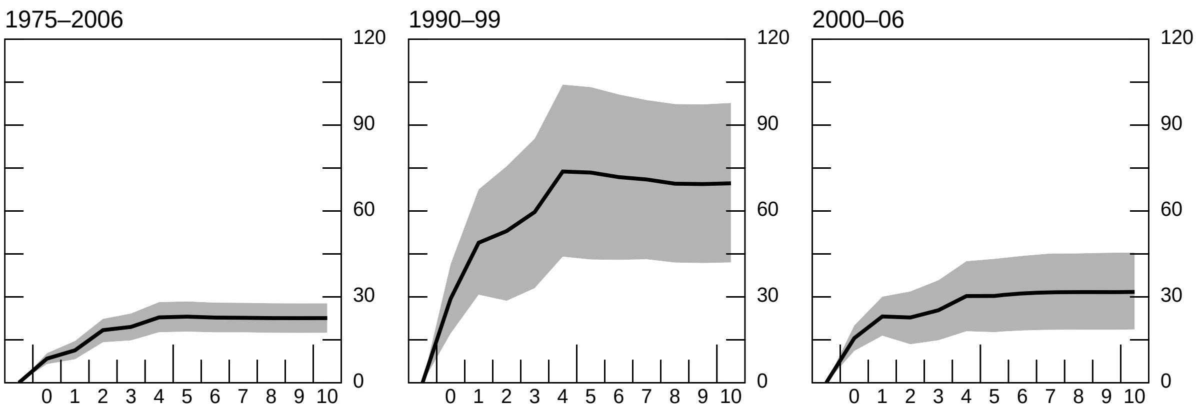
[1] P-values are below the coefficients.

[13] Here I distinguish between countries with low capital mobility (values 0 and 1) and those with high capital mobility (values 2 and 3).

The results from the impulse response functions support the regression results.[14] During the period 1975–2006, a 1% change in US interest rates leads to a 22.5 basis point change in domestic interest rates in the next 10 months (Graph 1).[15] Here again, we would expect the link between domestic and US interest rates to be higher during periods of fixed exchange rates and/or high capital mobility. Graph 1 shows that the interest rate pass-through from the US to emerging markets was about 70 basis points during 1990–99, a period characterised by a de facto pegged regime. But as flexibility in exchange rates has increased, the response rate has decreased to 30 basis points. The higher pass-through during the 1990s reflects the fixed exchange rate regime in most of these economies and/or higher capital mobility. Domestic interest rates also respond positively to global tightening (Graph A1). However, the response during 2000–06 is half of that during 1990–99. The link can decline either because of a greater willingness to let the exchange rate move or recourse to some other means than monetary policy (ie foreign exchange intervention) to stabilise it or because some other factors (exogenous to capital flows) are helping the exchange rate from falling. This may reflect the recent phenomenon where, despite interest rate hikes in the United States, capital still flowed to the emerging markets. Hence, these economies did not need to raise their interest rates to the same extent to prevent capital outflows and depreciations. Rather, they have been engaged in foreign exchange intervention to stabilise their exchange rates and prevent them from appreciating. Bank of Thailand (2008) notes that, despite a stable interest rate differential with the United States, the Thai baht has appreciated since 2004 because of deterioration in market sentiment over the US twin deficit and hence of the dollar. Consequently, large inflows into the region led to trend appreciation.

Graph 1

Impulse response of domestic interest rate to US interest rate



Capital mobility diminishes the ability of these economies to conduct an independent monetary policy.[16] Countries with intermediate or no capital mobility have very little or an insignificant link between the US interest rate and the domestic interest rate (Graphs A2 and A3). For

[14] Here again, to check for robustness, I exclude the high-inflation periods for Argentina, Brazil and Chile, and the results remain largely unchanged, except that the impulse responses for countries with low capital mobility (Graph A2, 1975–2006) and with floating exchange rates and mobile capital (Graph 7, 1990–99) become insignificant.

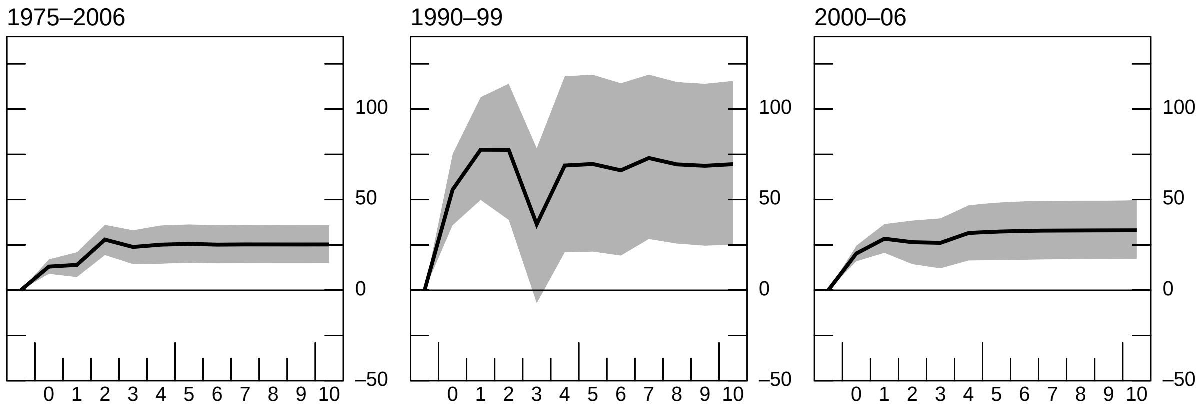
[15] The response increases to 50 basis points during 1983–2006 (since the Fed officially started targeting interest rates).

[16] I create dummies for no, middle and high capital mobility. No capital mobility means that the value of the capital mobility variable is 0; medium capital mobility is represented when capital mobility takes on the values 1 and 2. Full capital mobility means that the variable value is 3.

countries with full capital mobility, the interest rate pass-through was 70 basis points in 1990–99, but it declined to about 30 basis points in 2000–06 (Graph 2). Similarly, the results from countries with fully liberalised interest rates show that the response of domestic interest rates to US interest rates halved between 1990–99 (87 basis points) and 2000–06 (42 basis points) (Graph A4).

Graph 2

Impulse response of domestic interest rate to US interest rate for countries with full capital mobility



The impulse response functions in Graphs 3 and 4 indicate that pegged regimes show a greater interest rate pass-through (27 basis points) than flexible regimes (20 basis points) for the entire sample (1975–2006). However, during the recent periods (1990–99 and 2000–06), flexible regimes tend to exhibit greater co-movement with US interest rates (77 basis points and 34 basis points respectively) than the pegged ones (60 basis points and 25 basis points). This may reflect a “fear of floating”. While the classification of a country as a floater in this paper is based on the actual behaviour of the exchange rate, central banks that float still intervene in response to exchange rate movements that are perceived as excessive or to accumulate foreign reserves (see BIS Papers no 24). If the exchange rate is not allowed to adjust fully, domestic interest rates can still be affected. For example, if the foreign interest rate falls and the exchange rate appreciates less than required to achieve equilibrium, domestic interest rates can still fall even under a (de facto) floating regime. Although domestic interest rates have responded less to US interest rates since 2000, they still exhibit a high co-movement, implying that central bankers in emerging markets have still not gained full autonomy over their monetary policies, despite adopting inflation targeting and moving to exchange rate regimes that can be classified as flexible but not necessarily a free float.

The impulse responses in Graphs 5–8 shed light on what constrains monetary policy.[17, 18] For pegged regimes, the response of domestic interest rates to US interest rates is significant during all periods for countries with high capital mobility (Graph 5) and only significant during 1990–99 for those with low capital mobility (Graph 6). The high response during 1990–99 may reflect the absolutely higher volume of capital flows, even for economies with relatively low capital mobility, that may have required significant changes in domestic interest rates to match the changes in US interest rates to maintain the exchange rate pegs. In addition, most of these emerging markets experienced currency crises during this period, which may have exaggerated the response.

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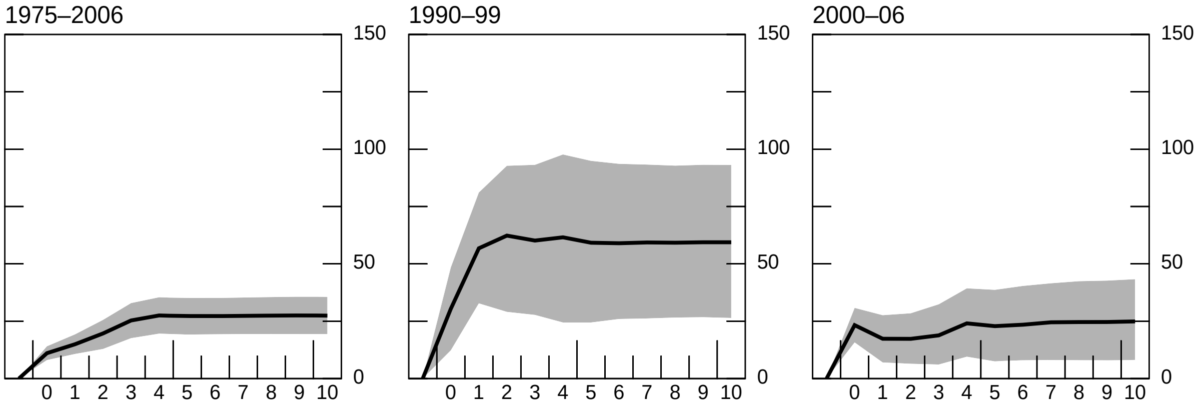
[17] Here I distinguish between countries with low capital mobility (values 0 and 1) and those with high capital mobility (values 2 and 3).

[18] There were insufficient data to estimate the impulse responses during 2000–06 for exchange rate regimes and immobile capital.

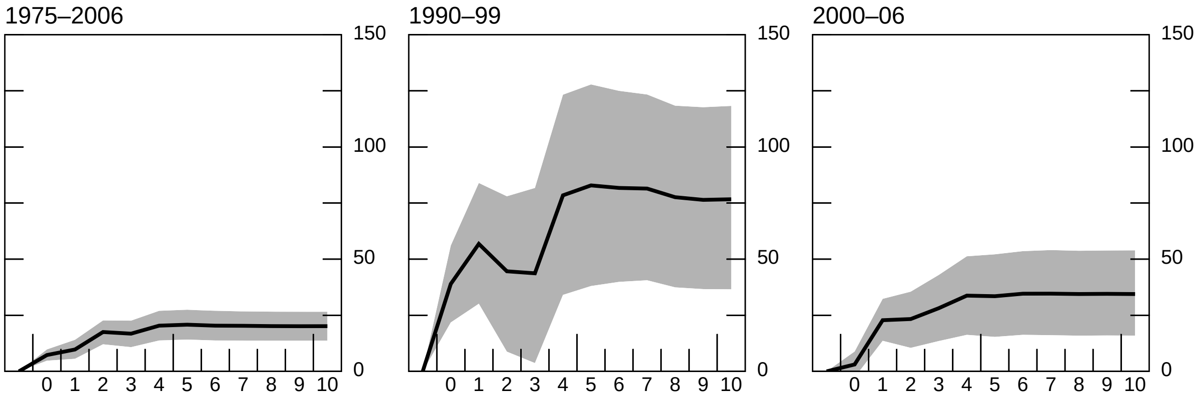
Graph 3

Impulse response of domestic interest rate to US interest rate when exchange rates are fixed



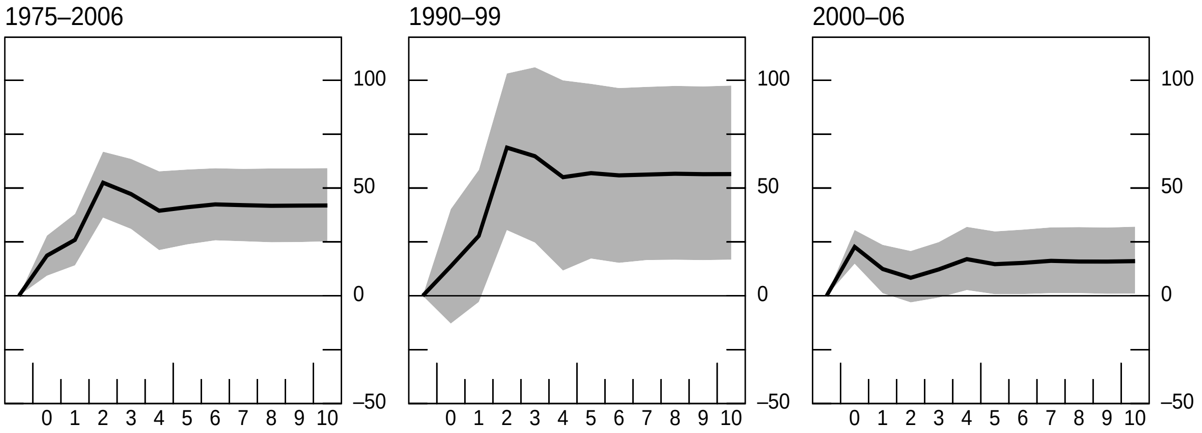
Graph 4

Impulse response of domestic interest rate to US interest rate when exchange rates are floating



Graph 5

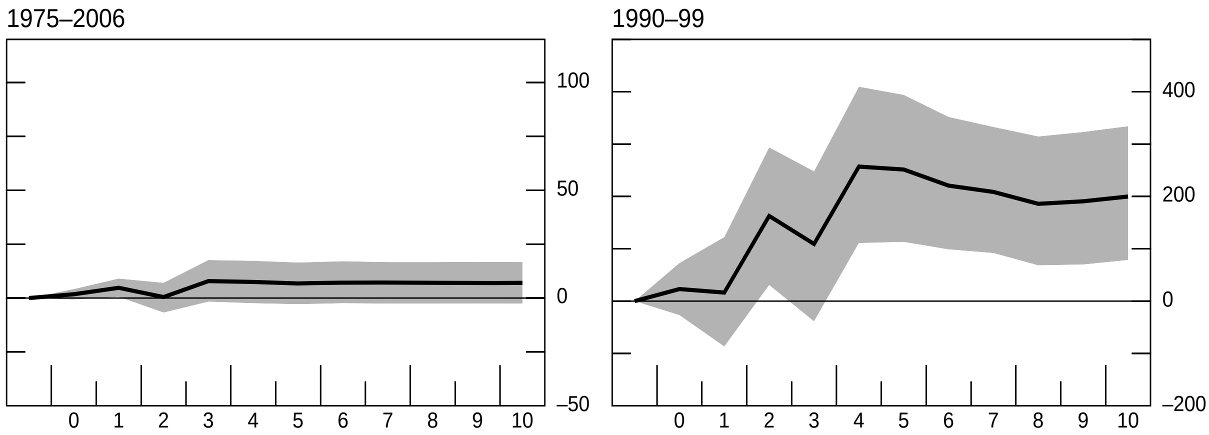
Impulse response of domestic interest rate to US interest rate when exchange rates are fixed and capital is mobile



We expect interest rates in countries with flexible exchange rates to be more independent of US interest rates and this is the case, especially since 1990 (Graph 8) for countries with low capital mobility. However, the link between the US interest rate and the domestic interest rate is significantly higher in countries with high capital mobility (Graph 7), implying that capital mobility may increase exchange rate fluctuations and induce central banks in these emerging markets to move their interest rates with foreign interest rates to cushion these movements.

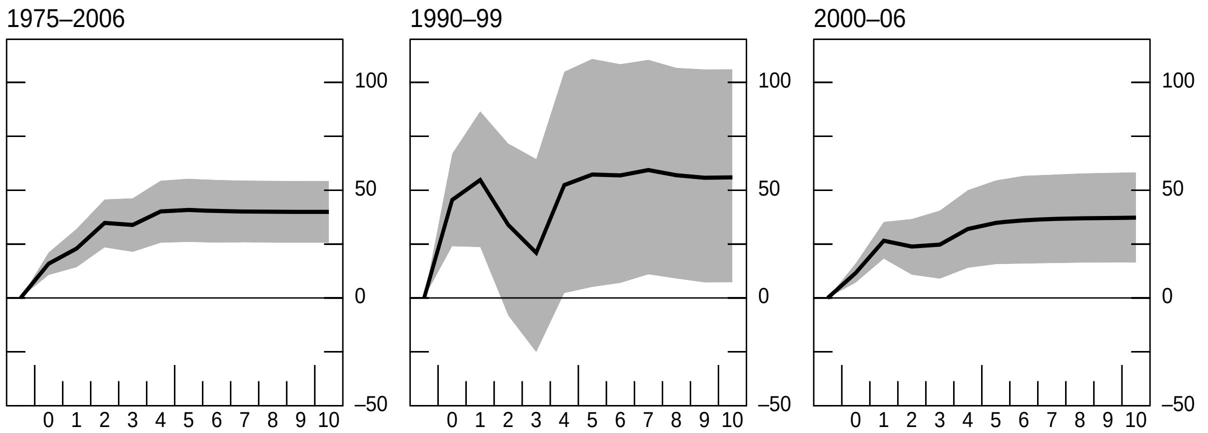
Graph 6

Impulse response of domestic interest rate to US interest rate when exchange rates are fixed and capital is immobile



Graph 7

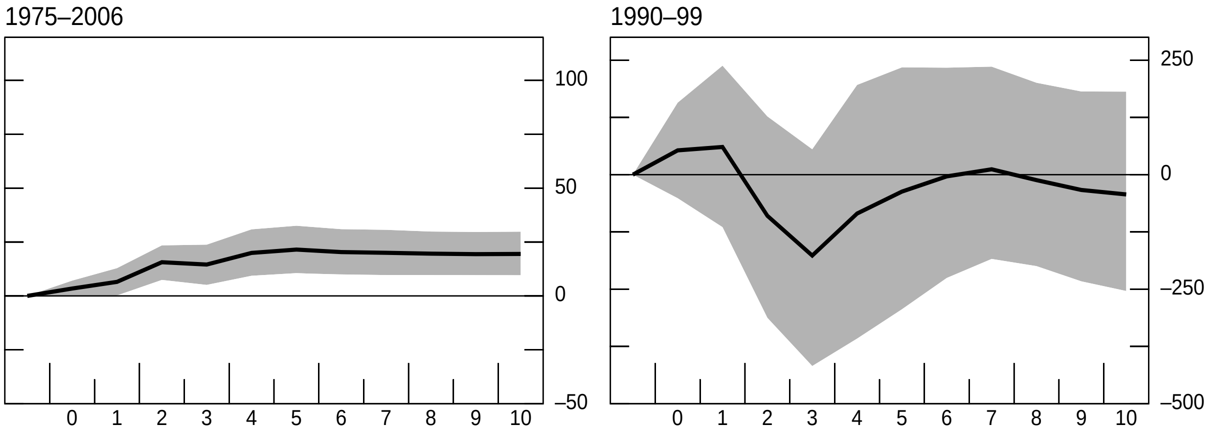
Impulse response of domestic interest rate to US interest rate when exchange rates are floating and capital is mobile



To summarise, unlike Frankel et al (2004), Shambaugh (2005) and Obstfeld et al (2005), the results in this paper suggest that domestic interest rates in countries with flexible exchange rate regimes exhibit a higher co-movement with US interest rates than in countries with pegged exchange rate regimes. This conundrum is resolved from Table 3 and Graphs 5–8, which show the link between domestic and foreign interest rates under different exchange rate regimes and levels of capital mobility. The response of domestic interest rates to changes in US interest rates is higher for countries with *flexible exchange rates and higher capital mobility*. Although exchange rates should undertake part of the burden of adjustment to a foreign interest rate shock and hence we should observe a lower link between domestic and foreign interest rates in case of floating regimes, this mechanism may be hampered when central banks intervene. The intervention may not necessarily reduce the volatility in the exchange rate to less than 2%, so that the exchange rate regime would still be considered a de facto float according to the classification used in the paper. Indeed, the probability that central banks intervene in a floating regime is about 40% in the period 2000-06 against 50% for 1975–2006. Another explanation is that the regimes classified as "floats" also have better developed financial markets, where the pass-through from foreign interest rates to domestic interest rates would be higher. These two factors could explain why the floating exchange rate regimes have been associated with a bigger link between domestic and foreign interest rates. Lastly, the estimation does not account for the possibility that central banks might *choose* to move their domestic interest rates in line with foreign interest rates due to fear of excessive volatility in foreign exchange markets or for business cycle reasons.

Graph 8

Impulse response of domestic interest rate to US interest rate when exchange rates are floating and capital is immobile



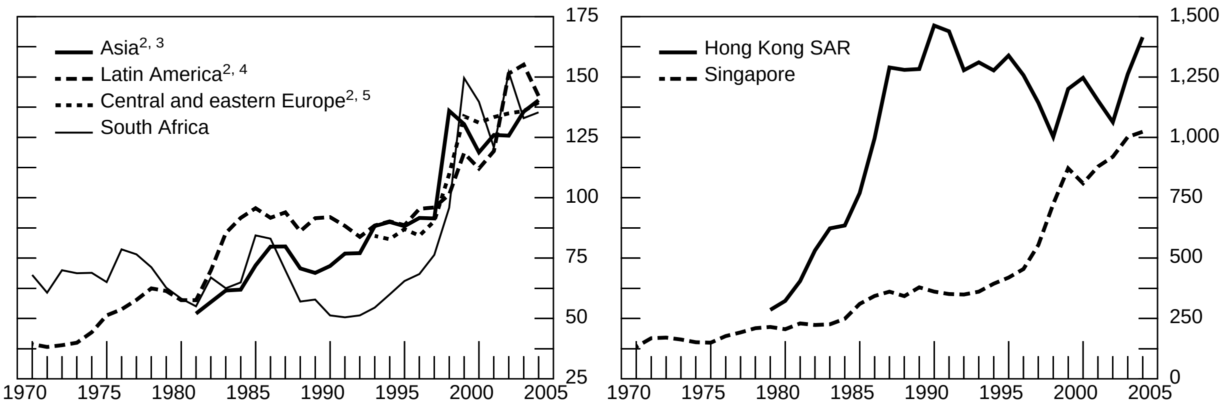
3. Financial globalisation and its (dis)content

Since 2000, there has been an increasing trend towards flexibility in exchange rates and the opening of capital accounts. For example, the proportion of observations with floating exchange rates and mobile capital is 72% during 2000–06 against 23% with fixed regime and mobile capital. These economies are also becoming financially globalised. Graph 9 shows foreign assets and liabilities as a percentage of GDP for various regions. This variable has grown at an unprecedented rate for all the regions. Ball (2006) argues that this form of globalisation has implications for monetary policy because it affects the behaviour of both interest rates and asset prices. Graph 10 shows that the five-year rolling correlations between regional and G7 stock markets fell after the Asian crisis of 1997–98, but began to rise again after the technology bubble burst in 2001. In fact, the correlations have ranged between 0.8 and 0.95 in recent times.

This financial integration can be a boon or a bane, depending on the circumstances and the kind of external positions these countries hold. Such internationalisation of portfolios is desirable as it increases international risk-sharing, but at the same time shocks in one country can be immediately transferred to foreign holders of financial instruments issued by that country. Hence international events can have stronger domestic repercussions (Lane and Milesi-Ferretti (2006b)). The recent May–June 2006 sell-off is a testimony to the vagaries of such shocks.[19] In the face of a slowdown of capital inflows, emerging markets can also be more vulnerable to a crisis if they have debt liabilities denominated in foreign currency (servicing costs rise with a depreciation) than if they rely on FDI (where returns are linked to the performance of the domestic economy).

Graph 9

Financial globalisation[1]

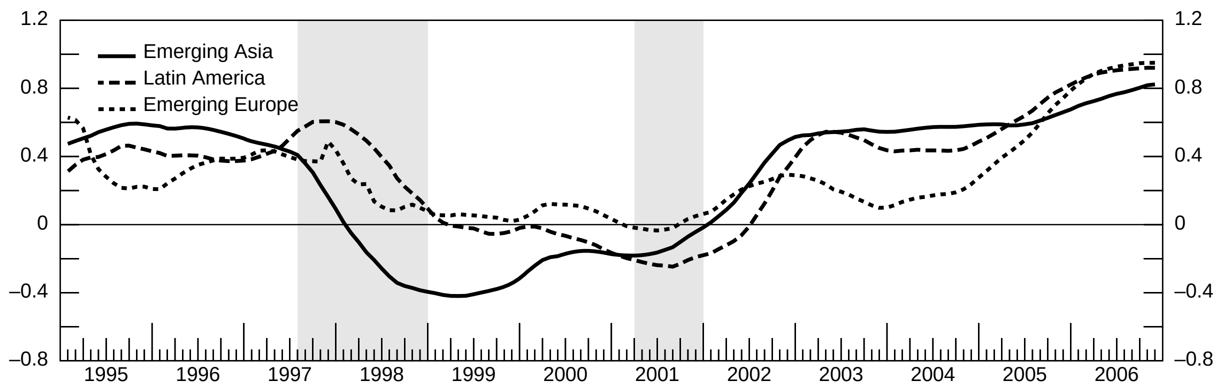


[1] Foreign assets plus foreign liabilities, as a percentage of GDP. [2] Simple average of the economies listed or cited. [3] China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan (China) and Thailand. [4] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [5] The Czech Republic, Hungary, Poland, Russia and Turkey.

Source: Lane and Milesi-Ferretti (2006).

Graph 10

Emerging stock markets' co-movement with the G7[1]



[1] Five-year rolling correlations of equity prices between the G7 and the regions. The shaded areas refer to the Asian crisis and the bursting of the technology bubble, respectively.

Sources: Datastream; MSCI; BIS calculations.

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[19] Basci et al (2008) show that the bond holdings of foreigners exhibited an upward trend after the 2001 Turkish crisis. In the recent May–June 2006 turbulence, the bond holdings of foreign investors declined sharply, while stock portfolios remained unaffected. As a result, both interest rates and exchange rates increased sharply in a very short time period.

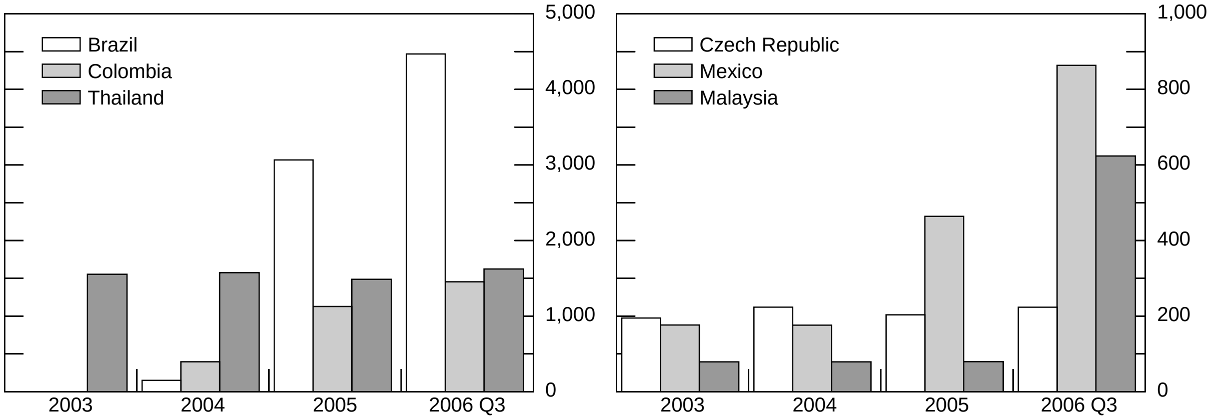
Although not a problem for developed countries whose liabilities are denominated in domestic currencies, but for emerging markets that are net debtors and whose external liabilities are primarily denominated in foreign currency, an exchange rate depreciation raises the domestic currency burden of foreign liabilities. The adverse effect of depreciation on the valuation of the external position can outweigh the gains in trade accruing from such depreciation. This is one reason why emerging markets are concerned about exchange rate volatility (Lane and Milesi-Ferretti (2006b)).[20] And this may perhaps explain why they intervene so frequently (40% of the time during 2000–06) even when the exchange rate is in fact floating.

Can they borrow in their own currency?

In order to shield themselves from the vagaries of exchange rates, Lane and Milesi-Ferretti (2006b) argue that emerging markets should promote local currency debt markets and increase the role of FDI and portfolio equity inflows. In fact, some of these countries (Brazil, Colombia, Thailand, the Czech Republic, Mexico and Malaysia) have been successful in issuing domestic currency denominated bonds in the international market (Graph 11).[21]

Graph 11

Local currency bonds and notes outstanding issued in international markets[1]



[1] By nationality of issuers, in millions of US dollars; end of period.

Source: BIS.

[20] Lane and Milesi-Ferretti (2006a) maintain that, with the increase in gross assets and liabilities, the valuation effects induced by changes in exchange rates and asset prices have become an important source of fluctuations in countries' external portfolios, often swamping the effects of the underlying capital flows.

[21] The reasons for issuing global bonds vary. Tovar (2005) considers the issuance of global bonds in three Latin American economies (Brazil, Colombia and Uruguay) and finds that the financial crises of the 1990s and early 2000s forced the governments to search for alternative financing to reduce their vulnerabilities. The crises also gave impetus to structural reforms that attracted investors. Global factors have also aided the issuance of bonds in domestic currency. For example, the success of emerging markets in reducing inflation in line with the global trend and their growing integration with developed financial markets has broadened the range of investors investing in emerging market securities.

Should exchange rate stability receive any attention? Issues in a dollarised economy?

As most emerging markets have moved towards floating exchange rates, monetary policy requires an anchor. Hence, there has been a shift towards inflation targeting.[22] How far such an approach can work in a dollarised economy is unclear; some have argued that, in such circumstances, the exchange rate should enter the central bank's objective function. Calvo (2006) argues in favour of aiming at exchange rate stabilisation (to the extent of outright pegging) *during sudden stops and when there is liability dollarisation*.[23] There is fairly good evidence suggesting that dollarised countries have more fragile corporate sectors; are more exposed to contractionary devaluations, devastating sudden stops and banking crises; and exhibit more output volatility (see Ize and Levy-Yeyati (2006) for references). Hence, the contractionary impact of real exchange rate depreciations limits the effectiveness of countercyclical monetary policy under large shocks.

In fact, dollarisation of the Peruvian economy has made monetary policy under inflation targeting less effective whenever there are stronger balance sheet effects (Rossini and Vega (2008)). Exchange rate volatility can also create a problem for countries where contracts are indexed in foreign currency. For example, rental contracts in Israel are indexed to the dollar (a tradition from the days of hyperinflation that still exists), hence the exchange rate pass-through into inflation of non-tradable goods is high and can lead to high costs in the event of a sharp depreciation of the shekel (Eckstein and Soffer (2008)). Morón and Winkelried (2003) argue that inflation targeting may be useful in guiding inflation expectations but, *a priori*, not to solve liability dollarisation issues, and hence suggest that it might be optimal to follow a non-linear policy rule that defends the real exchange rate in extreme circumstances in a financially vulnerable economy.

4. Conclusions

This paper presents the challenges faced by central banks in the face of highly mobile capital flows. The trilemma states that in such circumstances countries cannot simultaneously control their exchange rates and their interest rates. In order to gain monetary independence, countries either have to adopt a free float or impose full capital controls. Since emerging markets are moving towards higher capital mobility, they need to adopt a free floating exchange rate regime in order to gain any monetary independence. The econometric results from the paper indicate that although exchange rates have become more flexible in these economies, they are nonetheless not free floats and accordingly the interest rates of these economies do still respond to foreign rates to some degree. Nevertheless, the impulse response functions show a decreased response of domestic interest rates to changes in US interest rates since 2000, which might suggest that as these emerging economies gain credibility with their newer forms of monetary policies (a move away from fixed to flexible exchange rate regimes with inflation targeting), there may be further delinking between these

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[22] Under inflation targeting, central banks may be tempted to stabilise exchange rates even. For example, the central bank of the Philippines intervenes to dampen sharp fluctuations in the exchange rate, which tend to feed into domestic prices and hence affect both actual inflation and inflation expectations (Guinigundo (2008)).

[23] According to Bernanke (2005), the combination of an inflation target, central bank independence and a market-determined exchange rate tends to reduce variability in both inflation and output even in small open economies like Finland and New Zealand. However, these economies are financially robust and not dollarised like some emerging markets. Ball (1998) argues that, even for developed small open economies, if the policymakers minimise a weighted sum of output and inflation variance, then the optimal policy instrument is a Monetary Conditions Index based on both the interest rate and the exchange rate, while "long-run inflation" (an inflation variable purged of the transitory effects of exchange rate fluctuations) should be the target variable.

interest rates. Indeed, several central banks have stated that inflation targeting has helped bring expectations of inflation down and the expectation channel is becoming stronger, whereby stronger anticipated effects of monetary policy require less aggressive interest rate changes.[24] Such credibility will help monetary policy become more independent of external influences.

In addition, these economies have significantly increased their financial integration with the global economy. Such changes can impact the transmission mechanism of monetary policy. Most central banks have given up their exchange rates and moved towards formal/informal inflation targeting. In such a scenario, central banks need to reassess the importance to be assigned to exchange rate stability vis-à-vis price stability. Exchange rates may still play an important role in these economies if they are dollarised or have a substantial part of their debt denominated in foreign currencies. In order to increase the effectiveness of monetary policy in such economies, de-dollarisation should be encouraged by developing local currency debt markets and encouraging prices to be set in local currency (as in Peru).

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[24] See Sidaoui and Ramos Francia (2008) for Mexico, where the authors show that the expectations channel helps monetary policy reduce inflation pressures with a reduced output cost.

Annex

Data construction: Monthly data on short-term interest rates are from IMF International Financial Statistics. They cover 24 emerging markets from 1975 to 2006.[25] The variable on capital mobility and interest rate liberalisation is from Omori (2005). These variables are coded on a scale of 0–3. For capital mobility, 0 signifies a completely closed capital account and 3 the most open. For interest rate liberalisation, 0 means completely controlled interest rates, while 3 means market-determined. Since this dataset goes up to 2002, I extrapolate the 2002 observation for the following years, assuming that capital account liberalisation and interest rate liberalisation have neither progressed nor regressed from the 2002 level. The dummy variable for the float was constructed in the same spirit as Obstfeld and Rogoff (1995) and Shambaugh (2004). The idea is to see if the exchange rate remained within a ±2% band in a given year. Hence, the dummy variable for the float takes the value of 1 if the exchange rate is outside the ±2% band over the last 12 months, otherwise it is 0. The US interest rate (r*) is taken to represent the foreign or world interest rate.[26] The dummy for tight US monetary policy takes the value of 1 when the US interest rate rises, otherwise it is 0. The dummy for global tightness assumes the value of 1 if interest rates in the United States, the United Kingdom and Japan rise at the same time, otherwise it is 0.

Table A1

Impact of global tightening[1]

	1975–2006	**1975–1989**	**1990–99**	**2000–06**
Δr*	**0.08**	**0.05**	**0.43**	**0.18**
	0.00	0.00	0.00	0.00
Global Tight * Δr*	0.03	0.03	–0.01	**0.20**
	0.53	0.54	0.96	0.01
Rsq	0.00	0.00	0.00	0.04
DW statistic	1.80	1.87	1.73	1.52
Total observations	6,882	2,360	2,671	1,851
Cross sections	24	18	24	24

[1] P-values are below the coefficients.

[25] **Asia:** CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand; TW = Taiwan, China. **Latin America:** AR = Argentina; BR = Brazil; CL = Chile; CO = Colombia; MX = Mexico; PE = Peru; VE = Venezuela. **Others:** CZ = Czech Republic; HU = Hungary; PL = Poland; RU = Russia; SA = Saudi Arabia; TR = Turkey; ZA = South Africa.

[26] Since eastern European countries may not be so linked with the United States, I re-estimate the regressions without these countries. The results are robust.

Table A2

Impact of capital mobility

	1975–2006	1975–1989	1990–99	2000–06
Δr*	0.00	0.00	0.22	–0.18
	0.95	1.00	0.56	0.33
Capmob	0.00	0.00	0.00	0.00
	0.51	0.93	0.40	0.28
Capmob * Δr*	**0.04**	0.03	0.07	**0.13**
	0.05	0.14	0.62	0.04
Rsq	0.00	0.00	0.00	0.06
DW statistic	1.71	1.86	1.67	1.35
Total observations	5,454	2,109	2,003	1,342
Cross sections	17	16	17	17

[1] P-values are below the coefficients.

Table A3

Impact of exchange rate regime

	1975–2006	1975–1989	1990–99	2000–06
Δr*	**0.11**	**0.03**	**0.36**	**0.21**
	0.00	0.08	0.01	0.00
Float	**–0.0003**	0.00	**–0.001**	**–0.0002**
	0.07	0.51	0.02	0.05
Float * Δr*	–0.05	0.02	0.11	0.04
	0.17	0.39	0.54	0.49
Rsq	0.00	0.00	0.01	0.04
DW statistic	1.80	1.87	1.74	1.52
Total observations	6,862	2,320	2,671	1,871
Cross sections	24	18	24	24

[1] P-values are below the coefficients.

Table A4

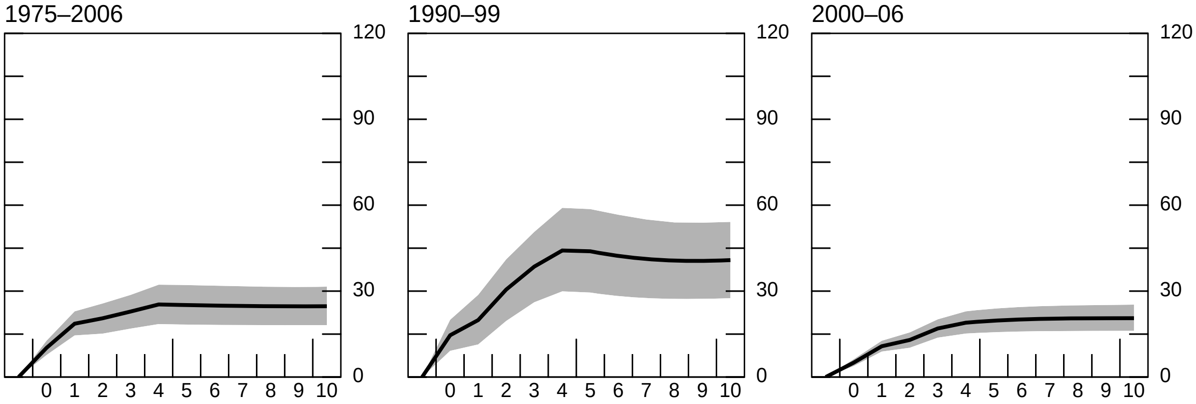
Impact of capital control and exchange rate regime

	1975–2006	1975–1989	1990–99	2000–06
Δr*	0.00	–0.01	0.07	**–0.34**
	0.91	0.71	0.87	0.09
Capmob	0.00	0.00	0.00	0.00
	0.57	0.72	0.86	0.16
Capmob * Δr*	**0.05**	0.04	0.12	**0.15**
	0.05	0.12	0.40	0.02
Float	**–0.0004**	0.00	**–0.001**	0.00
	0.03	0.34	0.01	0.22
Float * Δr*	0.00	0.01	0.13	**0.18**
	0.97	0.89	0.58	0.00
Rsq	0.00	0.00	0.01	0.07
DW statistic	1.72	1.84	1.67	1.38
Total observations	5,414	2,069	2,003	1,342
Cross sections	17	16	17	17

[1] P-values are below the coefficients.

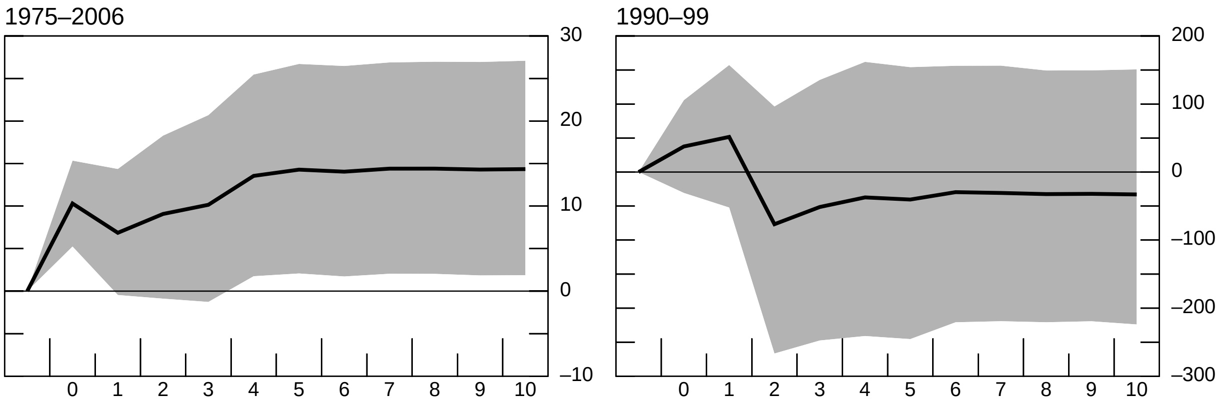
Graph A1

Impulse response of domestic interest rate to global tightening



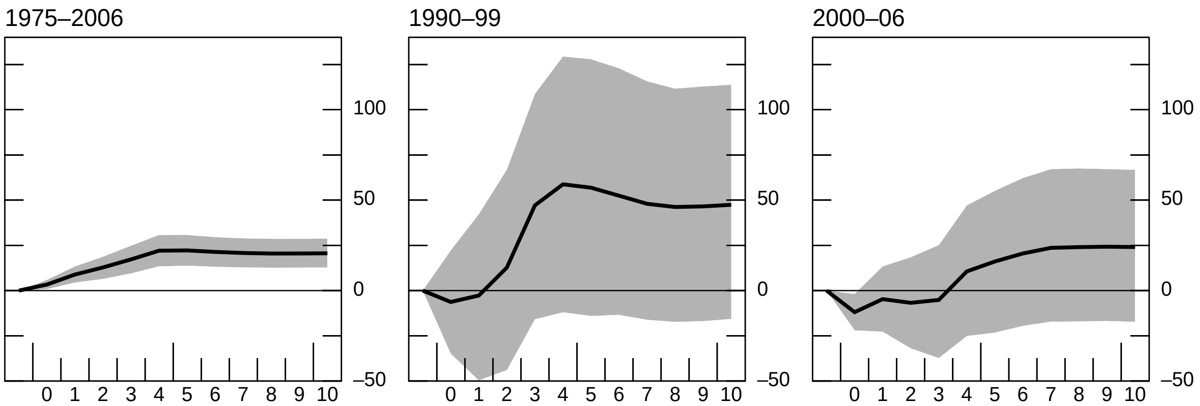
Graph A2

Impulse response of domestic interest rate to US interest rate for countries with no capital mobility



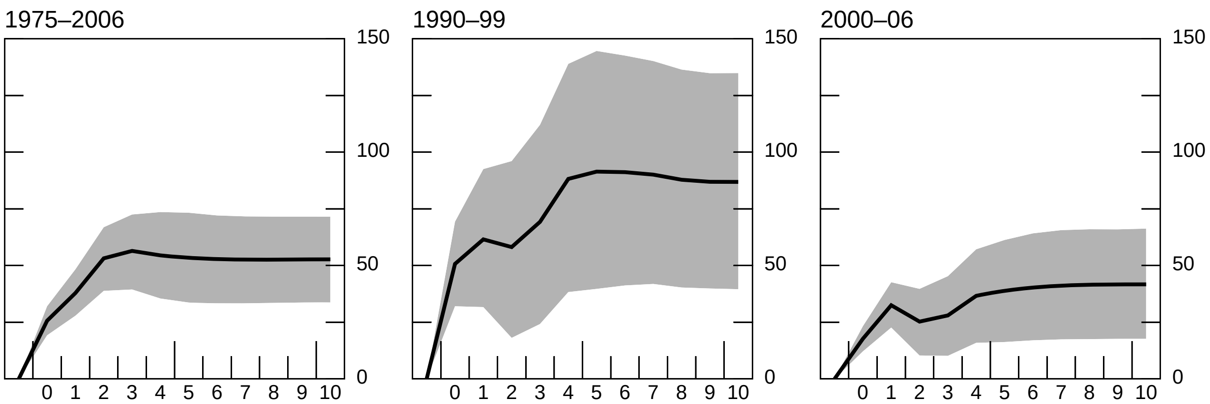
Graph A3

Impulse response of domestic interest rate to US interest rate for countries with intermediate level of capital mobility



Graph A4

Impulse response of domestic interest rate to US interest rate when interest rates are market-determined



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Exchange rate pass-through in emerging market economies: what has changed and why?

Dubravko Mihaljek and Marc Klau[1]

Introduction

Inflation has been fairly stable in many industrial and emerging market economies over the past few years despite wide swings in exchange rates. This development has drawn attention to the issue of the exchange rate pass-through to domestic prices and to whether and, if so, why it has declined. The last time this issue was discussed at a BIS meeting for emerging markets was in early 2001, in the aftermath of the Asian and Russian crises of 1997–98 and shortly before the onset of the most recent major emerging market crises, those in Argentina and Turkey.[2] Already at that time a decline in the exchange rate pass-through had been documented for the 1990s. However, the pass-through still seemed to be high: in countries with a history of high inflation, exchange rate changes were essentially fully passed into domestic CPI within a period of six months.

For the great majority of emerging market countries, the period since 2001 has been much more successful in terms of overall macroeconomic performance than the 1990s. Many central banks have implemented significant changes in their monetary policy frameworks. In larger economies, exchange rates were in many cases freed and inflation targeting was introduced. In a number of smaller countries, hard peg regimes were introduced in order to anchor inflation expectations. Many emerging market economies have experienced a dramatic decline in inflation partly as a result of these changes. Inflation has also declined globally as international and domestic competition has intensified since the late 1990s. In this environment, one might expect to observe a further decline in the pass-through of exchange rate changes to domestic inflation.

Against this background, this note provides estimates of the pass-through from exchange rate and foreign price changes to inflation for 14 emerging market countries for the period from 1994 to mid-2006. The main question addressed is whether the exchange rate pass-through has changed over time and, if so, what the likely determinants of this change have been. To verify whether the exchange rate pass-through has declined, estimates from this paper are compared with those for an earlier period (late 1980s to 2000) from Mihaljek and Klau (2001), using essentially the same data set and estimating framework. The paper also addresses some issues that have not been extensively analysed in the literature, such as the asymmetric and threshold effects of exchange rate changes on inflation, and the impact on the pass-through of the trend appreciation of real exchange rates in the catching-up economies.

The paper is organised as follows. Section 1 discusses recent developments in the literature and presents central banks' assessments of the exchange rate pass-through, which were provided in answers to the questionnaire prepared for this meeting. Section 2 describes the

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[1] The authors thank Dietrich Domanski, Corrinne Ho, Serge Jeanneau, Hoe Ee Khor, Toshitaka Sekine, Camilo Tovar and Philip Turner for valuable comments.

[2] See proceedings of a workshop on "Modelling aspects of the inflation process and the monetary transmission mechanism in emerging market countries" in *BIS Papers,* no 8, November 2001.

estimating framework and the data set used in the empirical part of the paper. Section 3 describes the estimation results. Section 4 provides tentative interpretations of possible reasons for the observed changes in the exchange rate pass-through.

1. Literature and central banks' assessments

The most direct way of transmitting nominal exchange rate changes into domestic inflation is by altering the domestic currency prices of imported goods. How the exchange rate affects domestic prices via import prices depends to a large extent on the pricing behaviour of exporting and importing firms.

Under so-called pricing to market, exporting firms and/or their importers/distributors fix the import price in the local currency of the market they are exporting to. Exchange rate movements therefore need not be reflected in local currency prices, implying, in an extreme case, a zero pass-through. This case is perhaps more relevant for large industrial economies such as the United States, the euro area and Japan than for smaller industrial and emerging market economies.

The other extreme is when prices of imported goods are quoted in foreign currency and are sold to consumers for local currency at the going market exchange rate. In such a case, any change in the exchange rate will be automatically transmitted to the consumer prices of the importing country, implying a complete exchange rate pass-through. This might be the case, for instance, in an environment of very high inflation or in highly dollarised economies.

The most relevant case for smaller industrial and emerging market economies would seem to be that of foreign exporters selling goods to local importers/distributors at prices quoted in foreign currency, and distributors then re-selling goods in the local market at prices quoted in local currency. If they operate in a competitive market, importers/distributors would partly absorb any effects of exchange rate changes by varying their mark-ups, so the pass-through would be incomplete.

Consistent with these theoretical considerations, a typical finding of the empirical literature for industrialised countries is that the exchange rate pass-through lies between 0 and 1 (Campa and Goldberg (2002)). The measured pass-through is usually the highest for imported goods prices, lower for producer prices and lowest for consumer prices. Several explanations have been offered for this hierarchy of pass-through effects.

- The first is that as imported goods reach consumers through wholesale and retail networks, their prices accumulate a substantial local input of services such as transportation, marketing and advertising, which partly cushions the impact of exchange rate changes on final retail prices (Burstein et al (2005)).
- The second explanation is that imports are mainly intermediate goods to which foreign currency pricing applies, so the pass-through is complete for prices "on the docks". By contrast, retail prices, as a combination of imported and local goods prices, are set in local currency and are adjusted only periodically due to menu costs (Engel (2002)). Exchange rate movements could thus be incorporated in retail prices, but only periodically, blurring the direct link between exchange rate changes and domestic inflation.
- A third explanation is that consumers in addition switch from imported goods to lower-quality, cheaper local brands when larger exchange rate depreciations occur (Burstein et al (2005)). Similarly, when the local currency strengthens, consumers might switch to higher-quality, more expensive brands, so inflation might not decline in tandem with exchange rate appreciation.

Another important finding in the literature is that the exchange rate pass-through is higher for emerging market countries and that it declines over time for both industrial and emerging market countries.[3] Three explanations have been proposed for this finding.

The first explanation focuses on shifts in the composition of imports from "high pass-through" goods to "low pass-through" goods (Campa and Goldberg (2002)). In the more developed countries, the pass-through is nearly complete for energy and raw materials and is considerably lower than unity for food and manufactured products. A shift in the composition of imports from raw materials to manufactured goods could thus lead to a decline in the measured exchange rate pass-through for both import and consumer prices.

The second explanation relates to the role of macroeconomic variables, especially inflation. Taylor (2000) conjectured that the slowdown in the pass-through – and the higher pass-through for emerging market than industrial countries – was due to changes in the macroeconomic environment, in particular in the level and variability of inflation. More precisely, monetary policy that credibly pursues a policy aimed at keeping inflation low and stable may, by anchoring inflation expectations, increase the readiness of firms to absorb exchange rate fluctuations in their profit margins. In a more stable inflationary environment, exchange rate shocks may be perceived as more temporary.

The third explanation is that the globalisation of economic activity has increased competition and the contestability of markets and reduced the pricing power of dominant firms in the tradable sector. In such an environment, firms may have to absorb temporary cost increases that are due to exchange rate movements, thereby reducing the exchange rate pass-through. To maintain profit margins, firms may outsource production to lower-cost countries, including the ones to which they are exporting, which might further reduce the pass-through.

Whether and, if so, how far the exchange rate pass-through has declined and why this has happened has been extensively discussed in the empirical literature. Frankel et al (2005), using highly disaggregated data on individual goods prices in a large sample of countries, found that the pass-through to the CPI level had decreased, but only in developing countries and not in the developed ones. They also found that the pass-through to import prices was incomplete and had increased over time. The United States was an outlier in that the pass-through to import prices was found to be considerably lower than in other developed economies. Campa and Goldberg (2006) also found that retail price sensitivity to exchange rates may have increased in industrial countries over the past decade, both for traded and for non-traded goods. They conjectured that one of the reasons might have been a large expansion of imported input use across sectors, implying greater sensitivity of the costs of imported and non-tradable goods to import prices and exchange rates.

The relationship between the monetary policy regime and the pass-through has been tested for a large number of countries by Devereux and Yetman (2003), Choudhri and Hakura (2001) and Ca'Zorzi et al (2005). These studies in general showed that high inflation was indeed conducive to perfect pass-through and was often associated with complete pass-through. Bailliu and Fujii (2004) found that for a set of 11 OECD countries the pass-through declined not just for consumer prices but also for import and producer prices during the 1990s. Other determinants of the decline in the exchange rate pass-through were found to be inflation variability (Gagnon and Ihrig (2001)) and openness and country size: the more open and the smaller a country is, the higher the pass-through seems to be (Soto and Selaive (2003)).

In addition to large cross-country studies, there have been many studies of the exchange rate pass-through focusing on individual emerging market countries and regions.[4] Research in both areas is continuing.

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[3] Sekine (2006) found that the pass-through declined over time in all major industrial countries. Campa and Goldberg (2002) argue that it could be observed only for half of the OECD countries.

Central banks' assessments

The literature on the exchange rate pass-through does not analyse in detail the role of the exchange rate regime as a possible determinant of the pass-through. In general, the pass-through is thought to be higher for countries where the exchange rate serves as a nominal anchor to inflationary expectations. In such countries, any change in the exchange rate would be rapidly incorporated into expectations and thus prices of both tradables and non-tradables. If the exchange rate is not used as an intermediate target, inflation expectations would be less strongly associated with changes in the exchange rate. This would result in a lower exchange rate pass-through. Finally, in an inflation targeting regime with floating exchange rates, inflation expectations are mainly anchored by the central bank's inflation target, so exchange rate developments can be expected to have relatively little influence on domestic CPI.

These observations are clearly present in central banks' assessments of recent changes in the exchange rate pass-through, which were communicated in answers to the BIS questionnaire prepared for this meeting. Table 1 summarises the central banks' views.

Ten out of 15 central banks found evidence of a recent decline in the exchange rate pass-through. For those central banks that could quantify the change more precisely, the pass-through coefficient declined by about one-third (Colombia, Israel, Peru, Turkey) to one-half (Poland), or even more (the Philippines). The main reasons for the decline were identified as greater exchange rate flexibility and the decline in inflation, which has in turn been associated in several countries with the introduction of inflation targeting.[5]

However, assessments of the decline in the exchange rate pass-through are not universally shared. Four central banks out of 15 have not observed a decline in the pass-through: in Hong Kong and South Africa it was not clear that the pass-through had declined; in Malaysia the pass-through has been relatively stable; and in Thailand it increased slightly.

One should note that in these four countries the exchange rate pass-through was relatively small to begin with. In addition, the fact that the pass-through had not declined might be partly related to the role of exchange rate regimes. The Hong Kong dollar has been closely linked to the US dollar for over two decades and the Malaysian ringgit for almost a decade. Provided most imports come from the wider dollar area and are invoiced in US dollars, a certain degree of stability of the exchange rate pass-through should not come as a surprise. Thailand switched from a relatively long period of a fixed exchange rate to a floating exchange rate with inflation targeting at the start of the 1997 crisis. As economic agents learned to deal with fluctuating exchange rates in this environment, some increase in the exchange rate pass-through might have been expected, although the pass-through remains small. The case of South Africa, which has a relatively long experience with exchange rate floating and inflation targeting, might suggest that inflation expectations might have become more firmly anchored by the central bank's inflation target than by exchange rate expectations.

Three central banks (the Czech Republic, Singapore and Thailand) reported a lower pass-through of exchange rate changes to domestic inflation than to import prices. The pass-through to import prices seems to be much faster than that to inflation; the latter takes from one year (Turkey) to two years or longer to complete (Singapore, Thailand). Finally, the central banks of Poland and South Africa found asymmetric effects of exchange rate changes on inflation, with depreciation having a larger impact than appreciation.

4 See for instance Bhundia (2002), Edwards (2005), Goldfajn and da Costa Werlang (2000), de Gregorio and Tokman (2004), Ito and Sato (2006), da Silva Correa and Minella (2006), Rincon et al (2005) and Rowland (2003).

5 See the papers in this volume by the Bank of Thailand (2008), Başçi et al (2008, on Turkey), Eckstein and Soffer (2008, on Israel), Guinigundo (2008, on the Philippines), Rossini and Vega (2008, on Peru) and Sidaoui and Ramos-Francia (2008, on Mexico).

Table 1

Central bank assessments of exchange rate pass-through

Country	Recent estimate of PT coefficient[1]	Has PT coefficient declined recently?	Main reason for the decline of PT	Relative size of PT to different price indices	Other
Hong Kong		No evidence that PT declined			
India	8–17%	Yes, since the 1990s	Decline in inflation; lower tariffs		
Malaysia		No; PT relatively stable in 1990–2006			
Philippines	1.2%	Yes, from 23% before 1993			PT is generally very low
Singapore	3%			CPI^{PT} < $Imp.Price^{PT}$	Complete PT after 2 yrs
Thailand	Small	Increased slightly	ER flexibility	CPI^{PT} << $Prod.Pr.^{PT}$ << $Imp.Pr.^{PT}$	PT to import prices full and rapid; PT to CPI not full even in the long run
Colombia	3% 2006	Yes, from 4–5% in mid-1980s			
Peru	10% 2006	Yes, from 10–20% in 2001–04			
Venezuela		Yes, during 2005–06	FX reserves↑; oil prices↑; lower ER volatility		
Czech Republic	0–40%	Yes	Inflation targeting, ER flexibility	CPI^{PT} << $Imp.Price^{PT}$	
Hungary		Yes	Widening of ER band, inflation targeting		
Poland	12% 2006	Yes, from 24% in 2002	Inflation targeting, ER float		Asymmetric response of PT (ER↓ > ER↑)
Israel	23% 1999–2004	Yes, from 33% in 1991–98	Decline in inflation, ER stabilisation		Half of PT via rental contracts fixed to USD
Turkey	42% Since 2001	Yes, from 63% before the float			Full PT takes 1 year (vs 4–5 months before)
South Africa	7.8%	Not clear that PT declined			Asymmetric, threshold effects apply

[1] Percentage increase in the CPI following a 10% depreciation of the exchange rate (individual country definitions may differ slightly).

Sources: Central bank answers to the BIS questionnaire; central bank studies.

2. Estimating framework and data

The framework used to estimate the pass-through effect in this paper is a simple single equation estimated separately for each country. The dependent variable is the average quarterly change in (the log of) a country's consumer price index (Δp_t) and the explanatory variables are average quarterly changes in (the logs of) lagged CPI (Δp_{t-1}), foreign prices measured in foreign currency (Δp^*_t), the nominal exchange rate (Δe_t) and a set of control variables:[6]

$$\Delta p_t = c + \beta_{1j}\Sigma(\Delta p_{t-j}) + \beta_2\Delta p^*_t + \beta_3\Delta e_t + \beta_{4j}Z_{jt} + u_t \qquad (1)$$

Lagged CPI (Δp_{t-j}) is included to allow the possibility of a partial adjustment of domestic inflation to the explanatory variables.[7]

Foreign prices measured in foreign currency (Δp^*_t) are included to separate the impact of exchange rate and foreign price changes (measured in foreign currency) on domestic inflation. This specification is more general than standard pass-through models, which have traditionally considered either how import prices in *domestic* currency are passed into domestic CPI, or how the exchange rate and foreign price movements that are passed into prices "at the docks" are subsequently absorbed in producer profit margins or mark-ups. In other words, in standard pass-through models the effects of exchange rate and foreign price changes are usually lumped into a single variable – import prices in domestic currency. Alternatively, it is assumed that their impact is "exhausted" on prices at the docks (ie, the first-stage pass-through is assumed to be approximately unity), and the estimation then focuses on the second-stage pass-through, which depends on the structure of competition in import-competing industries and the cost of domestic inputs (primarily labour) used in the distribution and sale of imported goods.

The first control variable used in the above specification is the domestic output gap ($y_t - y^*_t$), estimated using the Hodrick-Prescott filter. It controls for the effects of excess demand on inflation. Although it is common in studies of industrial countries, the output gap is still rarely used in studies of the pass-through in emerging market economies, partly because of incomplete data for many countries.

The second control variable is the equilibrium real exchange rate gap ($e^r_t - e^{r*}_t$), ie, the deviation of (the log of) the real effective exchange rate from its long-term equilibrium trend, which is estimated by a Hodrick-Prescott filter.[8] The rationale for including this control variable is the observed long-term tendency for real exchange rates to appreciate in the countries that are catching up with productivity levels and living standards in advanced industrial economies. The real exchange rate gap controls for the impact on inflation of the trending movement of real exchange rates and "non-equilibrium" deviations from this trend.[9] If one ignores these effects, one might underestimate the exchange rate pass-through, given

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6 Up to four lags of each explanatory variable are used in estimation, but only one lag is specified in equation (1) to simplify notation.

7 Thus, the short-run exchange rate elasticity is given by β_3, the long-run elasticity by $\beta_3/(1 - \beta_1)$ the short-run foreign price elasticity by the coefficient β_2, and the long-run elasticity by $\beta_2/(1 - \beta_1)$ etc.

8 By substituting the log of the real exchange rate $e^r_t = p_t - p_t^* - e_t$ into (1) and taking lags, it can be shown that this specification effectively imposes the long-run purchasing power parity restriction on equation (1). In this specification, the coefficient β_{4j} on the real exchange rate gap represents the instantaneous long-run exchange rate pass-through.

9 Estimating equilibrium real exchange rates in emerging market economies is of course much more complex. For an overview of this issue in transition economies see Égert et al (2006).

the observed tendency of real exchange rates to appreciate in recent years. So far, only one study (Darvas (2001)) has explicitly modelled this aspect of the exchange rate pass-through.

The expected signs of the first three parameters in equation (1) are all positive: higher inflation persistence, an increase in foreign prices and a currency depreciation are all expected to lead to higher domestic inflation. The same is true of a positive output gap. A positive real exchange rate gap – which occurs when the real exchange rate appreciates above its trend – is expected to have a dampening effect on inflation.

Other control variables that were considered but were not included in the above specification are oil prices and regulated prices. In more advanced economies there is usually complete pass-through of oil price changes to domestic inflation, so one can expect the coefficient on oil price changes to be close to unity. In many emerging market economies the pass-through of oil price changes to domestic inflation is muted through various fiscal measures (eg, consumer subsidies). In such cases the coefficient on oil prices would be lower than unity. In the present paper we do not model these effects separately because they are subsumed in changes in foreign prices measured in foreign currency (Δp^*_t). Changes in regulated prices clearly play an important role in the dynamics of inflation in emerging markets and their inclusion would have made estimates of pass-through coefficients more precise. However, it was not possible to collect the relevant data for all the countries in the sample.

The present paper attempts to model the asymmetric effects of exchange rate changes on inflation. As noted above, exchange rate depreciation is often believed to have a larger impact on inflation than exchange rate appreciation. This issue has not often been addressed in the literature but is potentially important for assessing the size and evolution of the exchange rate pass-through. The asymmetric effects are modelled by including separate dummy variables for periods when exchange rates are depreciating and those when they are appreciating. If the size of the coefficient for depreciation is found to be significantly higher than that for appreciation, one can conclude that asymmetric effects of exchange rate changes on inflation are likely to be present.

Similarly, an attempt is made to model the threshold effects of exchange rate changes on inflation, ie, to assess whether exchange rate changes affect inflation only when they exceed a certain large enough threshold in a given period. This effect has not been modelled in the literature so far. It is assessed by defining a special dummy variable equal to 1 when exchange rate changes exceed ±5% over one quarter, ie, ±22% on an annual basis.

Data

The analysis covers 14 emerging market countries: India, Korea, Malaysia, the Philippines and Thailand from Asia; Brazil, Chile, Mexico and Peru from Latin America; the Czech Republic, Hungary, Poland and Turkey from central and eastern Europe; and South Africa. The data series start in the first quarter of 1994 and cover the period up to the second quarter of 2006. 1994 was chosen as the initial year for the sample because of limited data for earlier years, in particular for transition economies from central and eastern Europe.

Most variables are defined in a standard way (see Data Appendix for details). The output gap is defined as a deviation of the actual growth rate of GDP from the trend growth rate, which is in turn calculated using the Hodrick-Prescott filter. Similarly, the real exchange rate gap is defined as a deviation of the actual real exchange rate from the trend real exchange rate, which is also calculated using the Hodrick-Prescott filter.

One non-standard variable is foreign price measured in foreign currency, which is derived from nominal and real effective exchange rates for each country. By construction, this variable is a multilateral foreign consumer price index, rather than the more narrow import unit value index often used in empirical literature.

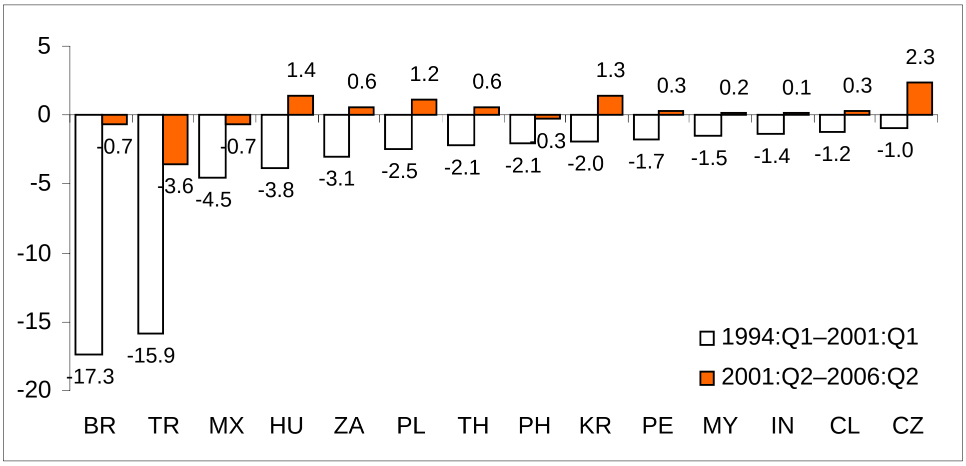
Average values and standard deviations of the main variables are shown in Appendix Table A1. They are compared in Graphs 1–3 for two illustrative sub-samples: 1994–2001:Q1 and 2001:Q2–2006:Q2. The first quarter of 2001 was chosen as a mid-point of the sample because it marks a period when the crises in Argentina and Turkey broke out. It is interesting in this regard that, despite a string of major emerging market crises from the mid-1990s up to the first quarter of 2001, the standard Chow test for in-sample structural breaks does not suggest the presence of structural breaks in the exchange rate pass-through for the majority of countries for the period from 1994 to 2001; the null hypothesis of no structural break was rejected only for the Czech Republic, Mexico and Thailand.

As can be seen from Graph 1, there was a dramatic change in the pattern of exchange rate changes between these two sub-periods. From 1994:Q1 to 2001:Q1, all countries in the sample experienced on average domestic currency depreciation, ranging from 17.3% per quarter in Brazil to 1% per quarter in the Czech Republic. By contrast, since the second quarter of 2001, only Turkey, Brazil and Mexico have on average experienced somewhat larger domestic currency depreciation; elsewhere, nominal exchange rates have appreciated by up to 2.3% per quarter on average. As noted above, this trend appreciation clearly needs to be isolated in estimates so as to avoid underestimating the exchange rate pass-through.

Graph 1

Changes in exchange rates

Quarterly percentage changes



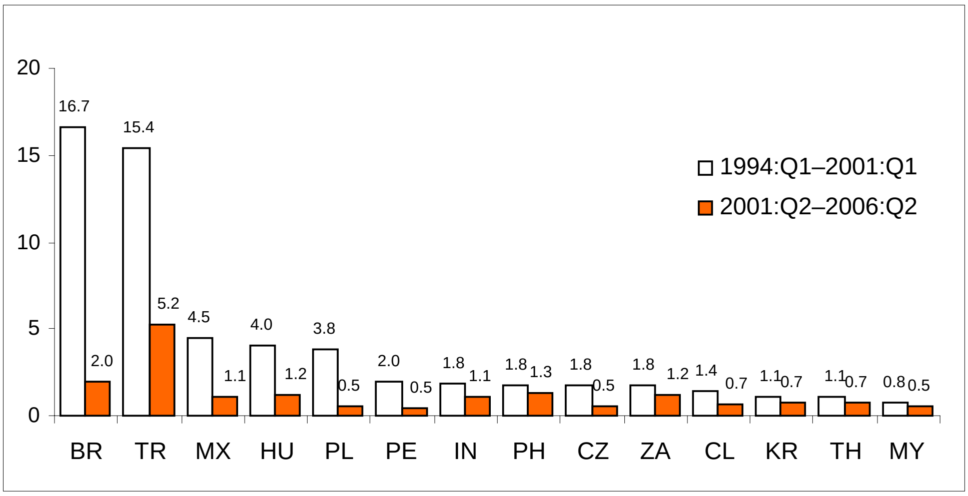
Sources: IMF; national data; BIS calculations.

Changes in inflation between the two sub-periods were in some countries no less dramatic; in others they were smaller but nonetheless visible. As shown in Graph 2, inflation declined between the two sub-periods most significantly in Brazil – from 16.7% per quarter (85% per annum) to 2% per quarter (8.2% per annum) – and Turkey, followed by Mexico, Hungary, Poland and Peru. Elsewhere, quarterly inflation rates declined by about 0.6 percentage points on average between the two periods.

Graph 2

Changes in inflation

Quarterly percentage changes



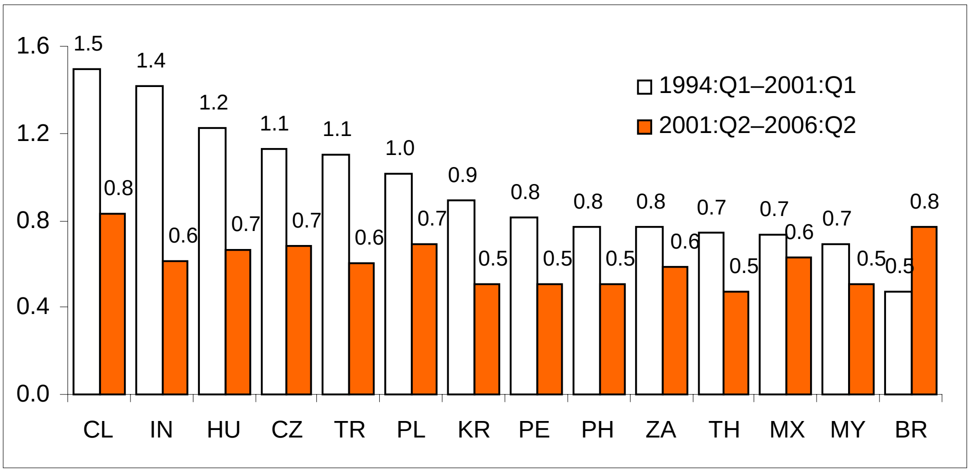
Sources: National data; BIS calculations.

Foreign prices have increased more slowly since 2001 in all the countries with the exception of Brazil (Graph 3). On average, foreign prices have increased by 0.6% per quarter since 2001:Q2, a third of a percentage point more slowly than during 1994:Q1–2001:Q1. This evidence provides support to the view that prices of imported goods have been trending down globally over the past few years, probably due to increased global competition.

Graph 3

Changes in foreign prices

Quarterly percentage changes



Sources: National data; BIS calculations.

3. Estimation results

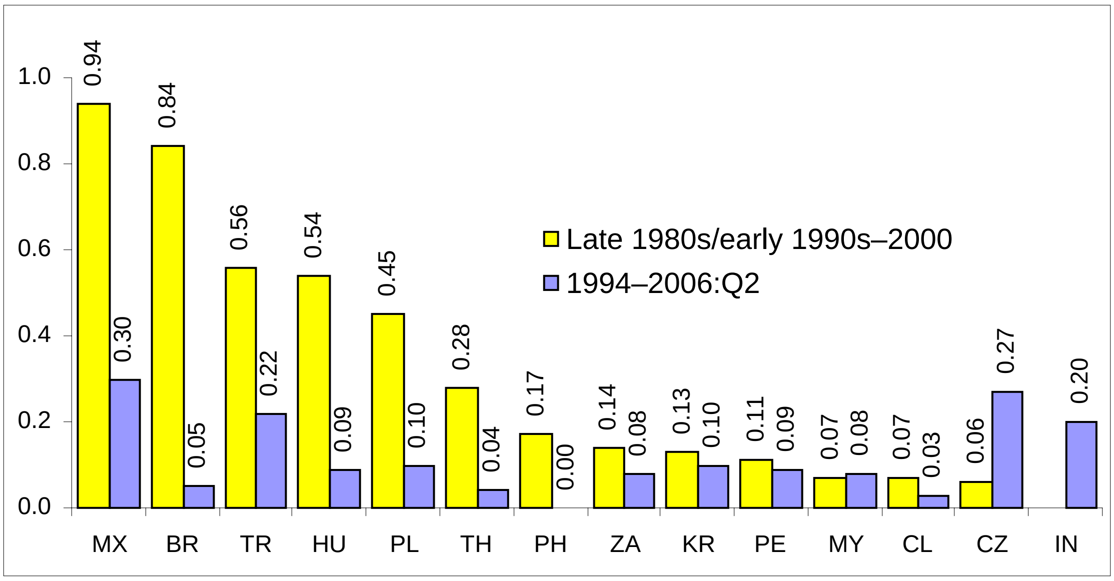
Least squares estimates of the parameters in equation (1) are shown in Appendix Tables A2 (without the real exchange rate trend, comparable to the estimates in Mihaljek and Klau (2001)) and A3 (with the real exchange rate trend).[10] All estimated coefficients are statistically highly significant; the overall fit of regressions and other standard test statistics are fairly good.

The change in pass-through coefficients over time is assessed by comparing pass-through coefficients for the period from 1994 to mid-2006 from this paper with those for the period from the late 1980s up to end-2000 presented in Mihaljek and Klau (2001). Given that the data used in these two papers are essentially the same, these comparisons over a partly non-overlapping period provide a relatively reliable indication of the direction of change in pass-through coefficients.[11]

As can be seen from Graph 4, the (short-term) **exchange rate pass-through** appears to have declined in all the countries in the sample since 2001, with the exception of the Czech Republic.[12] In Brazil and Mexico, for instance, the exchange rate pass-through was nearly complete for the period from the late 1980s to 2000. But in the period from 1994 to mid-2006, the pass-through coefficient declined to 0.3 in Mexico and just 0.1 in Brazil, meaning that the (quarterly) rate of inflation resulting from 1% nominal exchange rate depreciation increased by 0.3% and 0.1%, respectively. Hungary, the Philippines, Poland, Thailand and Turkey also seem to have experienced a substantial decline in the exchange rate pass-through. In Chile, Korea, Malaysia, Peru and South Africa, the exchange rate pass-through was already quite low before 2001 but appears to have further declined in the period since. Reasons for the small increase in the pass-through in the Czech Republic are unclear.

Graph 4

Pass-through of changes in exchange rates to inflation



Source: BIS calculations.

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[10] For India, the results of regressions with the trend are not shown because they were generally very poor.

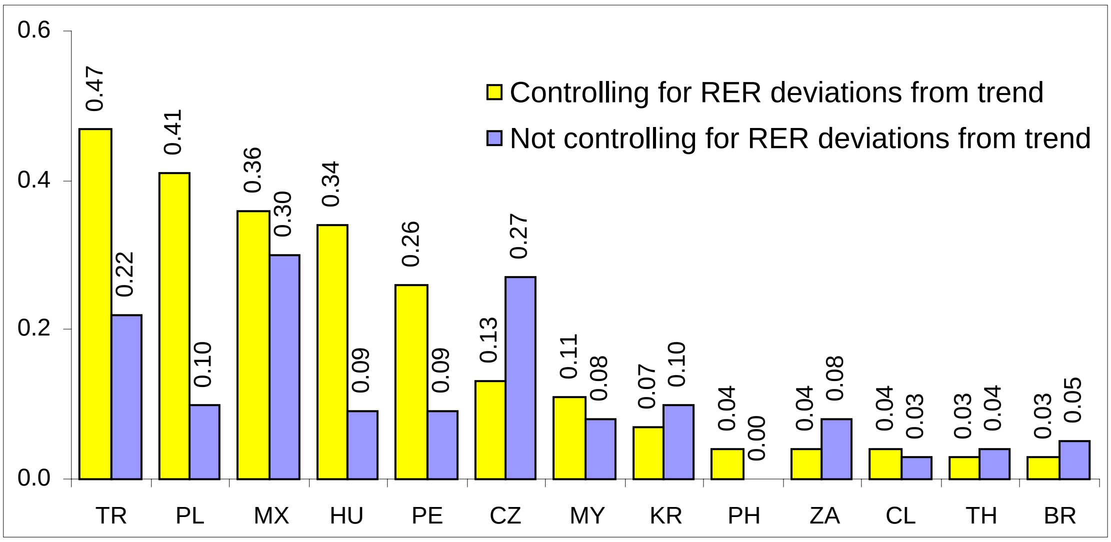
[11] The change in pass-through could have also been assessed by running separate regressions for periods before and since 2001:Q1. However, with the quarterly data used, the number of observations for the latter period (21 in total) would have been too small to allow statistically reliable conclusions to be drawn. Another possibility would have been to use the time-varying parameter approach, which was successfully applied to industrial countries by Sekine (2006). However, the shortness of individual data series and other data requirements made this approach impractical. The third possibility, yet to be explored, is rolling and recursive regressions.

[12] The pass-through coefficients shown in Graph 4 and subsequent graphs in this section represent sums of contemporaneous and lagged (up to four quarters) coefficients on the nominal exchange rate and other right-hand-side variables in equation (1) (see Appendix Table A2).

Graph 5 shows estimates of the exchange rate pass-through for the period 1994–2006:Q2 from alternative specifications of equation (1), with and without controlling for deviations of the real exchange rate from its trend. Consistent with the above remarks, controlling for real exchange rate appreciation increases the size of estimates of the short-term exchange rate pass-through for several countries that have experienced pronounced real exchange rate appreciation, such as Hungary, Mexico, Peru, Poland and Turkey.

Graph 5

Alternative estimates of exchange rate pass-through

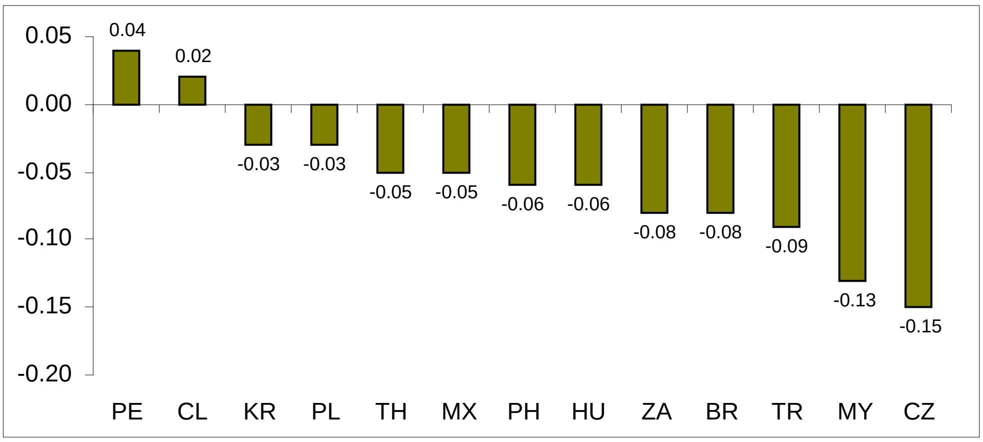


Source: BIS calculations.

In other countries that have experienced relatively strong trend appreciation (including the Czech Republic, Korea, South Africa and Thailand), controlling for this trend decreases slightly (in the case of the Czech Republic, significantly) the estimated pass-through coefficient. One reason might be that there were fewer large deviations of the real exchange rate from trend in these countries. In addition, lower initial pass-through may have played a role. For the countries where trend appreciation has not been pronounced, the difference between alternative estimates of the exchange rate pass-through is small.

Graph 6

Real exchange rate appreciation above trend and inflation



Source: BIS calculations.

With the exception of Chile and Peru, above-trend real exchange rate appreciation has had the predicted dampening effect on inflation. In the Czech Republic, for instance, real exchange rate appreciation of 1% above the trend reduces quarterly inflation by 0.15%, and in Malaysia by 0.13% (Graph 6).

There is also some evidence of **asymmetric effects** of exchange rate depreciation vs appreciation on domestic inflation. Exchange rate depreciation seems to have a significant and stronger effect on inflation than appreciation in Korea, Malaysia, Mexico, Poland and Turkey (Table 2). Appreciation seems to have a significant and stronger effect on inflation only in the Philippines, Brazil and Hungary. For other countries, this simple approach does not suggest the presence of asymmetric effects of exchange rate changes on inflation.

Table 2

Asymmetric and threshold effects of exchange rate changes on inflation

Depreciation[1]			Appreciation[1]		Threshold effects[2]	
Significant	**Not significant**	**Stronger effect than appreciation**	**Significant**	**Not significant**	**Significant**	**Not significant**
Korea		Korea	Korea*		Malaysia	Korea
Malaysia		Malaysia		Malaysia	Thailand	Philippines
	Philippines		Philippines*		Mexico	South Africa
	Thailand			Thailand	Hungary	Brazil
	South Africa			South Africa	Turkey	Chile
	Brazil		Brazil			Peru
	Chile			Chile		Poland
Mexico		Mexico		Mexico		Czech Rep
	Peru			Peru		
	Czech Rep			Czech Rep		
	Hungary		Hungary*			
Poland		Poland		Poland		
Turkey		Turkey		Turkey		

* denotes borderline significance (at a 10% test level) of the corresponding dummy variable.

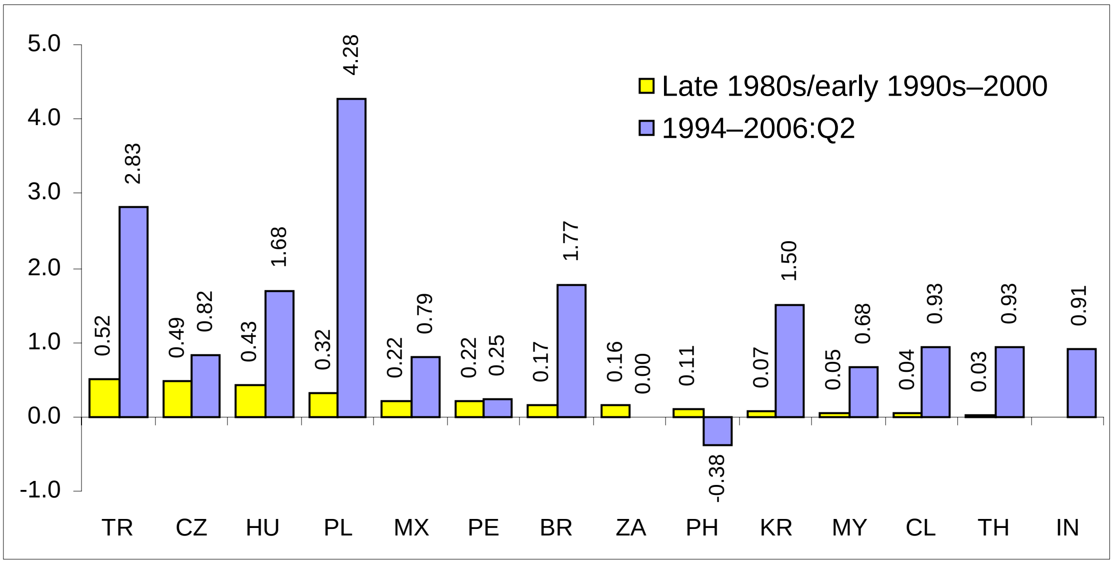
[1] Estimated using dummy variables equal to 1 when the exchange rate depreciates (appreciates), zero otherwise, for regressions specified in Appendix Table A3. [2] Defined as quarter-on-quarter changes in the average quarterly exchange rate greater than or equal to 5%.

Threshold effects of exchange rate changes on inflation, ie, the effects of exchange rate changes only above ±5% over a quarter (±22% over a year), seem to apply in Malaysia, Thailand, Mexico Hungary and Turkey (Table 2). Threshold effects do not seem to be significant elsewhere, including in countries such as Brazil, Poland and South Africa, which have otherwise experienced considerable volatility in nominal exchange rates. Perhaps the very fact that exchange rates have been quite volatile in these countries has dampened the pass-through of larger changes in exchange rates to inflation, as economic agents learned to expect that nominal exchange rates could move both down and up by significant amounts.

Estimates of the **foreign price pass-through** to domestic inflation are shown in Graph 7. As noted above, this variable is a multilateral foreign consumer price index measured in foreign currency, derived from nominal and real exchange rate indices. It is interesting that despite the decline in this measure of foreign prices (Graph 3), the pass-through of changes in foreign prices to domestic inflation seems to have increased in all the countries with the exception of the Philippines. This may reflect the increased weight of foreign goods in CPI baskets of emerging market economies in the past five years, but also significantly higher prices of oil and non-oil commodities (as well as fewer energy subsidies to consumers in some countries). Why individual coefficient estimates are so high (up to 4.3 in the case of Poland, suggesting a 4.3% increase in the quarterly rate of inflation when foreign price inflation increases by 1% in a quarter) is unclear.

Graph 7

Pass-through of foreign price changes to inflation



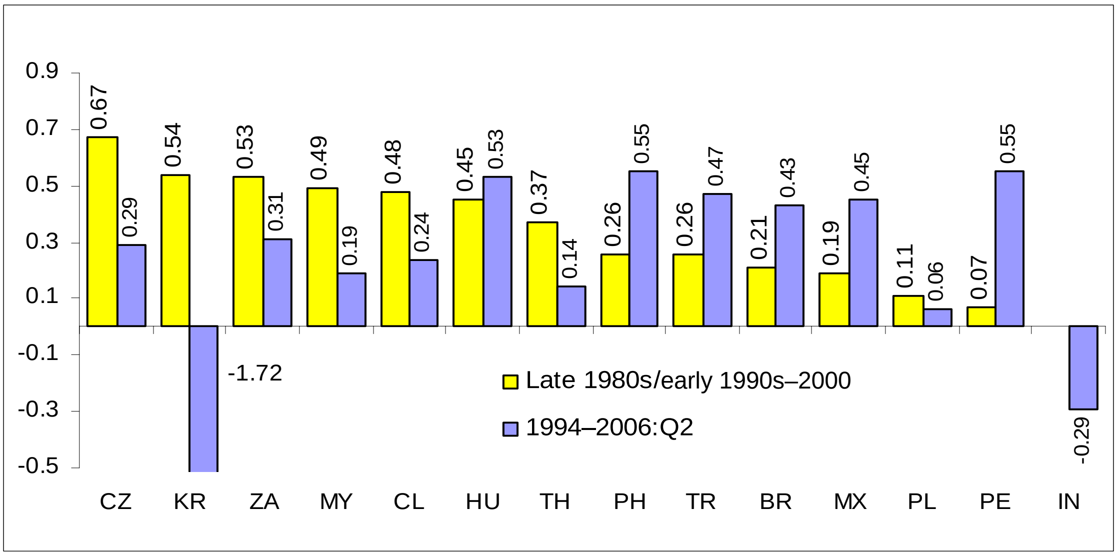
Source: BIS calculations.

Regarding **inflation persistence**, defined here as the elasticity of current inflation to changes in past inflation (cumulated over three quarters), the cross-country picture is mixed. Inflation persistence seems to have declined most significantly in Korea, followed by the Czech Republic, Chile, Malaysia, Thailand and South Africa (Graph 8). But in Peru, Mexico, the Philippines and, to a lesser extent, Brazil and Turkey, the sensitivity of current inflation to past inflationary developments seems to have increased. Moreover, inflation "inertia" remains relatively high: the cumulative increase in the quarterly rate of inflation of 1% over the past three quarters results in most countries in 0.4–0.6% higher inflation in the current quarter. The reasons for this pattern of results are unclear. Both groups of countries include some inflation targeters and in both groups inflation has declined on average since 2001 (with the exception of Turkey and, to a lesser extent, the Philippines).

The estimated relationship between the **output gap and inflation** is statistically significant for all the countries and the sign is mostly positive. With few exceptions, differences in the size of coefficients are not so large – 1 percentage point faster growth of output relative to trend is estimated to raise the quarterly rate of inflation by about 0.2% in Brazil, Mexico, the Philippines and South Africa (Graph 9). The large negative coefficient for Turkey probably reflects disinflation accompanied by a rapid recovery of growth following the 2001 crisis.

Graph 8

Inflation persistence



Source: BIS calculations.

Graph 9

Output gap and inflation

Source: BIS calculations.

To further assess the dynamic behaviour of the variables in equation (1), a series of Granger causality tests was performed. The results indicate that the assumption of statistical causality running from the nominal exchange rate (and deviations of the real exchange rate from trend) to consumer prices is valid for most of the countries in the sample. In particular, the null hypothesis that exchange rate changes do not cause changes in inflation is rejected for most countries; the exceptions include Chile, India, Thailand and, surprisingly, Brazil and Turkey (Table 2). The same pattern can be observed for the null that deviations of the real exchange rate from trend do not cause changes in inflation. The null that foreign prices measured in foreign currency do not cause changes in domestic inflation is rejected for Korea, Brazil, Poland and (marginally) Hungary. Finally, no causality between the output gap and inflation is rejected for Korea, the Philippines, Thailand, Chile, Peru and Hungary.

Table 3

Granger causality tests

Null hypothesis	India	Korea	Malaysia	Philip-pines	Thailand	South Africa	Turkey
$\Delta \log (P^*) \rightarrow \Delta \log (P)$		√					
$\Delta \log (E) \rightarrow \Delta \log (P)$		√	√	√		√	
$(RERGAP) \rightarrow \Delta \log (P)$		√	√	√		√	
$(GDPGAP) \rightarrow \Delta \log (P)$		√		√	√		
	Brazil	**Chile**	**Mexico**	**Peru**	**Czech Rep**	**Hungary**	**Poland**
$\Delta \log (P^*) \rightarrow \Delta \log (P)$	√					√*	√
$\Delta \log (E) \rightarrow \Delta \log (P)$			√	√	√	√*	√
$(RERGAP) \rightarrow \Delta \log (P)$			√		√	√	√
$(GDPGAP) \rightarrow \Delta \log (P)$		√		√		√	

Based on quarterly data. *P* = consumer price index; *P** = import trade-weighted foreign consumer price index; *E* = nominal exchange rate (up means depreciation); *GDPGDP* = output gap; *RERGDP* = real effective exchange rate gap; Δ = quarterly change.

- The bivariate regressions are of the form: $X_t = \alpha_0 + \alpha_1 X_{t-1} + \ldots + \alpha_n X_{t-n} + \beta_1 Y_{t-1} + \ldots + \beta_n Y_{t-n}$

  $Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \ldots + \alpha_n Y_{t-n} + \beta_1 X_{t-1} + \ldots + \beta_n X_{t-n}$

  for all possible pairs of (X,Y) series in the group.

- √ means that the hypothesis that X does not cause Y is rejected at a 5% level (* at a 10% level). The results are based on an F-test for the joint hypothesis that β1 = β2 = … = βn are jointly equal to zero for each equation.

4. Tentative interpretations

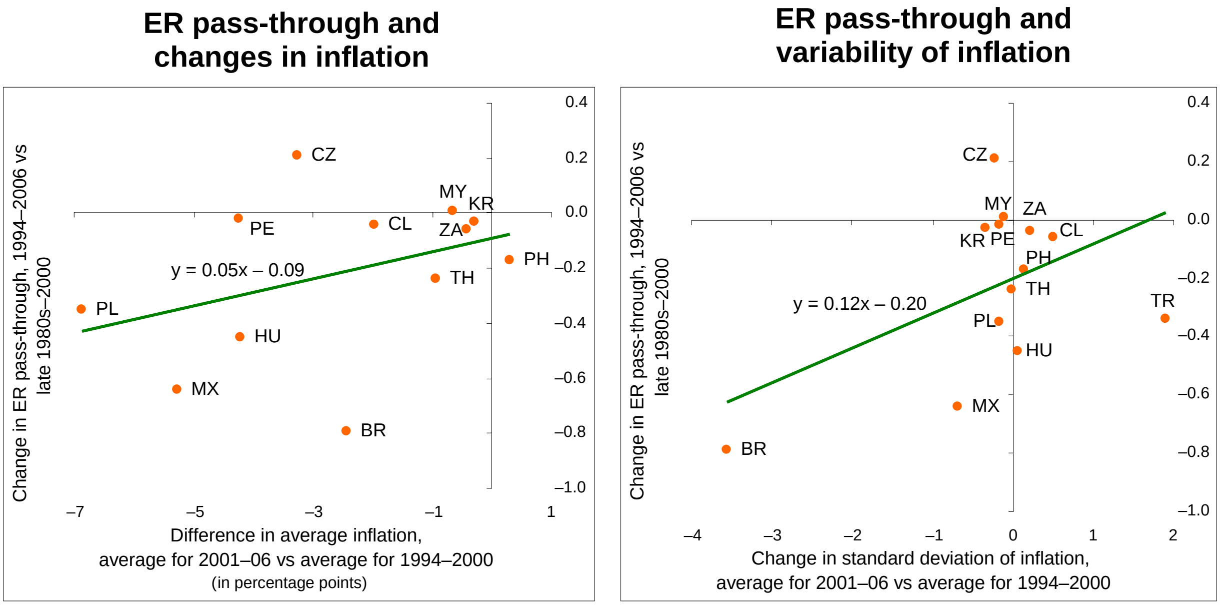
The above results would seem to support the hypothesis that the exchange rate pass-through to domestic CPI has declined in emerging market countries in recent years. At the same time, the sensitivity of inflation to foreign price changes measured in foreign currency may have increased, even though foreign prices have on balance increased more slowly since 2001. It was shown that the trend appreciation of real exchange rates can significantly affect the measured exchange rate pass-through. Finally, there is some evidence of asymmetric and threshold effects of exchange rate changes on inflation in several countries.

How do these findings relate to explanations for the decline in the exchange rate pass-through advanced in the literature? To assess this issue, changes in pass-through coefficients over time are plotted against some of their determinants identified in the literature.

Graph 10 shows relationships between the decline in the exchange rate pass-through and the decline in inflation and its variability. The decline in the exchange rate pass-through is measured as the difference between estimates for the period from 1994 to 2006, and those for the period from the late 1980s to 2000. As can be seen from the left-hand panel of

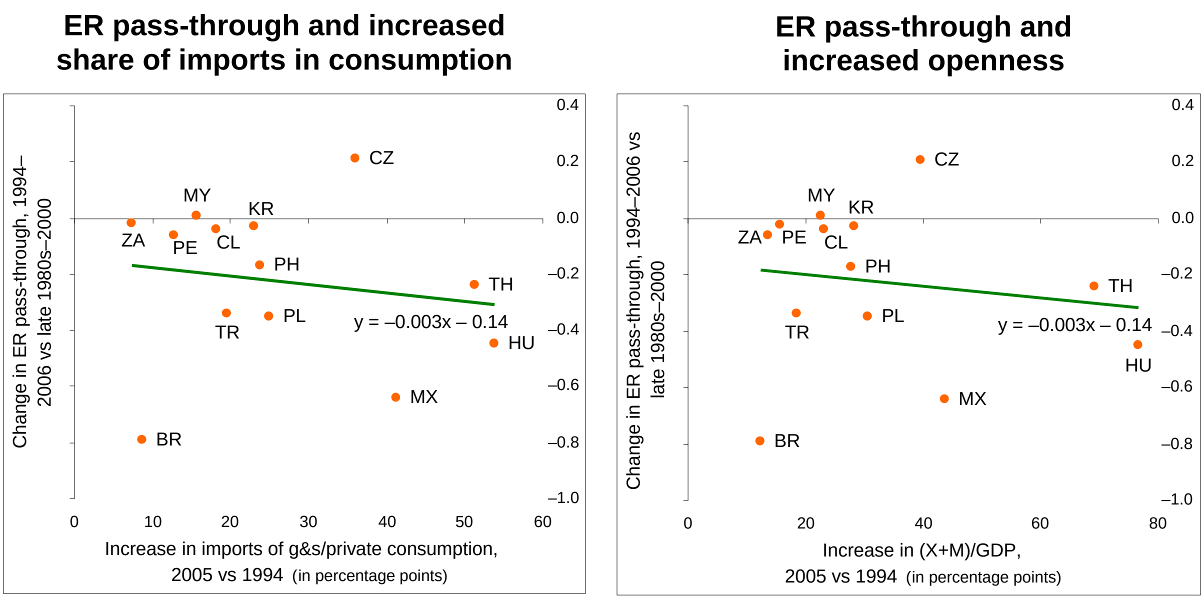
Graph 10, the exchange rate pass-through (measured along the vertical axis) has tended to decline more in those countries that have seen a larger decline in inflation in the 2000s compared to the 1990s. However, this relationship is not particularly strong. Somewhat stronger seems to be the relationship between the decline in the exchange rate pass-through and the decline in the volatility of inflation. As can be seen from the right-hand panel of Graph 10, the more the volatility of inflation has declined (ie, the more inflation has become stable), the more the exchange rate pass-through has tended to decline.

Graph 10



Source: BIS calculations.

Graph 11

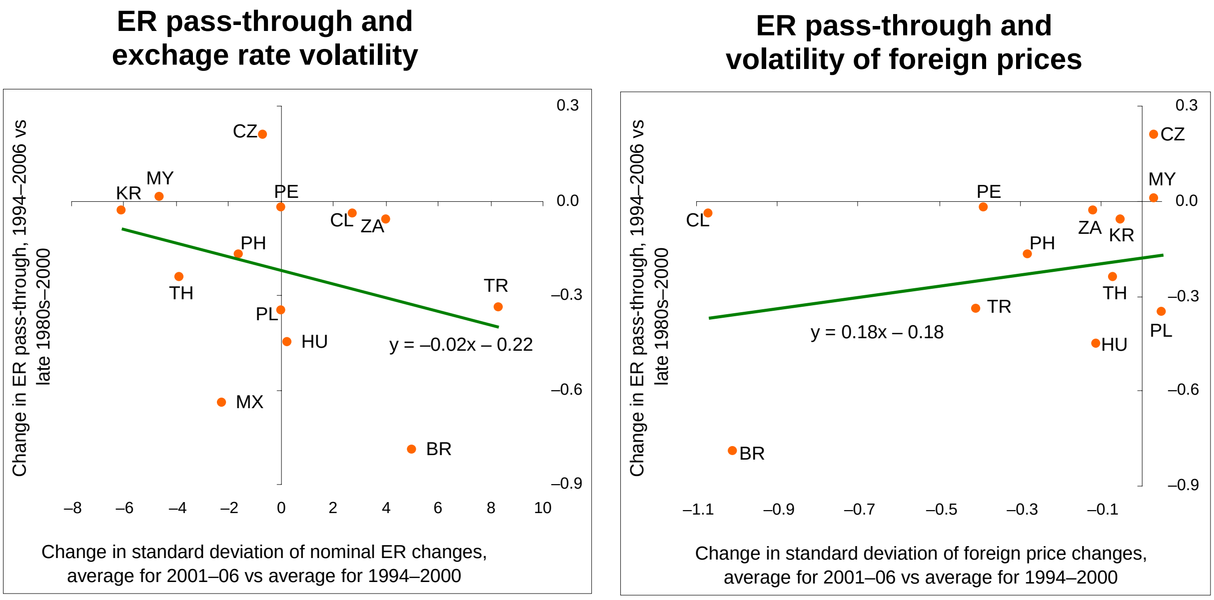


Source: BIS calculations.

Graph 11 suggests that the decline in the exchange rate pass-through has been associated with an increase in the share of imported goods in consumption (left-hand panel) and an increase in the openness of emerging market economies. The relationship is not particularly strong. Nonetheless, it indicates that, contrary to some arguments made in the literature, retail price sensitivity to exchange rates may not have necessarily increased with the greater openness and higher share of imports in the consumption of emerging market economies in recent years. On the other hand, the measured increase in the pass-through of foreign price changes to inflation has been positively correlated with the increased share of imports in consumption and greater openness of emerging market economies, although these relationships are statistically weak (graphs not shown).

Graph 12 (left-hand panel) suggests that greater volatility of nominal exchange rates has been associated – somewhat surprisingly – with the *decline* in the exchange rate pass-through. This would be consistent with earlier observation that countries such as Brazil, South Africa and Poland have experienced a decline in the exchange rate pass-through at the same time as their nominal exchange rates have become more volatile. Changes in foreign prices, on the other hand, seem to have been related to the exchange rate pass-through in an intuitively plausible way: as foreign prices have become less volatile since 2001, the exchange rate pass-through has tended to decline.

Graph 12



Source: BIS calculations.

In summary, while some of the decline in the exchange rate pass-through since 2001 seems to be related to the lower level and lower volatility of domestic inflation, as well as lower volatility of foreign prices, links to other factors identified in the literature – such as greater exchange rate volatility, increased share of imported goods in consumption and greater openness of emerging market economies – are weak or could not be established. Further research in this area will be needed to clarify these issues.

Appendix:
Database description

Countries cc:

IN = India; KR = Korea; MY = Malaysia; PH = Philippines; TH = Thailand

BR = Brazil; CL = Chile; MX = Mexico; PE = Peru

CZ = Czech Republic; HU = Hungary; PL = Poland; TR = Turkey

ZA = South Africa

Indicators:

CPIcc = consumer price index (base 2002 Q1)

LCPIcc = consumer price index, log

RERcc = real effective exchange rate; starting 1994 (base 2002 Q1)

NERcc = nominal effective exchange rate; starting 1994 (base 2002 Q1)

XRcc = spot exchange rate (local currency/US$)

XReurocc = spot exchange rate (local currency/euro) (for CZ, HU, PL)

GAPcc = output gap, deviation from HP-calculated trend

GAPRERcc = real effective exchange rate gap, from 1994, deviation from HP-calculated trend

MPcc = import unit value index, in local currency (base 2002 Q1)

LMPcc = import unit value index, in local currency, log

LCPFcc = log multilateral foreign CPI, from 1994, defined as (LOG 'CPIcc'

PLUS((LOG('NERcc'))MINUS(LOG('RERcc')))

LCPF1cc = log multilateral foreign CPI, from 1985, defined as (LOG 'CPIcc'

PLUS((LOG('NEFcc'))MINUS(LOG('REFcc')))

Frequency: Quarterly averages

Table A1

Changes in exchange rates, domestic and foreign inflation[1]

	Exchange rate[2]				**Domestic inflation**				**Foreign inflation**			
	Quarterly average		**Standard deviation**		**Quarterly average**		**Standard deviation**		**Quarterly average**		**Standard deviation**	
	94Q1–01Q1	01Q2–06Q2	94Q1–01Q1	01Q2–06Q2	94Q1–01Q1	01Q2–06Q2	94Q1–01Q1	01Q2–06Q2	94Q1–01Q1	01Q2–06Q2	94Q1–01Q1	01Q2–06Q2
India	–1.4	0.1	2.2	1.8	1.8	1.1	2.2	1.0	1.4	0.6	1.9	0.8
Korea	–2.0	1.3	9.8	2.8	1.1	0.7	1.1	0.5	0.9	0.5	0.5	0.3
Malaysia	–1.5	0.2	6.2	0.6	0.8	0.5	0.6	0.4	0.7	0.5	0.3	0.3
Philippines	–2.1	–0.3	6.0	2.2	1.8	1.3	0.9	0.7	0.8	0.5	0.7	0.3
Thailand	–2.1	0.6	8.1	2.8	1.1	0.7	0.9	0.8	0.7	0.5	0.4	0.3
South Africa	–3.1	0.6	5.1	8.1	1.8	1.2	0.9	1.1	0.8	0.6	0.5	0.3
Brazil	–17.3	–0.7	46.9	9.2	16.7	2.0	47.7	1.3	0.5	0.8	1.7	0.5
Chile	–1.2	0.3	3.1	5.1	1.4	0.7	0.6	0.6	1.5	0.8	2.2	0.4
Mexico	–4.5	–0.7	12.5	3.1	4.5	1.1	3.5	0.5	0.7	0.6	0.4	0.4
Peru	–1.7	0.3	1.9	1.7	2.0	0.5	1.3	0.6	0.8	0.5	0.8	0.3
Czech Republic	–1.0	2.3	4.8	3.9	1.8	0.5	1.3	0.7	1.1	0.7	0.5	0.4
Hungary	–3.8	1.4	2.8	3.8	4.0	1.2	2.2	1.0	1.2	0.7	0.7	0.4
Poland	–2.5	1.2	3.9	3.9	3.8	0.5	2.5	0.9	1.0	0.7	0.5	0.4
Turkey	–15.9	–3.6	14.6	13.0	15.4	5.2	6.1	5.3	1.1	0.6	1.4	0.8

[1] Quarterly percentage changes (based on quarterly average data). [2] An increase indicates an appreciation.

Table A2

Pass-through of foreign price and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi_{t-1}	Δcpi_{t-2}	Δcpi_{t-3}	$\Delta fcpi$	$\Delta fcpi_{t-1}$	$\Delta fcpi_{t-2}$	$\Delta fcpi_{t-3}$	Δxr	Δxr_{t-1}	Δxr_{t-2}	Δxr_{t-3}	gap	gap_{t-1}	gap_{t-2}	gap_{t-3}	R^2	Durbin-Watson
India	–0.15	–0.14		0.91				0.20							–0.17	0.78	2.16
	(–1.81)	(–1.70)		(9.17)				(92.57)							(–1.33)		
Korea	–0.77	–0.49	–0.46	0.72	0.78				0.06		0.04	–0.22	0.19		0.13	0.75	1.95
	(–6.44)	(–3.97)	(–3.74)	(2.64)	(3.54)				(4.57)		(2.94)	(–4.49)	(3.13)		(2.71)		
Malaysia	0.28	–0.35	0.26				0.68		0.04	0.04			0.07	–0.07		0.61	2.08
	(2.12)	(–2.83)	(2.25)				(4.15)		(2.73)	(2.24)			(1.94)	(–1.73)			
Philippines	0.32	0.46	–0.23			–0.38			0.04		–0.04			0.15		0.44	1.70
	(2.36)	(3.60)	(–1.91)			(–2.33)			(1.81)		(–2.09)			(1.82)			
Thailand			0.14*	0.93				0.04				–0.06		0.13		0.52	1.73
			(1.59)	(3.70)				(3.00)				(–1.79)		(4.06)			
South Africa	0.66	–0.35				–0.69	0.69	0.04			0.04			10.43		0.51	2.03
	(4.98)	(–2.57)				(–1.74)	(2.30)	(2.64)			(2.38)			(0.84)			
Brazil	0.37		0.06*	0.67		0.61	0.49		0.05				–0.29	0.35	–0.29	0.76	2.46
	(3.33)		(3.36)	(1.93)		(2.89)	(2.50)		(3.81)				(–2.60)	(2.60)	(–2.75)		
Chile			0.24*	0.60		0.58	–0.25				0.03*		0.09			0.54	1.80
			(2.00)	(2.51)		(2.92)	(–2.59)				(1.68)		(2.66)				
Mexico	0.31	0.23*	0.14				0.79	0.09	0.21						0.12	0.94	1.93
	(6.87)	(4.15)	(2.52)				(2.07)	(5.53)	(14.03)						(1.96)		
Peru	0.38		0.17				0.25		0.09					0.15		0.79	1.79
	(3.71)		(1.76)				(1.41)		(2.00)					(3.29)			

Table A2 (cont)

Pass-through of foreign price and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi_{t-1}	Δcpi_{t-2}	Δcpi_{t-3}	$\Delta fcpi$	$\Delta fcpi_{t-1}$	$\Delta fcpi_{t-2}$	$\Delta fcpi_{t-3}$	Δxr	Δxr_{t-1}	Δxr_{t-2}	Δxr_{t-3}	gap	gap_{t-1}	gap_{t-2}	gap_{t-3}	R^2	Durbin-Watson
Czech Republic		0.29		0.82					0.16		0.11		0.13		0.18	0.71	2.12
		(2.51)		(2.33)					(3.94)		(2.45)		(2.87)		(4.64)		
Hungary	0.49	–0.35	0.39	1.68						0.09		–0.14				0.89	2.20
	(5.37)	(–2.98)	(4.51)	(5.46)						(1.80)		(–3.08)					
Poland	0.25	–0.19		2.69			1.59		0.10			0.34			0.25	0.79	1.96
	(2.55)	(–2.08)		(5.91)			(4.10)		(2.61)			(3.56)			(2.66)		
Turkey	0.24		0.23			0.85	1.98	0.22					–0.25	0.29		0.92	2.05
	(3.13)		(3.66)			(2.77)	(7.27)	(2.96)					(–2.05)	(2.40)			

* Coefficient for $_{t-4}$.

Δcpi = quarterly average change in log of consumer prices; Δfcpi = quarterly average change in log of foreign consumer prices; Δxr = quarterly average change in log of nominal exchange rate; gap = output gap (percentage deviation of actual GDP from potential); t–statistics are shown in parentheses.

Table A2

Pass-through of foreign price and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi_{t-1}	Δcpi_{t-2}	Δcpi_{t-3}	$\Delta fcpi$	$\Delta fcpi_{t-1}$	$\Delta fcpi_{t-2}$	$\Delta fcpi_{t-3}$	Δxr	Δxr_{t-1}	Δxr_{t-2}	Δxr_{t-3}	gap	gap_{t-1}	gap_{t-2}	gap_{t-3}	R^2	Durbin-Watson
India	–0.15	–0.14		0.91				0.20							–0.17	0.78	2.16
	(–1.81)	(–1.70)		(9.17)				(92.57)							(–1.33)		
Korea	–0.77	–0.49	–0.46	0.72	0.78				0.06		0.04	–0.22	0.19		0.13	0.75	1.95
	(–6.44)	(–3.97)	(–3.74)	(2.64)	(3.54)				(4.57)		(2.94)	(–4.49)	(3.13)		(2.71)		
Malaysia	0.28	–0.35	0.26				0.68		0.04	0.04			0.07	–0.07		0.61	2.08
	(2.12)	(–2.83)	(2.25)				(4.15)		(2.73)	(2.24)			(1.94)	(–1.73)			
Philippines	0.32	0.46	–0.23			–0.38			0.04		–0.04			0.15		0.44	1.70
	(2.36)	(3.60)	(–1.91)			(–2.33)			(1.81)		(–2.09)			(1.82)			
Thailand			0.14*	0.93				0.04				–0.06		0.13		0.52	1.73
			(1.59)	(3.70)				(3.00)				(–1.79)		(4.06)			
South Africa	0.66	–0.35				–0.69	0.69	0.04			0.04			10.43		0.51	2.03
	(4.98)	(–2.57)				(–1.74)	(2.30)	(2.64)			(2.38)			(0.84)			
Brazil	0.37		0.06*	0.67		0.61	0.49		0.05				–0.29	0.35	–0.29	0.76	2.46
	(3.33)		(3.36)	(1.93)		(2.89)	(2.50)		(3.81)				(–2.60)	(2.60)	(–2.75)		
Chile			0.24*	0.60		0.58	–0.25				0.03*		0.09			0.54	1.80
			(2.00)	(2.51)		(2.92)	(–2.59)				(1.68)		(2.66)				
Mexico	0.31	0.23*	0.14				0.79	0.09	0.21						0.12	0.94	1.93
	(6.87)	(4.15)	(2.52)				(2.07)	(5.53)	(14.03)						(1.96)		
Peru	0.38		0.17				0.25		0.09					0.15		0.79	1.79
	(3.71)		(1.76)				(1.41)		(2.00)					(3.29)			

Table A2 (cont)

Pass-through of foreign price and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi_{t-1}	Δcpi_{t-2}	Δcpi_{t-3}	$\Delta fcpi$	$\Delta fcpi_{t-1}$	$\Delta fcpi_{t-2}$	$\Delta fcpi_{t-3}$	Δxr	Δxr_{t-1}	Δxr_{t-2}	Δxr_{t-3}	gap	gap_{t-1}	gap_{t-2}	gap_{t-3}	R^2	Durbin-Watson
Czech Republic		0.29		0.82					0.16		0.11		0.13		0.18	0.71	2.12
		(2.51)		(2.33)					(3.94)		(2.45)		(2.87)		(4.64)		
Hungary	0.49	–0.35	0.39	1.68						0.09		–0.14				0.89	2.20
	(5.37)	(–2.98)	(4.51)	(5.46)						(1.80)		(–3.08)					
Poland	0.25	–0.19		2.69			1.59		0.10			0.34			0.25	0.79	1.96
	(2.55)	(–2.08)		(5.91)			(4.10)		(2.61)			(3.56)			(2.66)		
Turkey	0.24		0.23			0.85	1.98	0.22					–0.25	0.29		0.92	2.05
	(3.13)		(3.66)			(2.77)	(7.27)	(2.96)					(–2.05)	(2.40)			

* Coefficient for $_{t-4}$.

Δcpi = quarterly average change in log of consumer prices; Δfcpi = quarterly average change in log of foreign consumer prices; Δxr = quarterly average change in log of nominal exchange rate; gap = output gap (percentage deviation of actual GDP from potential); t–statistics are shown in parentheses.

Table A3

Pass-through of foreign prices and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi $_{t-1}$	Δcpi $_{t-2}$	Δcpi $_{t-3}$	Δfcpi	Δfcpi $_{t-1}$	Δfcpi $_{t-2}$	Δfcpi $_{t-3}$	Δxr	Δxr $_{t-1}$	Δxr $_{t-2}$	Δxr $_{t-3}$	gap	gap $_{t-1}$	gap $_{t-2}$	gap $_{t-3}$	rergap	rer-gap $_{t-1}$	rer-gap $_{t-2}$	R^2	Durbin-Watson
Korea**	–0.68	–0.50	–0.41	0.55	0.77				0.04		0.03				0.17	–0.03			0.80	2.00
	(–6.08)	(–4.62)	(–3.65)	(2.29)	(3.94)				(2.88)		(2.40)				(5.34)	(–2.14)				
Malaysia**	0.33	–0.39		0.54			0.58	0.06		0.05		–0.04				0.08	–0.13	–0.08	0.73	1.96
	(2.70)	(–3.40)		(2.82)			(4.11)	(2.82)		(2.49)		(–2.11)				(3.71)	(–4.75)	(–2.99)		
Philippines**		0.32		0.41				0.10			–0.06				0.22	0.10	–0.16		0.54	1.81
		(2.99)		(2.59)				(2.54)			(2.56)				(2.94)	(2.41)	(–3.98)			
Thailand**			0.17	0.82				0.03						0.11			–0.05		0.62	1.75
			(1.70)	(3.66)				(2.09)						(4.95)			(3.66)			
South Africa**			–0.20*	1.17	0.79			0.04						0.24			–0.08		0.74	1.76
			(–2.62)	(4.37)	(3.89)			(2.70)						(2.92)			(–8.25)			
Brazil			0.12		0.75	1.13	0.27	0.03						0.23			–0.08		0.74	1.79
			(4.85)		(2.01)	(3.92)	(2.31)	(1.95)						(1.95)			(–6.33)			
Chile			0.24*	0.55				0.09		–0.05			0.07			0.09	–0.11	0.04	0.56	2.13
			(2.60)	(2.69)				(2.83)		(–2.15)			(2.47)			(2.28)	(–2.48)	(1.84)		
Mexico	0.38		0.21		–0.47			0.12	0.24			0.19						–0.05	0.92	2.02
	(5.52)		(4.27)		(–1.24)			(6.88)	(11.18)			(2.27)						(–1.80)		
Peru	0.81		–0.12	1.17	–0.50	–0.20	–0.07	0.34	0.06	–0.14			0.22	–0.26		0.33	–0.29		0.98	2.08
	(8.31)		(–2.96)	(9.10)	(–4.61)	(–2.12)	(–2.73)	(5.74)	(1.77)	(–3.18)			(2.45)	(–3.02)		(8.13)	(–5.75)			

Table A3 (cont)

Pass-through of foreign prices and exchange rate changes to inflation for selected emerging market economies, 1994:Q1–2006:Q2

Countries	Δcpi_{t-1}	Δcpi_{t-2}	Δcpi_{t-3}	$\Delta fcpi$	$\Delta fcpi_{t-1}$	$\Delta fcpi_{t-2}$	$\Delta fcpi_{t-3}$	Δxr	Δxr_{t-1}	Δxr_{t-2}	Δxr_{t-3}	gap	gap_{t-1}	gap_{t-2}	gap_{t-3}	rergap	rer-gap_{t-1}	rer-gap_{t-2}	R^2	Durbin-Watson
Czech Republic		0.48		0.67				0.13							0.14		–0.15		0.69	2.16
		(5.02)		(1.98)				(2.79)							(3.65)		(–4.57)			
Hungary**	0.36	–0.24	0.19	1.39				0.34				–0.09				0.32	–0.38		0.94	2.09
	(4.75)	(–2.51)	(2.41)	(5.66)				(5.19)				(–2.26)				(4.30)	(–4.64)			
Poland**	0.14		0.33*	0.94				0.41				0.15				0.47	–0.50		0.94	1.43
	(2.67)		(5.37)	(2.89)				(6.05)				(2.46)				(6.31)	(–7.29)			
Turkey	0.22		0.13			0.58	1.17	0.47				–0.21	–0.20			0.34	–0.43		0.94	2.11
	(3.55)		(2.37)			(2.22)	(4.22)	(8.89)				(–1.91)	(1.85)			(4.54)	(–6.03)			

* Coefficient for $_{t-4}$. ** Includes a time dummy.

Δcpi = quarterly average change in log of consumer prices; Δfcpi = quarterly average change in log of import unit value (expressed in local currency); Δxr = quarterly average change in log of nominal exchange rate; gap = output gap (percentage deviation of actual GDP from potential); rergap = real effective exchange rate gap (percentage deviation of actual rate from potential); t–statistics are shown in parentheses.

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Transmission mechanisms for monetary policy in emerging market economies: what is new?

Miguel Angel Pesce[1]

In recent years the macroeconomic environment in emerging market economies as well as in industrialized countries has become more stable in terms of price stability and growth. Nevertheless, international financial markets continue to be a source of uncertainty that poses important challenges for monetary policy, particularly in developing economies. The rapid integration of financial markets has led to increased capital flows and higher liquidity, which contributed to global growth but has also permitted current account imbalances on an unprecedented scale, whose correction, if sudden and unexpected, could be harmful and costly for emerging markets.

The improvements in fiscal policies have been remarkably important, leaving monetary policy plenty of room for playing its role in stabilizing the economy by providing it with a nominal anchor. The movement towards a more active stabilizing role of monetary policy came along with more exchange rate flexibility.

There is no conclusive answer to the question of whether in developing countries, as well as in industrialized ones, greater openness and trade integration have been key factors behind improvements in inflation. The continuous rise in exports by China, India and other countries from East Asia and Eastern Europe clearly became a source of downward pressure on the prices of a wide range of goods and services. Whether or not this has in fact contributed to the present environment of low inflation, there are significant implications for the conduct of monetary policy. There is also a strong and unfinished debate around the role to be played by money and the conduct of monetary policy in an environment of higher globalization.

In the case of Argentina, after 10 years under a currency board regime in which the monetary policy was passive, in January 2002, in the middle of a very deep currency and financial crisis, there was a move in the direction of exchange rate flexibility and monetary policy became active. It is important to recall that the economic recession that began in 1998 shocked the financial sector, reducing the real volume of banking credit to the private sector by practically two thirds. The ratio of bank loans to GDP fell from 24% at the beginning of 1999 to 8% towards the end of 2004.[2]

In that setting, the process of rebuilding monetary capacity had to be gradual, since no instruments or markets were available for the Central Bank of Argentina (BCRA) to influence the demand for funds in the financial system at that moment. At the peak of the financial crisis, the channels of monetary policy did not work.

During the first months of 2002, policy actions were implemented to handle the peak of the crisis in order to stop both the fall of the peso and the persistent drain of money from banks. The BCRA first focused on providing liquidity to financial institutions as much as required to avoid a massive bankruptcy and to stabilize the exchange rate market.

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[1] Central Bank of Argentina.

[2] Due to the crisis, in 2002 the GDP fell 10.2%, inflation went up to 65%, the peso fell around 300% in just four months, open unemployment skyrocketed to 25%, and poverty and indigence indicators reached record levels of 55% and 30% respectively.

An initial step to get some control over monetary aggregates was to set up a market for BCRA notes and bonds (LEBACs), mainly in pesos, which at that time allowed the BCRA to sterilize the monetary effects of assistance to financial institutions. This policy was extremely successful in stabilizing expectations and preventing hyperinflation after the sharp depreciation that the peso had suffered during the first quarter of 2002.

Once the BCRA was able to stabilize expectations and get control over the situation of financial institutions, it recovered a certain capacity to manage the supply of base money so as to preserve certain equilibrium with the demand for funds. Since the interbank market was virtually non-existent at that time, the BCRA did not have enough capacity to influence liquidity through a reference rate. In the face of these restrictions the BCRA decided to conduct monetary policy using an intermediate quantitative monetary target, which since 2002 has been set under an annual Monetary Program (PM).

During 2003 and 2004, the central bank designed a Monetary Program, presented to the Congress, based on intermediate targets for the broad monetary base (BMB) and other monetary aggregates. These quantitative targets are consistent with the inflation target, which is one of the main objectives of monetary policy. The targeting of money aggregates is consistent with BCRA forecasts for the growth in money demand and for real GDP, and with the inflation objective of the BCRA.

Initially, the target was set for the BMB, the monetary aggregate which the BCRA had the most ability to control for two reasons. The first reason was the huge contraction of the banking system after the 1998–2001 crisis. The extremely poor impetus of lending activity kept the monetary multipliers at low and stable levels, so that the MB summed up most of the relevant information about the state of monetary aggregates. The second reason was the immediate availability of data on the BMB, so that the BCRA could very rapidly inform the public of the performance of the Program, to help to build up its credibility.

In 2006, based on the empirical evidence that the demand for M2[3] seemed to be more related to its inflation goal, CPI inflation, and once money multipliers began a clear recovery, the focus for tracking compliance with the Program shifted from the BMB to M2. This change was in response to the positive transformations observed in the banking and financial system during recent years and will result in a better adjusted control of monetary variables than that allowed for by the BMB.

Thus, the approach of the BCRA during this transition process to a more active role for monetary policy has been gradual and pragmatic. This strategy, which is still at work, recognizes the various uncertainties faced by the BCRA. It is widely accepted by policy-makers and academics that, in a world of globalized financial markets, central banks have to deal with unexpected changes in the international environment. At the same time, monetary policy is also facing uncertainty related to the weak knowledge a central bank has about the real model that governs its dynamic interactions with the domestic private sector.

The particular complexity of the local financial system, the lower degree of monetization in the economy, the long periods of macroeconomic instability and the most recent crisis in the banking system all suggest that the problems the BCRA faces are much tougher. It is clear that the frequent structural changes in Argentina make it even more difficult to interpret the evidence shown by its monetary history.

As mentioned above, the passive monetary policy implemented during the period 1991–2001, as well as the lasting effects of the currency and financial crises of 2002 on agents' behavior, added important additional uncertainties. In particular, on the way out of the crisis,

[3] Means of payments which include the cash held by the public plus the deposits in current and savings accounts, in pesos, of the private and public sectors.

the BCRA did not have much knowledge of the probable effects of its own policy actions on the behavior of economic agents.

The BCRA had to rebuild the instruments and channels of monetary policy, not only because of the disruption created by the currency and financial crises that began in 2001, but also because the focus of the Bank in the past decade had been rather different.

That undertaking has been a main task for the BCRA since 2002. As mentioned before, the market for notes and bonds of the central bank, LEBACs and NOBACs, has been steadily developing as from that year (Figure 1).[4]

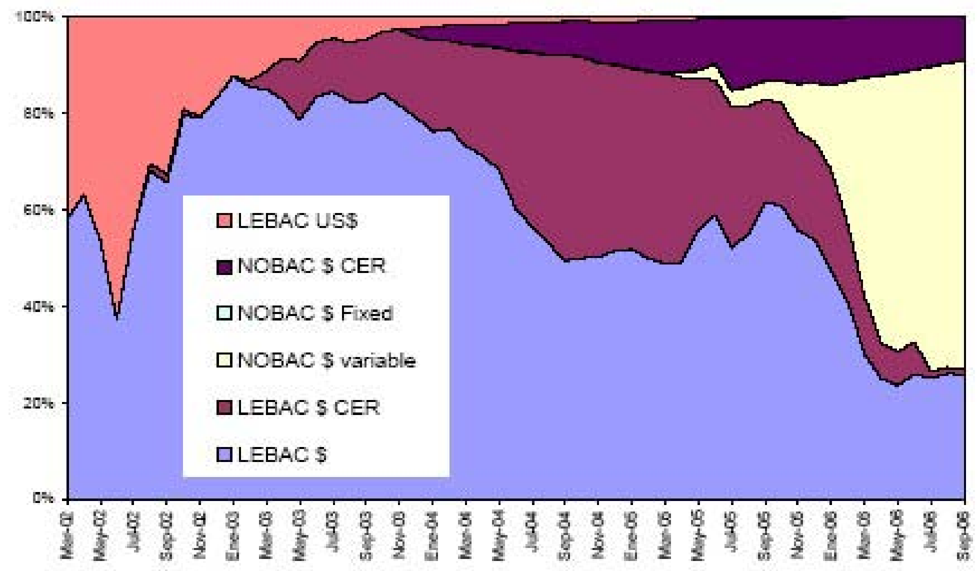
The issuance of central bank notes initially addressed compensation for the expansionary effects of the financing to banks during the crisis and the massive selling of foreign reserves to sustain the value of the peso. In a second stage, it has been used as an instrument to offset the expansionary effects of the precautionary policy of reserve accumulation developed by the BCRA, thus preventing monetary aggregates from deviating from the target.

The central bank has also started active intervention in the repo market to increase the responsiveness of the interbank credit market, which shows strong signs of segmentation. Such intervention, along with the deepening of the market for central bank notes (LEBAC and NOBAC bills) has been helping to generate a benchmark interest rate. The signals are sent by means of an interest rate range (floor and ceiling around the reference rate) that makes it possible to lower the volatility of the interest rate and regulate money market liquidity more efficiently. During this process, the BCRA has also been able to extend the maturity of its debt, creating instruments that help monetary policy influence longer-term interest rates and thus be more effective in affecting investment, consumption and saving decisions.

Figure 1

Central bank instruments

Share of total



4 Starting in April 2002, the BCRA issued different types of notes and bonds in different periods, adapting its strategy to market conditions (the BCRA issued instruments denominated in pesos and in US dollars, at fixed and variable rates).

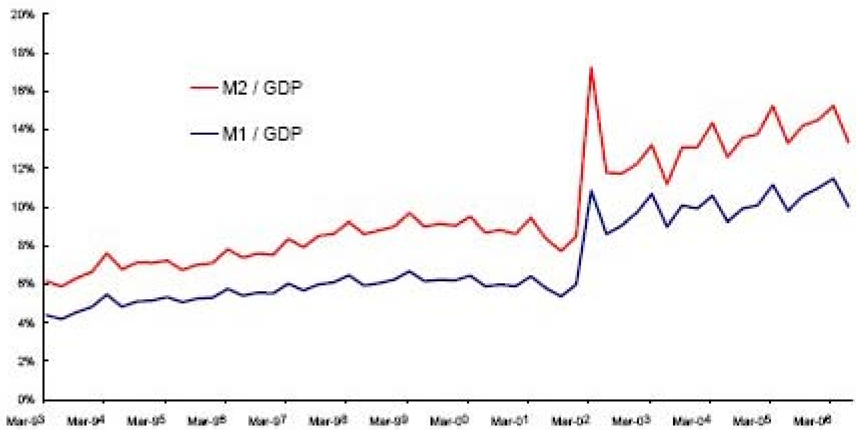
Repo transactions are carried out through the REPO trading session of the electronic over-the-counter market (MAE). Transactions are in pesos, have maturities of up to 30 days, and are settled with non-indexed LEBACs as the underlying asset, with a 10% haircut (the value of the underlying asset delivered in excess of the pesos received). With the aim of regulating liquidity in the money market, the BCRA carries out both repos and reverse repos.[5]

As stressed before, the BCRA had to build knowledge about how monetary impulses are transmitted to the real economy and inflation. Although during times of regime change past history could not be very informative about the current channels of monetary policy, the BCRA has conducted some empirical research on the transmission of monetary impulses to the economy.[6] During the period of low inflation (1993–2006), inflation responded significantly to interest rate shocks, money growth and nominal exchange rate volatility, in that order.

The results of the research indicate that the interest rate channel is important in the transmission of nominal shocks to the real economy and inflation. (Figure 2 illustrates trends in money aggregates.) Money aggregates respond negatively, as expected, to shocks to the nominal interest rate. The response is rapid and persists for two quarters. Impulses on the interest rate also have a rapid negative effect on GDP growth. In this case, the effects of the shock remain significant over three quarters. Shocks to money aggregates (money for transactions as measured by M1) have a positive but much weaker impact on GDP, and their effect lasts for only one quarter. The exchange rate channel also appears to be significant.

Figure 2

Ratios of M1 and M2 to GDP



The success of a central bank in ensuring price stability largely depends on its ability to guide and coordinate expectations. As part of an effort in this direction, the BCRA has developed a Market Expectations Survey (REM). The results of this survey are systematized and published by the central bank, in order to make available to the general public forecasts of main macroeconomic indicators produced by a large group of private consultants, commercial and investment banks as well as academic institutions. The survey summarizes

5 In the former (repos) the central bank receives pesos and delivers LEBAC spot, producing a contraction of the monetary base (which naturally implies an expansion of the monetary base when the deal matures), and consists in the exchange of one short-term monetary liability for another. In the latter (reverse repo) the central bank delivers pesos in exchange for LEBACs, increasing the monetary base through the spot sale.

6 See Basco, D’Amato and Garegnani (2006) for further details.

relevant information about market expectations and has become an important reference point for domestic and international economic analysts. The results of the survey are also used by the central bank in its assessment of the cyclical position of the economy.

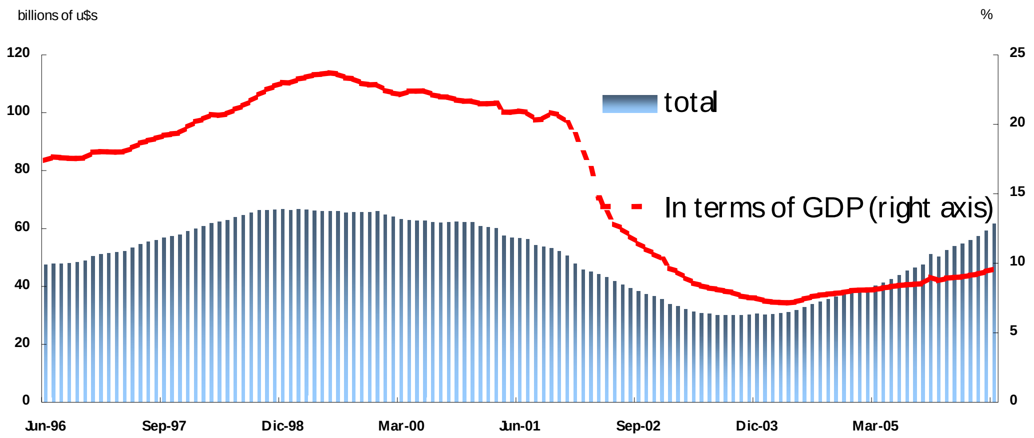
It is important to stress that (despite the research noted above), given the low degree of capital deepening and the reduced ratio of private credit to GDP since the 2001–2002 crisis, changes in interest rates have a larger effect in the short run on output than on headline inflation. At the same time, the above-mentioned lack of full understanding of how transmission mechanisms, which are not independent from politics, operate and the fact that they are far from being stable in time, limited the scope of monetary policy as an instrument for stabilizing economic activity during the first year after the crisis.

With the progressive recovery of financial intermediation, money multipliers are recuperating from the low levels reached during the financial crisis. As public confidence in the domestic currency and the local financial system returned, along with a sustained upturn of the real economy, financial markets began to recover, and the central bank has been gradually gaining control over developments in money and credit markets. The improvement of financial intermediation will also allow the credit channel to play a greater role in the transmission of monetary impulses to the economy. Since the end of 2004, credit to the private sector has been growing very rapidly, at an annual average growth rate of around 30%. This recovery has been led by short-term credit to firms and households while the upturn of mortgages seems to be slower. Despite the strong growth that the sector showed in the period 2005–2006, it can be seen from Figure 3 that the ratio of private credit to GDP is still at low levels (around 10%).

Figure 3

Loans to the private sector

Monthly average



Source: BCRA.

The crowding out by the public sector during the last decade has been a steady concern of the central bank in the last four years. The proportion of public sector debt in banks' total asset portfolio increased dramatically in the nineties. With the recovery of the real economy, the rise of private sector credit demand in conjunction with a better regulatory framework allowed banks to reduce their exposure to public sector debt, but the share of such debt in total assets is still high. It can be said that the recovery of the real economy after the crises was mainly based on self-financing by firms and households.

In order to help banks recompose their portfolios, the BCRA allowed them to adjust the value of their bond holdings as to make them converge to market value in 2007. Taking into account that the central bank wants to prevent banks from being excessively exposed to government debt risk as they were in the past (particularly during the late nineties), important changes have been introduced in prudential regulations: government debt holdings in banks' "banking book" are now subject to capital requirements that gradually converge to the Basel standard (8%). This is a recognition of the risky nature of this asset and the need to prevent banks from taking excessive risks. Additionally, the central bank imposed a global limit of 35% for the total exposure of banks to the public sector.

The BCRA is also developing policies to stimulate bank financing to the private sector, both households and firms, while managing banking risks. For households and small enterprises the central bank encourages the use of mathematical techniques, such as credit scoring, which require less specific information on debtors. For mortgages, a higher loan to value ratio was allowed for tenants with a good rent payment history who do not own a home. Incentives for banks to lend to private sector firms and to extend the maturity of such loans have also been provided.

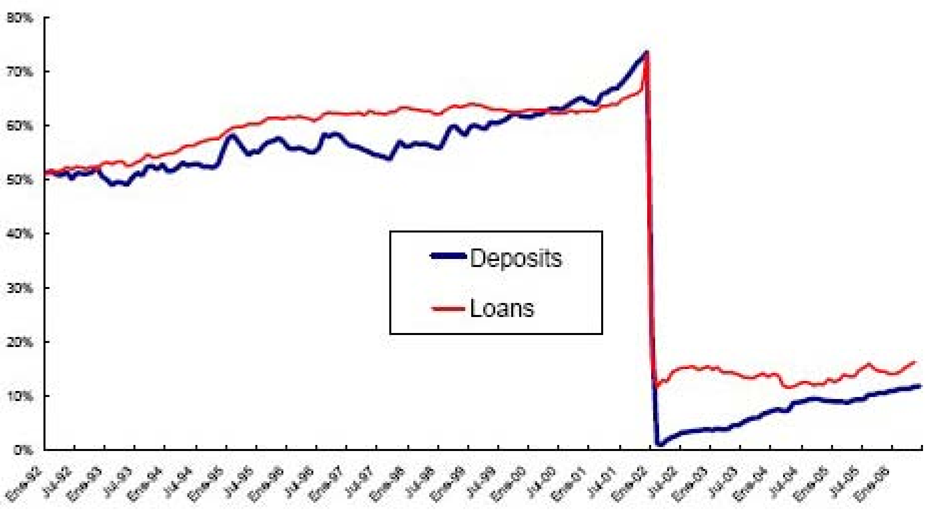
In order for monetary policy to be fully effective, domestic currency must recover a major role in transactions and savings. The Argentine economy, and in particular the financial system, were highly dollarized (Figure 4). It is important to stress that in a highly dollarized economy the speculative money demand is made in a foreign currency. So when macroeconomic volatility rises and general confidence in the price of domestic assets falls, there is no demand for local currency but only for foreign currency. The result is that a financial crisis triggers an external balance crisis.

After the currency and financial crises of 2002, an active process of de-dollarization of financial assets began. The abandonment of the currency board alone implied the end of the implicit currency insurance created by the Convertibility Law. The central bank accompanied this process with several regulatory changes aiming to de-dollarize bank balance sheets and prevent them from taking excessive currency risk.

On the one hand, financial restrictions were introduced on the use of dollar deposits and higher bank reserves were required against such deposits. Restrictions were also imposed on the allocation of foreign currency denominated deposits by banks. Such deposits now can only be applied to financing tradable sector firms or to long-run investment projects which foster export sector production. The measure seeks to prevent the solvency risk created in the previous decade by unrestricted foreign currency financing to debtors whose income was denominated in the domestic currency.

Figure 4

Dollarisation ratio



Finally, it is important to mention that the de-dollarization of financial assets has been significant: the share of peso deposits to total deposits increased from 34% in 2001 to 90% at the end of 2006.

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Brazil: taming inflation expectations[1]

Afonso S Bevilaqua[2], Mário Mesquita[3] and André Minella[4]

Introduction and background

Brazil adopted inflation targeting (IT) in the aftermath of the devaluation and floating of the real in 1999.[5] The new regime was instrumental to anchor expectations after the collapse of the nominal exchange rate peg, and marked a substantial improvement regarding the transparency of monetary policymaking in Brazil. Initial concerns about fiscal dominance proved unfounded, as fiscal policy was strengthened in line with the requirements of the new regime. Instead, the early years of IT in Brazil were marked by three waves of currency depreciation, to which monetary policy reacted.[6] The Brazilian real (BRL) weakened by 48.9% in 1999, by 18.5% in 2001 and by 53.2% in 2002. While there were signs, and consensus amongst analysts, that the real had been substantially appreciated before the float, the exchange rate moved progressively towards equilibrium in the following couple of years, so that the potential inflationary impact of additional depreciation, and the actual fallout, became gradually more severe. For 2001, for instance, the Central Bank of Brazil (BCB) estimated that inflation would have been 4.8% in the absence of exchange rate depreciation, not too far from the 4% target, as opposed to the 7.7% actual rate (Figure 1).

Since the beginning of the IT regime, inflation expectations have played an important role in the policymaking process. Regular surveys of market expectations on inflation, taken amongst some 100 professional forecasters, mainly financial institutions, have been compiled since the early years of the regime and a summary of consensus macroeconomic forecasts is published weekly.[7] In order to strengthen incentives for accurate reporting of forecasts, the BCB regularly publishes rankings of the best short- and medium-term forecasters of several variables. The survey system in place has been considered exemplary and has been imitated by other central banks.

Simply put, the BCB's monetary policy committee (Copom) guides its policy decisions by its own forecasts for inflation in the relevant time horizon and the prospective balance of risks. Market expectations of inflation are important inputs in the BCB's forecasting models, as is usual in this framework. Expectations, in turn, have been influenced by past inflation

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[5] The first two sections draw heavily on Bevilaqua and Loyo (2005).

[6] Bevilaqua and Azevedo (2005) describe foreign exchange developments during this period.

[7] In addition to forecasts of various inflation indices (annual and monthly), the weekly publication includes annual forecasts of interest rates, exchange rates, the trade and current account balances, FDI, GDP growth, industrial production, and net public sector debt. The BCB's website (www.bcb.gov.br) contains daily data on median, average, and standard deviation of inflation forecasts, starting, for the official inflation index, in January 2000. A fledgling market for long-dated inflation-linked government bonds in principle creates scope for derivation of inflation expectations from asset prices. However, relatively low liquidity at time horizons that are policy relevant has so far limited the reliability of these indicators.

behavior, the inflation targets, exchange rate and commodity price developments, economic activity, and the stance of monetary policy. Recursive estimates suggest that the backward-looking component of market expectations has been ceding ground to the inflation target, evidence that the IT system is gaining credibility. Nevertheless, as will be seen below, credibility has not been perfect, so oftentimes inflation expectations seem to have over-reacted to current developments, in particular to upward inflation surprises. Thus, the BCB often had to act so as to prevent negative short-term developments from contaminating the medium-term outlook. In this sense, the process of disinflation has been, and still is, a process of taming inflation expectations.

2003: disinflation and recovery

The 2002 sudden stop of capital inflows and consequent currency depreciation left a burdensome legacy for monetary policy. The BCB's challenge was to undertake major disinflation in an environment of limited credibility ("conservative" monetary policy having been a constant focus of heavy criticism by the political party that won the elections of that year), and after inflation expectations had shifted upwards in an apparently persistent fashion. The monetary policy response began before the political changeover was completed, in an off-schedule meeting of the monetary policy committee on October 14, 2002, when the basic interest rate was hiked by 300 basis points to 21% pa. This was the first and last, to date, Copom meeting outside the pre-announced schedule since the beginning of the IT regime. Monetary tightening continued until February 2003, with a cumulative 550 basis point increase in the basic interest rate, which peaked at 26.5% pa, complemented by an increase in the reserve requirements of commercial banks.

Given Brazil's history of chronically high inflation, which both thrived on and fostered sophisticated indexation techniques, monetary policymakers naturally had a stronger preference against too gradual a disinflation process, even if that might have been desirable from the viewpoint of minimizing GDP volatility – and even this last point is questionable.[8] Issues of credibility also argued for faster rather than more protracted disinflation. First, despite the new government's commitment to fiscal austerity, confirmed by the increase in the target for the primary (before interest spending/revenues) surplus of the consolidated public sector from 3.75% of GDP in 2002 to 4.25% in 2003, there was still concern about fiscal dominance. The argument was that monetary tightening would worsen debt dynamics, thereby leading to BRL depreciation and higher, rather than lower, inflation.[9] Another line of reasoning, which is still recurrent in Brazil, despite the results of recent years, refers to monetary policy ineffectiveness, presumably derived from blockages in the transmission mechanism (low credit-to-GDP ratios and limited if not perverse wealth effects owing to a large share of floating rate public debt) and the presence of indexation of utility rates and other contracts.

Thus a strategy of relatively rapid disinflation was adopted and implemented, in spite of difficult initial conditions. The average monthly inflation rate between October 2002 and March 2003 was 1.9%, or some 25.5% in annualized terms, and inflation expectations for 2003 continued to worsen until late April, peaking at 12.5%, compared with an (adjusted) inflation target of 8.5%, with expectations for 2004 at 8.0%. It was only when Copom decided, in its April 2003 meeting, against tremendous public outcry, to keep the basic Selic rate unchanged at 26.5% pa for the third month in a row, that monetary resolve showed

8 Ball (1994).

9 Blanchard (2005).

signs of paying off by lowering expectations. These started subsiding for both the 2003 and 2004 horizons.[10] The Selic went unchanged again in May, and by the June policy meeting market expectations for 2003 and 2004 had receded to 11.7% and 7.4% respectively. Copom opted for a modest 50 basis point rate cut in June. When the committee met in July, expectations had fallen to 10.4% for 2003 and 6.5% for 2004, which prompted a further 150 bp rate cut, bringing the Selic to 24.5% pa.

A powerful signal that the government supported the disinflation strategy was given in late June, when it set a 5.5% official inflation target for 2004 (remember that inflation was 12.5% at the end of 2002) and a 4.5% target for 2005, both with a tolerance margin of ±2.5%. The fruits of assertive monetary policy became apparent by mid-year, when monthly inflation, helped by appreciation of the BRL, was very low (there was actually deflation in June) (Figure 2). As would recur in the following years, this quickly elicited claims that inflation was dead in Brazil, and that the way was already open for even faster monetary easing. Copom's interpretation of events was that the mid-year collapse of inflation was a transitory event. The committee took comfort instead in the fact that, indeed, estimates of inflation persistence were on the way down, auguring well for further disinflation.

At that stage the challenge was to calibrate the pace of monetary easing so as not to put the disinflation process at risk. BCB officials signaled, through statements and Copom minutes, that rate cuts would continue as long as disinflation progressed but that the reduction would follow a gradual approach. A special effort was made to spread the familiar message that monetary policy affects the economy through shifts in the entire term structure of interest rates, which in turn depends on the overnight rate as well as on where markets think overnight rates will be in the future. In a process of disinflation, the current Selic rate was, by itself, a particularly poor measure of the policy stance, as market rates for longer maturities, which are the ones relevant for the pricing of bank credit, already incorporated expected rate cuts. Too steep a (negatively sloped) yield curve could undermine the intended contractionary stance, and therefore jeopardize the disinflation path.

With actual twelve-month accumulated inflation averaging 3% pa between June and November 2003, inflation expectations fell sharply, creating scope for significant easing. From the beginning of the easing cycle to November 2003, the nominal Selic was cut by 900 bp, and the one-year nominal rate fell by 820 bp, while the inflation-adjusted one-year rate fell by almost 500 bp. There was, thus, substantial monetary stimulus already in the pipeline.

Towards the end of the year inflation expectations for 2004 were close to 6% pa, compared with a target of 5.5% for the year and with 8% expected in the beginning of the year. Expectations for 2005 were at 5%, higher than the 4.5% target, but also lower than they had been at the beginning of the year. Under these circumstances, another rate cut of 100 bp was undertaken. By that time it was apparent that the economy had recovered fairly rapidly from its early 2003 slowdown. In fact, after contracting in 2003Q2 and growing by just 2% in annualized terms in 2003Q3, growth surged to about 7% in the last quarter of the year.

2004: inflation rebound and policy response

Inflation had accelerated in late 2003 and early 2004, activity was strengthening at a healthy clip, and a substantial share of previous monetary impulses was yet to feed through the

[10] Targets are set by the National Monetary Council (CMN) in June for the inflation of the calendar year, two years ahead. However, in January 2003, the BCB announced that it would follow an adjusted target of 8.5% for 2003 and of 5.5% for 2004.

economy. In that environment, after a pause in the January meeting, Copom cut rates again in March and April, now by a more parsimonious total of 50 bp. During the early months of 2004, rising prices of manufactured goods at the wholesale level posed a short-term risk for consumer price inflation. However, expectations for consumer price inflation remained stable throughout March and early April, which suggested that current inflationary pressures would not have a lasting impact.

The outlook for inflation worsened substantially thereafter, under various negative influences. The most visible, albeit not the sole, trigger for this process was a sudden, sharp, depreciation of the real ahead of the beginning of the cycle of monetary tightening in the US. The sovereign spread widened from 559 bp at the end of March to 650 bp at the end of June, and the exchange rate, which had been relatively range-bound around BRL2.90/USD since the beginning of February, rose to BRL3.20/USD within a few weeks. Interestingly, these movements were soon reversed, as the country's improved balance of payments position reasserted its influence over asset prices. Nevertheless, the damage on the inflation front was more lasting, and would eventually elicit a policy response.

Inflation expectations for 2004 had been stable, a little over 6.0%, compared with a target of 5.5%. Similarly, expectations for 2005 were stable at 5.0%. Revisions to forecasts in the first fourth months of the year mostly reflected short-term inflation surprises and had not impacted the public's medium-term inflation scenarios. This changed in May, when depreciation of the real, in an environment of strong economic activity, led to increased projections for changes in wholesale prices and in so-called managed prices.[11] Inflation expectations for the coming twelve months increased from 5.5% at the time of the April policy meeting to 5.7% in the May meeting, and to 6.0% at the time of the June meeting, months in which the basic rate was unchanged. Heightened uncertainty regarding the external scenario, thanks to the looming Fed tightening, translated into increased uncertainty about the domestic inflation outlook, impacting the targets' role as an attractor to market expectations. The influence of current and expected BRL depreciation over the inflation outlook called for additional policy caution. In sum, not only was there an upward shift in the path of expected inflation, but uncertainty surrounding this path was also increasing.[12]

It is worth stressing that currency depreciation was not the only issue, as other factors were also important drivers of the process. As of mid-2004 the economy was growing by about 5% pa, after two quarters expanding by close to 7% pa, signaling that the output gap was probably closing. Moreover, indices of capacity utilization in manufacturing were above historical averages, in some sectors actually reaching unprecedented levels. Clearly, these signs suggested that currency depreciation and rising commodity prices hit an economy where firms faced favorable conditions to increase their prices.

At the end of June the National Monetary Council (CMN) set the inflation target for 2006 at 4.5%, and narrowed the tolerance interval to ±2%. By that time, the prospects for further easing had dimmed, and market participants began to ponder, and price in, the eventuality that a new cycle of tightening might be needed to ensure convergence of inflation to the targets (Figure 2). Inflation expectations continued to increase, from 6.1% as of the July

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[11] About a third of the official inflation index, the IPCA, consists of prices that are set by contracts rather than by the interplay between current demand and supply. These prices are dubbed "managed". Said contracts often include backward indexation clauses, linking the change in managed prices to the accumulated changes in the IGP-DI family of inflation indices, in which wholesale prices dominate, and which are themselves highly sensitive to exchange rate changes, as they have an important commodity component. Thus, real depreciation and/or increases in international prices of export commodities tend to have a meaningful lagged impact on managed prices.

[12] The standard deviation of twelve-month ahead inflation expectations, for instance, rose from a 0.43 pp average in April to a 0.76 pp peak around the September meeting.

Copom meeting to 6.2% in August, with the basic rate still unchanged. Continuously deteriorating market expectations indicated that inflation, without policy intervention, would not slow down on its own, and would not converge towards the targets.

Thus, in September the basic rate was increased to 16.25% pa, the beginning of the first cycle of monetary tightening under the inflation targeting regime that was not a consequence of financial distress (after peaking at around 700 bp at the end of May, the sovereign spread was below 500 bp by September; similarly, the real had strengthened from BRL3.19/USD to BRL2.86/USD).

Clearly, given the lags in the transmission mechanism of monetary policy, it was important, at the time, to signal to the public what would be the strategy to bring about convergence towards the 4.5% targets for 2005–06, as it was clear that inflation was going to deviate substantially from the targeted path in 2004. Therefore, in the September meeting minutes Copom outlined a gradualist approach to deal with the consequences of the expected overshoot of inflation in 2004. The committee estimated that regular inflationary inertia stemming from the expected 2004 overshoot would amount to 0.9% in 2005. Making use of the flexibility inherent in the inflation targeting regime and in a manner consistent with maximum transparency, the committee opted to accommodate 2/3 of this inertia, namely adopting an explicit policy objective of 5.1% inflation in 2005, rather than the 4.5% target midpoint. This was tantamount to extending the length of the convergence period from 12 to 24 months, as the target for 2006 remained unaltered.

More important, by committing to a 5.1% objective for 2005, Copom indicated that it would not allow inflation to remain close to the top end of the acceptable range, the 7% neighborhood to which market expectations seemed to be converging. Besides laying out clearly its baseline disinflation objectives, Copom announced that it would respond asymmetrically to shocks that could disturb the baseline trajectory, remaining particularly vigilant against the effects of shocks that threatened to increase the deviation of inflation from the original targets, while taking full advantage of favorable shocks that might help bring inflation down towards those targets.

Monetary tightening had limited initial impact on inflation and inflation expectations. In the last three months of 2004, annualized core inflation was running at around 7.5% pa, and rising. Inflation expectations for 2005 were hovering at 5.8%, higher than before the beginning of the cycle, despite various factors that might have helped, such as a tighter policy stance, currency appreciation, signs of accommodation in economic activity and lower international prices of some important commodities. Market participants and professional forecasters were clearly skeptical about the prospects for disinflation.

This skepticism had several causes, in addition to the inevitable credibility issues in a regime that had faced so much turbulence in its early years and in which institutions were still evolving. As the balance of payments continued to improve and asset prices to rise, the link between the basic interest rate and market rates appeared to have become weaker than in previous cycles, in a Brazilian version of the yield curve “conundrum”. Three months after the 2001 tightening cycle had begun, for instance, the spread between the one-year rate and the basic rate stood at 540 bp, and the ex-ante real one-year interest rate had increased by 630 bp.[13] This time, after three additional basic rate hikes, the yield curve had flattened, and the increase in the one-year real interest rate was just 40 bp. Moreover, buoyant asset prices contributed to preserve private sector wealth as well as consumer confidence, which may have further hindered the transmission of the monetary tightening.

[13] The spread was also very wide, some 360 bp, at a similar point in the 2002–03 tightening cycle.

Last, but not least, institutional changes adopted in 2003 began to take effect, fostering credit growth, especially to the household sector, thereby supporting the demand for consumer durables.[14] New lending to households increased by 9% between the third and fourth quarters of 2004, against an increase of 6% in the same period of 2003, and year-on-year growth in the stock of credit to households reached 37.8% in December 2004, compared with 29.3% in September.

As of the December policy meeting, when the Selic was increased by 50 bp to 17.75% pa, there were as yet no clear signs of convergence to the inflation target path.

2005–06: consolidating disinflation

The first quarter of 2005 finally brought some relief on the inflation front, with longer horizon projections by the BCB as well as independent analysts pointing to slower price increases. However, annualized core inflation was still at some 7.8%, far from the target path. Despite improvements in the medium-term outlook, market participants were still revising upwards their inflation expectations for 2005, from 5.7% in December 2004 to 5.9% in March, away from the policy objective. In this scenario the basic interest rate increased by an additional 150 bp, in three monthly installments of 50 bp, during the first quarter.

By the second quarter of 2005 monetary policy was at a crossroads. Forward looking analysis and model projections of inflation by BCB economists were pointing towards convergence to the target sometime in 2006, but current rates of inflation remained stubbornly high. Moreover, under the influence of negative current inflation data, inflation expectations of independent analysts were still diverging from the targets. Specifically, inflation expectations for the twelve months through December 2005 were moving towards 6.5%, compared with the policy objective of 5.1% and the original target of 4.5% for the year (Figure 3). Thus, in April and May the basic rate increased by 50 bp more. These not entirely anticipated policy moves strengthened the perception, amongst market participants, that Copom would not allow inflation to become entrenched above the targeted path.

During the disinflation process, when central bank credibility is still being established, inflation expectations tend to over-react to current developments. This reinforces the case for a commitment by policymakers to allow positive surprises to be fully incorporated into firms' price setting decisions, while actively counteracting negative surprises. The authorities' avowedly asymmetric stance meant that a series of favorable inflation surprises, in June, July, and August, led to a sharp fall in the mean and dispersion of inflation expectations, as convergence toward the target accelerated (Figure 4). It is not that the last couple of 25 bp rate hikes broke inflation inertia, but rather the cumulative effect of previous policy moves combined with the signaling effect of these last few increases seem to have done the trick.

Currency appreciation, on the back of strong balance of payments fundamentals, contributed importantly to the process, as part of the transmission mechanism in an open economy, with tradable goods prices leading the disinflation process. Although tradable goods initially led the way towards the inflation targets, the stance of monetary policy helped to spread the disinflation process to the prices of nontradables, including services.[15]

With rates unchanged until September, the disinflation process was consolidated during the middle of 2005, when the economy was cooling off. In fact, GDP growth would fall from an average of 3.2% in the first half of the year to 0% in the second half. The argument for

[14] Expansion of payroll backed loans, regulated by a 2003 law, was, and remains, particularly strong.

[15] See the box "Preços de Itens não Comercializáveis – Evolução Recente" in Banco Central do Brasil (2006).

persistence with a firm monetary policy stance, even in the face of a temporary deceleration of growth, stressed the fact that the BCB was already pursuing an objective that exceeded the target set by the National Monetary Council, and that, while moving towards the targeted path, inflation expectations, and inflation itself, were even higher than the 5.1% objective (inflation ended at 5.7% for the year as a whole). Moreover, there was in that period no major supply shock that would justify reconsidering the announced strategy and allowing inflation to drift towards the upper limit of the ±2.5% band. The authorities' stance, in sum, tried to ensure that the Brazilian inflation targeting regime began to see inflation hovering around the central target, instead of permanently moving between the central target and the ceiling of the acceptable range. Short-term costs, in terms of foregone economic activity, should be seen as an investment in stability, one that would pay off in the years to come through increased monetary policy credibility and effectiveness, and a reduction in the inflation risk premium would lead to lower real interest rates in the medium term, and hence faster growth.

By September 2005 inflation expectations for 2006 were down to 4.6% (Figure 3), close to the 4.5% target, and a new process of monetary easing could begin with a 25 bp rate cut. This was followed by additional cuts of 150 bp in the last three policy meetings of the year. In October 2005 Copom announced that, thanks to the economy's reduced vulnerability to shocks, it would lower the frequency of its meetings from twelve to eight per year – every 45 days or so – starting in January 2006. The easing cycle that began in the third quarter of 2005, and which continues to this day, has been the first sustained monetary relaxation process under the IT regime that did not coincide with the recovery period after a financial crisis, and as a result saw smaller initial changes in asset prices. In spite of the apparent effects of monetary policy shifts on the relevant macroeconomic variables, the old theme of ineffectiveness emerged again during the course of the ongoing cycle.

Because the previous easing cycle (2003–04) had been largely anticipated by the markets, the yield curve became inverted in the second quarter of 2003, leading to a fall in the cost of credit, which drove a recovery from the third quarter of that year. The same type of anticipation happened in 2005. Longer rates (specifically the 360-day swap rate) began to fall by April 2005, five months before the actual beginning of the easing process, and, as seen above, at about the same time as inflation started to turn around. Understandably, however, this effect was more muted than in 2003, when the basic rates had been raised much higher: when the 2003 loosening cycle began, the spread between the long rate and the basic rate was –330 bp; in the beginning of the current cycle this spread was –159 bp. In both episodes, the yield curve would gradually become less inverted, but this flattening move started earlier in the 2003–04 cycle.

Thus, neither was the qualitative behavior of the yield curve in 2005 a novelty, nor was the fact that longer rates started falling ahead of the basic policy rate and that their fall slowed down while the basic rate kept being reduced proof of any decline in policy effectiveness. On the contrary, longer rates seem to have become, if anything, more sensitive to actual and expected changes in the basic interest rate. This, in turn, is consistent with the hypothesis that monetary policy has gained credibility and works through smoother movements in the basic rate, and also with a scenario in which, with lower macroeconomic vulnerability to shocks, risk premia are smaller and less volatile.

Copom continued to cut the basic interest rate aggressively throughout the earlier part of 2006, bringing it back to 15.25% pa in May, until then the minimum under the IT regime. At that meeting the committee reduced the pace of easing, from 75 bp to 50 bp. The move had been signaled in the minutes of previous policy meetings, and was anticipated. Yet, the decision came during a period of stress in international financial markets that led to a spike in local market rates, so some market participants actually positioned themselves for a cut of just 25 bp or even a pause in the process. Yet the economy had, basically through substantial external deleveraging, become more resilient to mood swings in international markets, and asset prices soon recovered as it became clear that the changing international scenario would not jeopardize access to the necessary external funding.

Rather than the external scenario, at that stage the main risks to an otherwise benign inflation outlook referred to the transmission mechanism of monetary policy and the behavior of commodity prices, especially oil. Given the relatively short time series, estimates of the lags of the transmission mechanism are inevitably less robust for Brazil than for economies with a longer history under the monetary policy regime in force. Moreover, recent innovations in the credit market have the potential to impinge on the transmission mechanism. In addition, the easing process has lasted for more than a year, and has brought nominal and inflation-adjusted interest rates to historical lows. If the traditional pattern holds, however, the current state of domestic demand in Brazil does not yet incorporate fully the effects of the monetary easing already observed.

International oil prices continued to increase until late August, but have receded since then. Despite this latest move, oil prices are still highly volatile, and a new upward trend cannot be ruled out. While Brazil's self-sufficiency in oil shields the current account from oil prices, rising fuel costs could have an important effect on inflation, not only through their direct impact on the official consumer price index (IPCA), but also through likely increases in managed prices such as bus fares and other potential second round effects. Moreover, higher oil prices feed through the important petrochemical production chain, and tend to have a non-negligible impact on inflation expectations.

Inflation expectations continued to drift lower throughout 2006. Median market forecasts for inflation in 2006 broke through the 4.5% target by early April, and those for 2007 broke through the target some five months later. Specifically, at the time of writing market expectations for 2007 were around 4.1%, compared with a target of 4.5% ± 2%. Copom continued to cut the basic interest rate throughout the second half of 2006, for a total of 200 bp in four meetings, bringing it to 13.25% pa in November, its lowest level ever. Last year, for the first time since the adoption of the IT regime, inflation undershot the target midpoint, but remained within the tolerance band, closing the year at 3.1%. This was a novel experience for Brazil, although quite usual for other inflation targeting economies. Its importance should not be underestimated, since private agents, if they regard the lower half of the tolerance band as all but unattainable, would hardly choose to assign to inflation a subjective probability distribution with a mean at the target midpoint. For as long as expectations remain biased towards the upper half of the tolerance band, the monetary authority has to keep actively leaning against such skepticism just to hit the midpoint.

Inflation expectations: convergence to the targets and lower inflation uncertainty

The critical test of implementation of IT is whether policy is able to anchor expectations to the targets. In the early years of the regime, the economy underwent several shocks, as discussed above, and consequently, in some periods the BCB pursued either adjusted targets, such as the one announced in January 2003, or an off-center objective within the original target range, announced in September 2004, which constituted the focal point for agents. In the early stages of the inflation targeting regime, expectations converged to the declining targets, but during the confidence crisis in 2002 they deviated substantially from the target path (Figure 5). Recently, however, they have been put back on track.

There is evidence that monetary policy under IT and the overall improvement in macroeconomic fundamentals in Brazil have contributed substantially to create a more stable and predictable environment. In particular, there are signs that inflation uncertainty has declined. One such signal is the behavior of forecast errors, measured as the difference between twelve-month actual and expected inflation (Figure 6). Since the forecast horizons overlap over time, those errors are highly correlated. Rising inflation in 2001, and even more so in the second half of 2002 and first quarter of 2003, yielded forecast errors as high as

12.8 pp. However, as price acceleration was reversed, forecast errors declined. Most importantly, forecast errors became negative from November 2003 through June 2004; that is, inflation expectations formed during the confidence crisis clearly overestimated future inflation. The trough of negative errors corresponds to inflation expectations at 9.0% formed in April 2003, compared with an inflation outturn of 5.9% in March 2004. This shows both the magnitude of the task faced by policymakers in 2003 and the extent of the change that was achieved. In recent years, forecast errors have been substantially lower. From July 2005 through August 2006, all forecast errors in absolute values were lower than 1 pp.

Another indicator of inflation uncertainty is the dispersion of inflation expectations across survey respondents. Using the Survey of Professional Forecasters in the US, Giordani and Soderlind (2003) compute the aggregate inflation uncertainty as the combination of individual uncertainty (average standard deviation of individual histograms) and disagreement on the point forecast. In the case of the Brazilian survey, however, the respondents provide only point forecasts instead of probabilities for different intervals, and the only available measure of uncertainty is the disagreement among participants. In spite of this limitation, disagreement seems to capture to a large extent the degree of inflation uncertainty, as it is known to move together with individual uncertainty in the US survey (correlation of 0.6). The coefficient of variation across respondents, measured as the ratio of standard deviation to the average, soared above 0.3 between mid-2002 and mid-2003, but has generally remained below 0.1 since late 2003 (Figure 7). After peaking at 2.6 pp, the standard deviation averaged 0.4 pp in the last two years.

Furthermore, there is evidence that the risk premium implicit in longer-term interest rates has declined.[16] Lower uncertainty about future inflation and, more directly, about the future movements in interest rates tends to strengthen the transmission mechanism of monetary policy, as it increases the signal/noise ratio of policy actions.

Moreover, the role of inflation targets as attractors for inflation expectations is found to be statistically significant in econometric exercises. Initially, we simply regress inflation expectations on inflation targets in an exercise similar to those found in the literature that tests for rational expectations. Our concern here is to test whether there is a systematic deviation of inflation expectations from the target (a constant term different from zero) and whether movements in the target affect expectations (if expectations are well anchored to targets, the slope coefficient would be close to one). We found that the constant term is positive and significant at the 10% level, indicating inflation expectations higher than the target for some relevant period (Table 1, specification I). On the other hand, an estimated coefficient on the inflation target statistically different from zero and not different from one points to the important role played by targets in the expectation formation process. These results, however, have to be analyzed with caution because of the problem of omitted variables in the regression.[17]

To assess the behavior of these coefficients over time, we also estimate 36-month rolling window regressions. In particular, we are interested in checking whether a sample period that does not include the 2002 confidence crisis presents considerably different results (Figures 8 and 9). For the sample period more concentrated in the confidence crisis, the point estimates for the constant are higher than four and statistically significant, whereas for the recent period these are around zero and not significant. The coefficient declines abruptly for the sample starting in 2003 because, in this case, the sample does not contain the months immediately previous to the adoption of the adjusted target, when the difference

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[16] See box "Conteúdo Informacional dos Spreads de Taxas de Juros" in Banco Central do Brasil (2006).

[17] We cannot assert that targets are uncorrelated with omitted variables because they have been set in light of inflation history.

between inflation expectations and the target was large, which tends to increase the value of the constant.

The behavior of the coefficient on the inflation target over time also reflects the different stages of IT implementation in Brazil. Its estimates start around one, but decline to lower than half and become statistically not significant as the sample period is more concentrated in the confidence crisis. For the recent period, however, the coefficient is significant and close to unity. Therefore, these regressions indicate the important, albeit not uniform, role played by the inflation targets, and, in particular, for the recent period, the better anchoring of expectations by the target.[18]

Nevertheless, targets are not the whole story, and to assess the influence of different variables on the behavior of inflation expectations, we must include other regressors. The objective here is also to test the robustness of the previous results. We include variables that, according to a basic Phillips curve analysis, should affect inflation. Specifically, the regressors are the inflation target, the output gap – measured using a HP filter applied to the industrial production series, six-month nominal exchange rate changes, and accumulated twelve-month inflation.[19]

We find that the constant and output gap terms are not significant, whereas the other coefficients are all significant and have the right sign (Table 1, specification II). Furthermore, the coefficient on the inflation target is not statistically different from one. The coefficient on the exchange rate change is 0.06, which is similar to the pass-through coefficient usually found in Phillips curve estimations for Brazil using data for the same period. Past inflation also affects inflation expectations, although the point estimate is relatively low – a 1 pp increase in the actual twelve-month inflation impacts twelve-month ahead inflation expectations by 0.20 pp

Of course, the presence of statistically significant regressors apart from the inflation target is not necessarily an indication of low credibility of the monetary authority, but rather of how rich and complex the transmission mechanism is and of the fact that even highly credible IT regimes cannot completely eliminate fluctuations of inflation, including those associated with the business cycle. The simple presence of lags in the transmission mechanism of monetary policy implies that not all inflationary pressures will be curbed completely in the short run. Note that the dependent variable is not expectations of the inflation prevailing twelve months ahead, but expectations of the twelve-month inflation twelve months ahead. It includes, therefore, the very short run.[20]

We also report the coefficients in a 36-month rolling window regression (Figures 10–14). Although the point estimates differ from those in the simple regression, the pattern is similar: in the sample period concentrated around the confidence crisis, the constant term is significant and the coefficient of the inflation target is low or not significant, whereas in the recent period the opposite is true (the constant is even negative, reflecting the downward trend of inflation expectations). Furthermore, we cannot reject the hypothesis that the inflation target coefficient is one.

[18] The relevant role played by the targets was also found for a shorter sample size in Minella et al (2003) and Cerisola and Gelos (2005). See also Alves and Areosa (2005).

[19] We use a six-month change of the exchange rate because monthly changes are too noisy. Output gap is lagged twice instead of once because industrial production data is released with a two-month lag. One shortcoming here is that we are using revised data and the HP filter was applied to the full sample series.

[20] Moreover, since inflation is calculated using the price average over the month, price increases that take place after the first week of the month also appear in the index of the following month.

Behavior of the other coefficients presents two important results. In the recent period, the coefficient on the exchange rate change is lower (even not significant), possibly indicating a reduction in the pass-through in the economy. Most importantly, the term for past inflation is around zero and not significant. Those results are also consistent with an increasing role played by the inflation target.

As a final robustness exercise, we consider an additional specification, which includes the Embi+ Brazil and the gap between the real effective exchange rate and its trend (calculated using an HP filter) instead of the change in the nominal exchange rate (Table 1, specification III). The main difference is that past inflation is not significant in this specification when considering the full sample. The results using a rolling window regression (not shown) are, on the whole, similar to those found in the previous specification. In particular, the coefficient of past inflation is significant for the period more concentrated in the confidence crisis, but it is not significant in the recent period.

Summing up

Price stability is a precondition for faster sustainable growth. Stability should contribute to creating an environment conducive to long-term funding, be it of public debt, or the private sector, including of course labor intensive industries like housing. But long-term planning requires not only that agents are comfortable about the central forecast for inflation, but also that they attach low probability to outliers. That is to say, what matters is not only the mean or median consensus forecast of inflation, but also the floor and – more relevant given Brazil's history of large upward inflation surprises – the ceiling of such forecasts.

In this regard, while much has been achieved, Brazilian monetary policy still needs to establish a firmer track record of monetary stability. An imputed ceiling of inflation expectations twelve months ahead (which we calculated simply as the sum of mean and two standard deviations of inflation forecasts) has averaged 7.2% pa since December 2001. Most of the time, this ceiling has been within 5% pa to 10% pa, and about 15% of the time it has actually exceeded 10% pa. Only 13% of the time has the ceiling of market expectations of inflation been below 5% pa (it currently stands at some 4.6% pa).[21]

The Brazilian experiment with IT illustrates, perhaps more forcefully than most other cases, the importance of credibility and the consequences of the lack thereof. Credibility was negatively affected by an erroneous notion that the government would deny support to a stability-oriented, autonomously implemented, monetary policy. In addition, a widespread misunderstanding of how monetary policy works, with recurrent qualms about policy ineffectiveness, seems to have prevailed. These handicaps have increased the effort required but have not weakened the resolve of the BCB to tame inflation expectations and to deliver on inflation convergence.

[21] Inflation within 5% to 10% is clearly outside what most economists, and most central banks, would normally associate with the notion of price stability.

Table 1

Estimation of inflation expectations – several specifications

Dependent variable: 12-month ahead inflation expectations (2000:1–2006:8)

Regressors	Specifications		
	I	II	III
Constant	1.81*	0.25	0.97
	(1.03)	(0.58)	(1.00)
Inflation target (12-month ahead)	0.80***	0.77***	0.60**
	(0.18)	(0.23)	(0.29)
Output gap (–2)		0.09	0.14*
		(0.11)	(0.08)
12-month inflation (–1)		0.20*	0.09
		(0.11)	(0.10)
Six-month nominal exchange rate change (–1)		0.06***	
		(0.01)	
Embi + Brazil (–1)			0.15***
			(0.05)
Real effective exchange rate gap (–1)			0.08***
			(0.03)
R-squared	0.2939	0.6904	0.7995
Adjusted R-squared	0.2849	0.6739	0.7859

Notes: Standard errors – shown in parentheses – were corrected by Newey-West heteroskedasticity and autocorrelation consistent covariance matrix estimator since estimation residuals present autocorrelation and heteroskedasticity. *, **, and *** indicate the coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Figure 1

Inflation, targets and expectations (% a.a.)

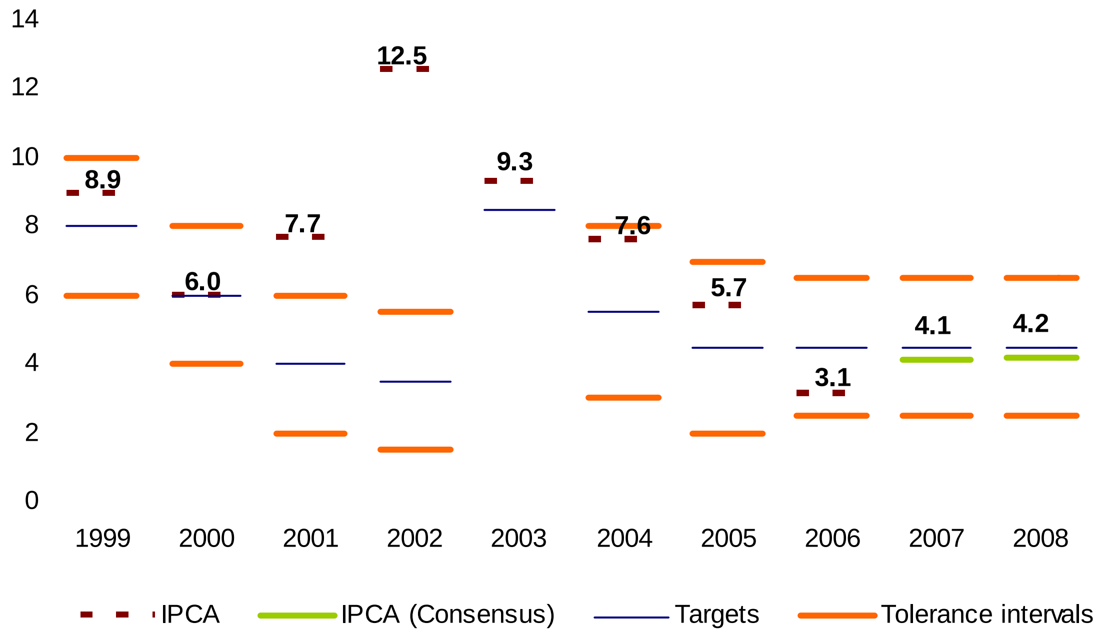


Figure 2

IPCA inflation

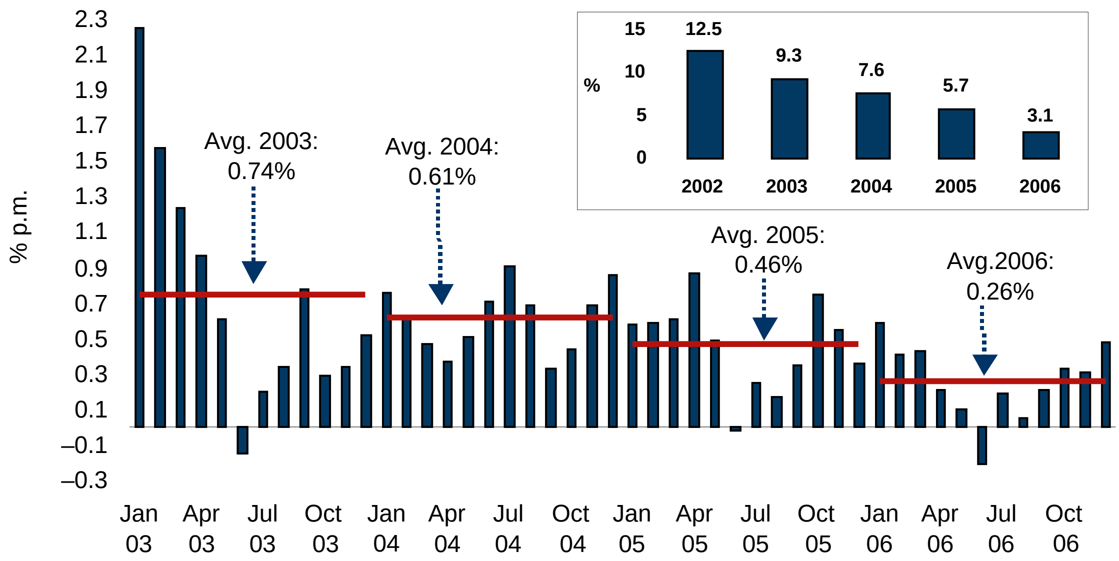


Figure 3

Market Expectations for Inflation

%12m Dec

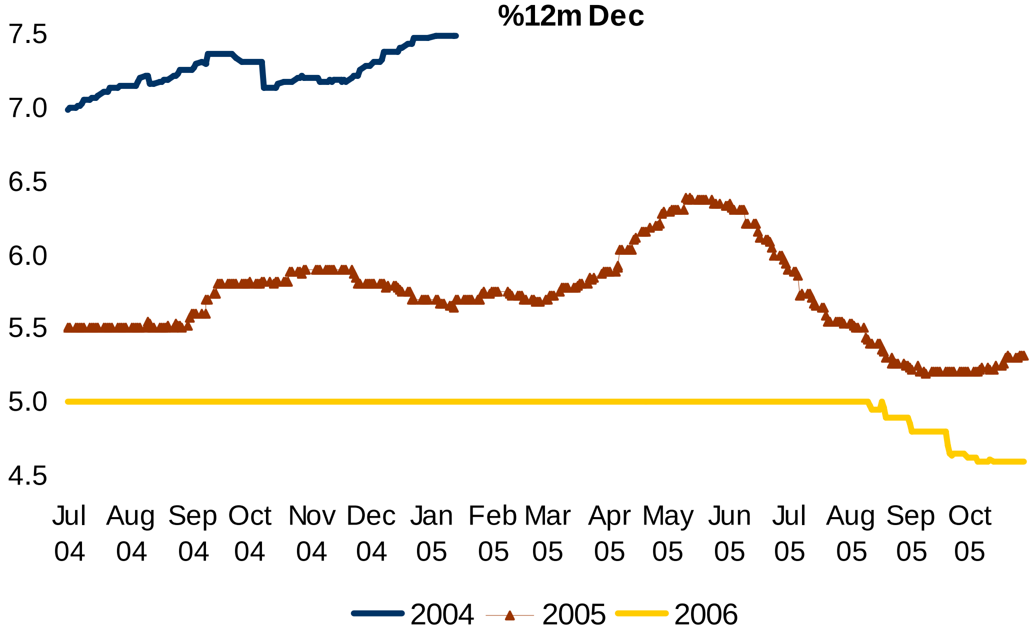


Figure 4

Market expectations for 2005 inflation in 2005

% pa

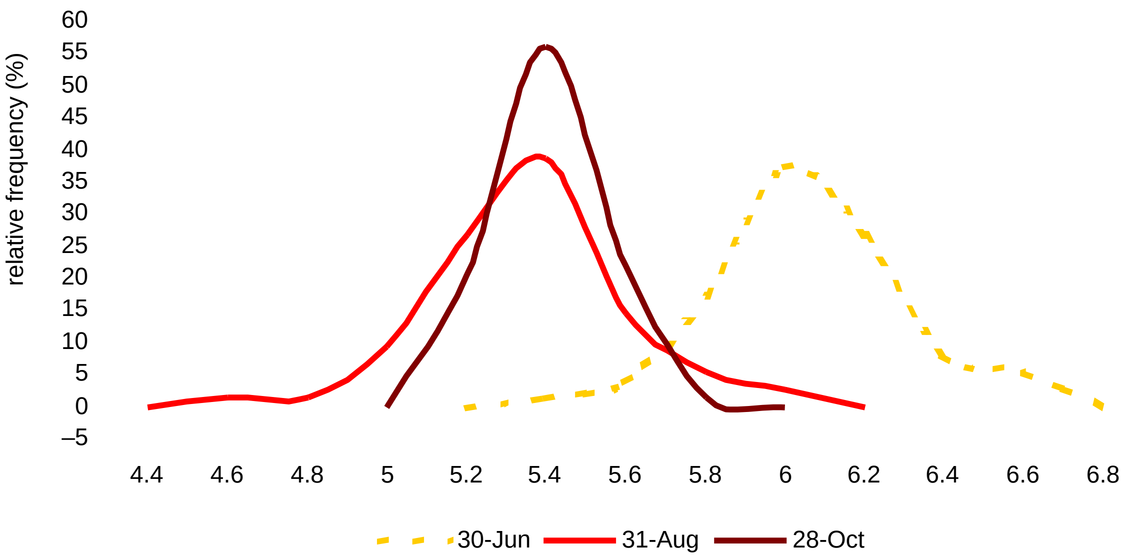


Figure 5

12-month ahead inflation expectations and targets

1999:7–2006:8

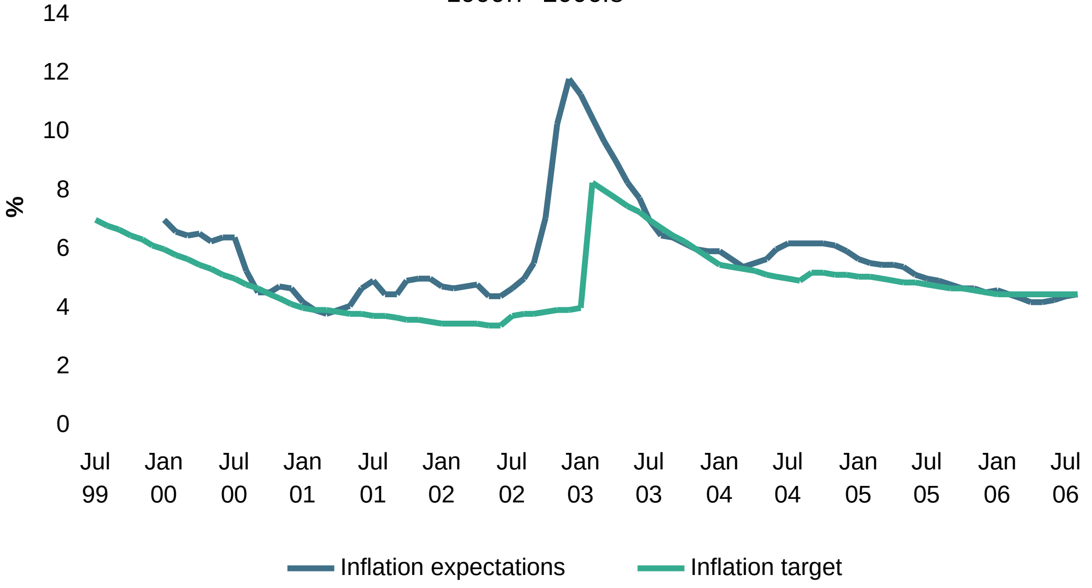


Figure 6

12-month forecast errors (2000:12–2006:8)

Actual minus forecasted inflation

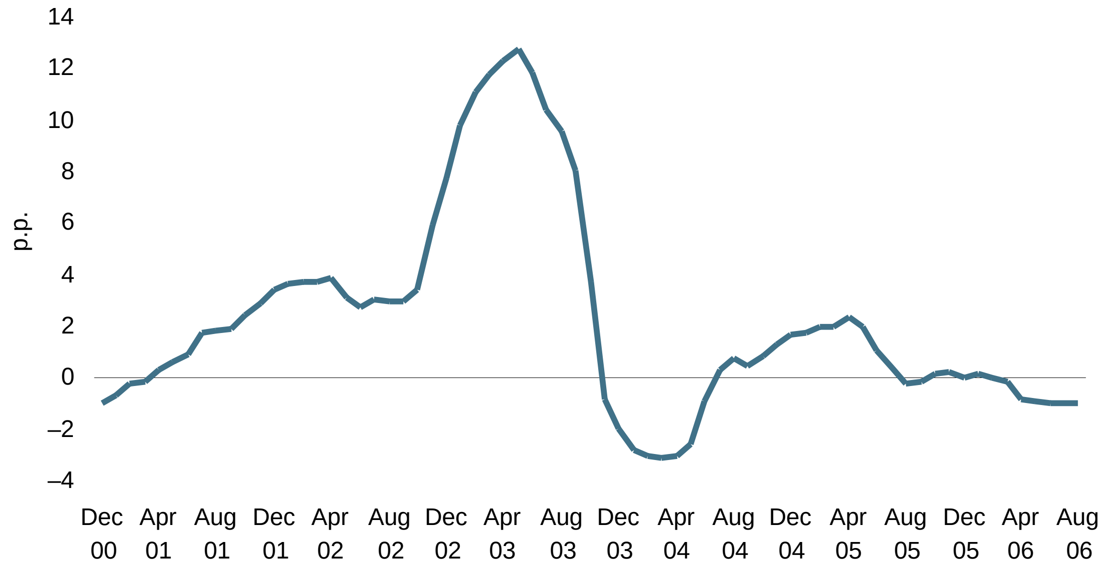


Figure 7

Dispersion of inflation expectations – coefficient of variation

2001:12–2006:8

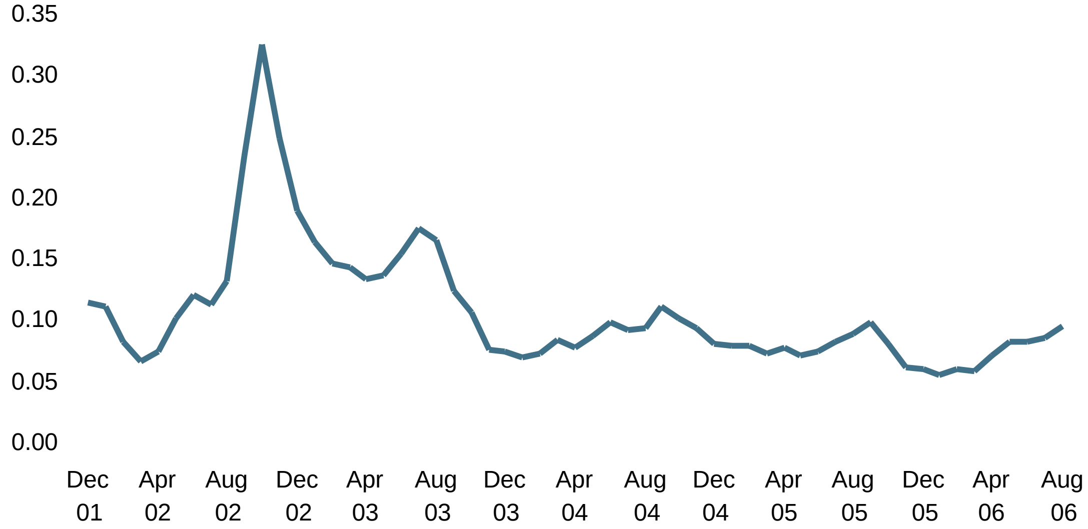


Figure 8

36-month rolling window regression – constant term

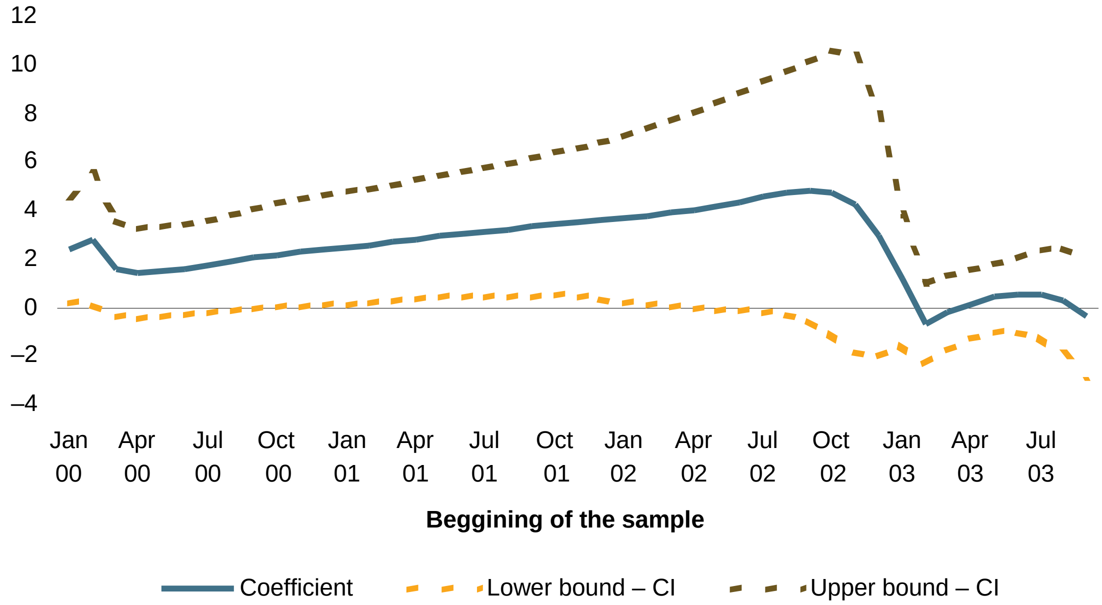


Figure 9

36-month rolling window regression – coefficient on the inflation target

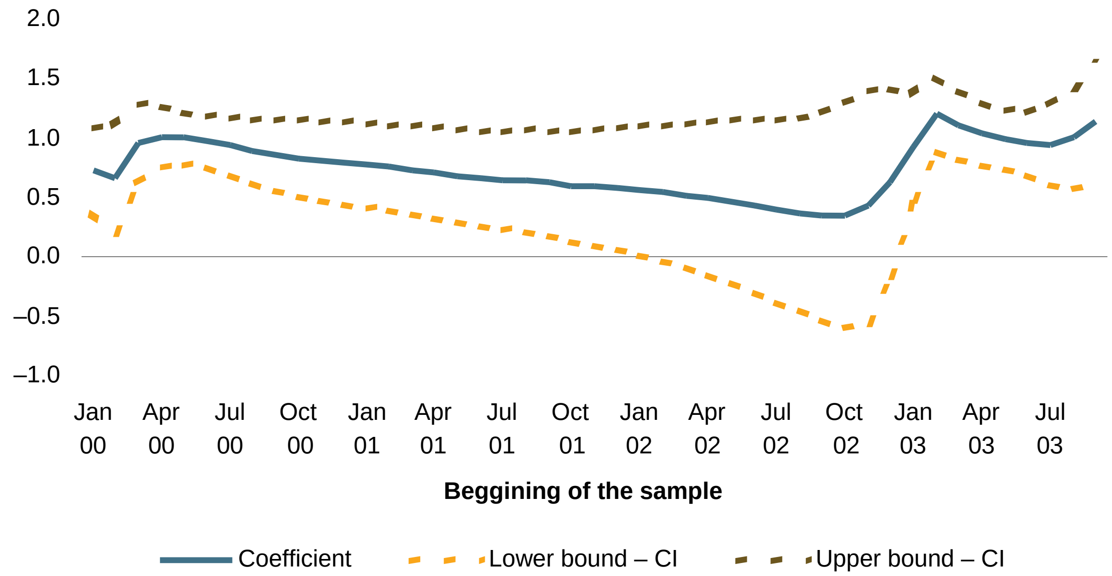


Figure 10

36-month rolling window regression – constant term

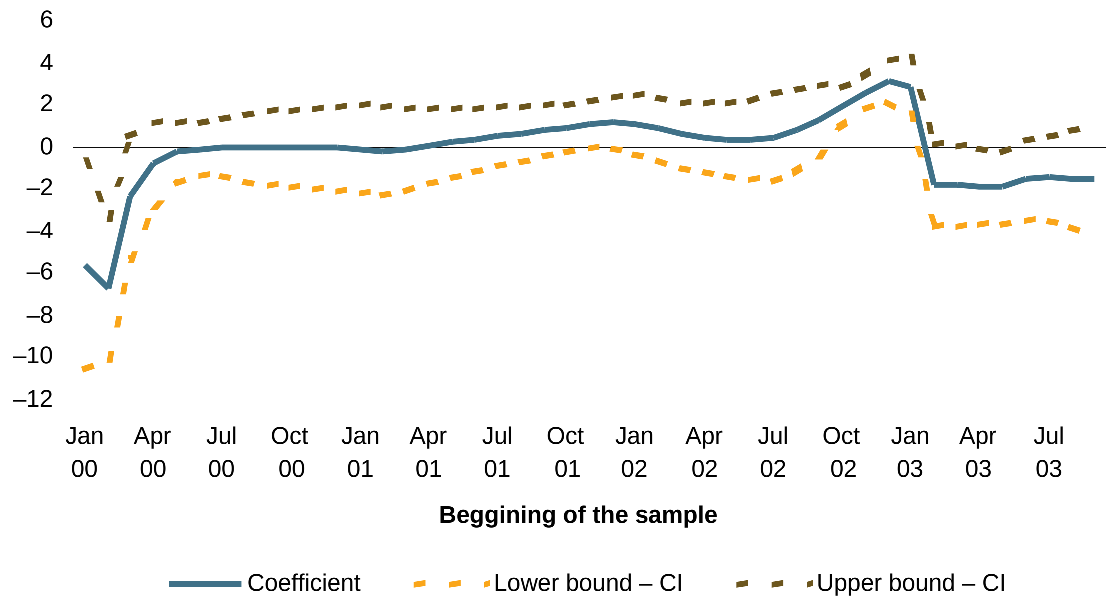


Figure 11

36-month rolling window regression – coefficient on the inlation target

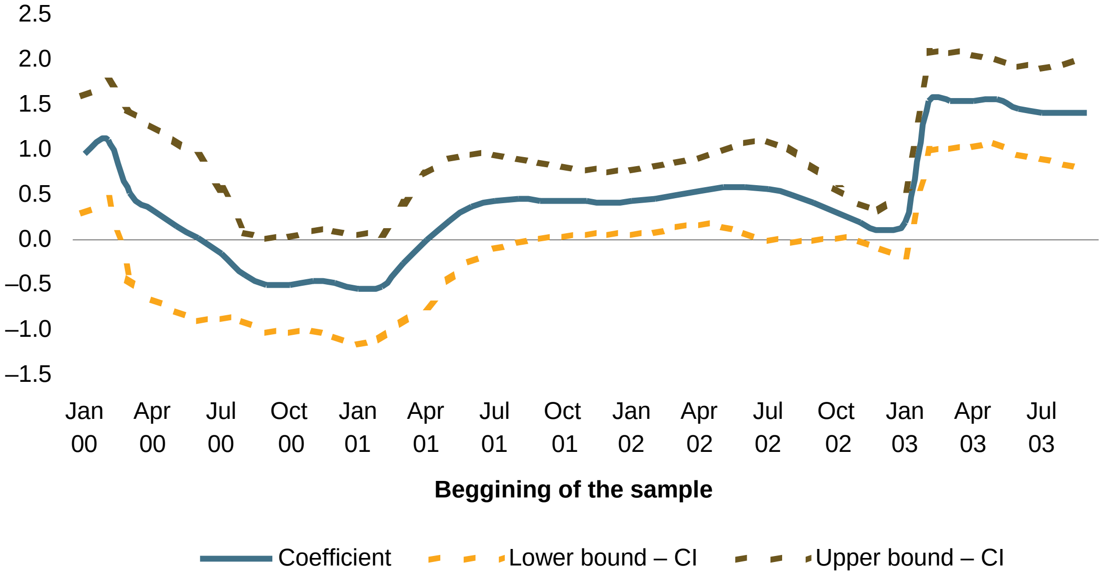


Figure 12

36-month rolling window regression – coefficient on output gap

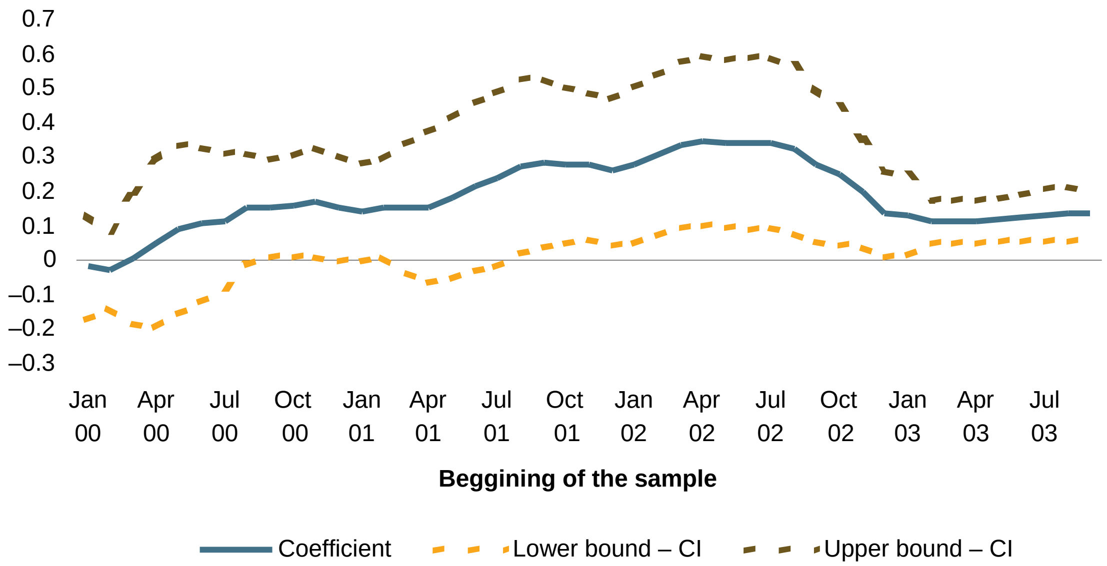


Figure 13

36-month rolling window regression – coefficient on past inflation

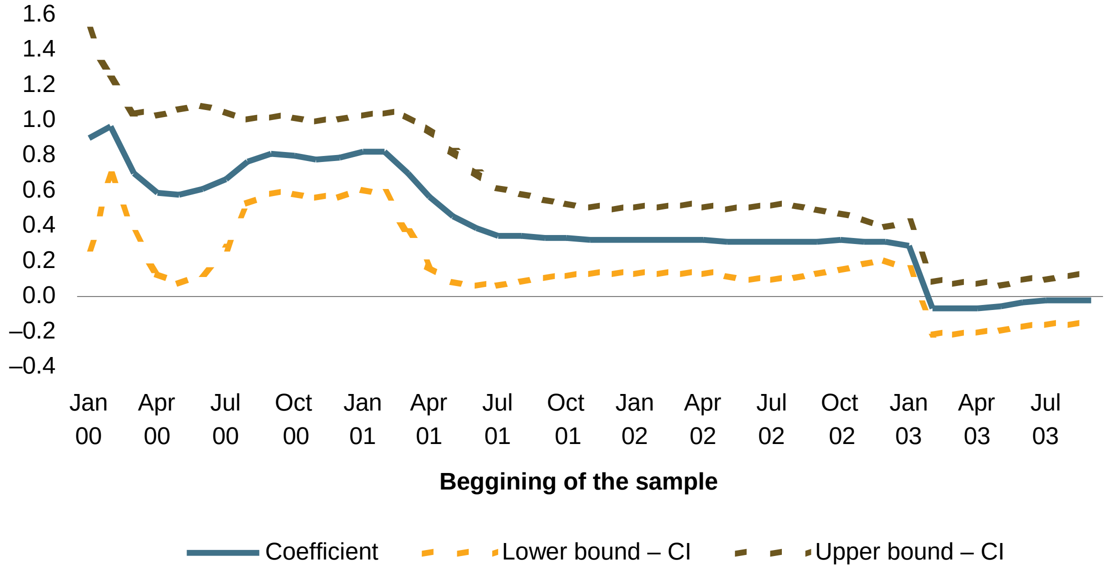
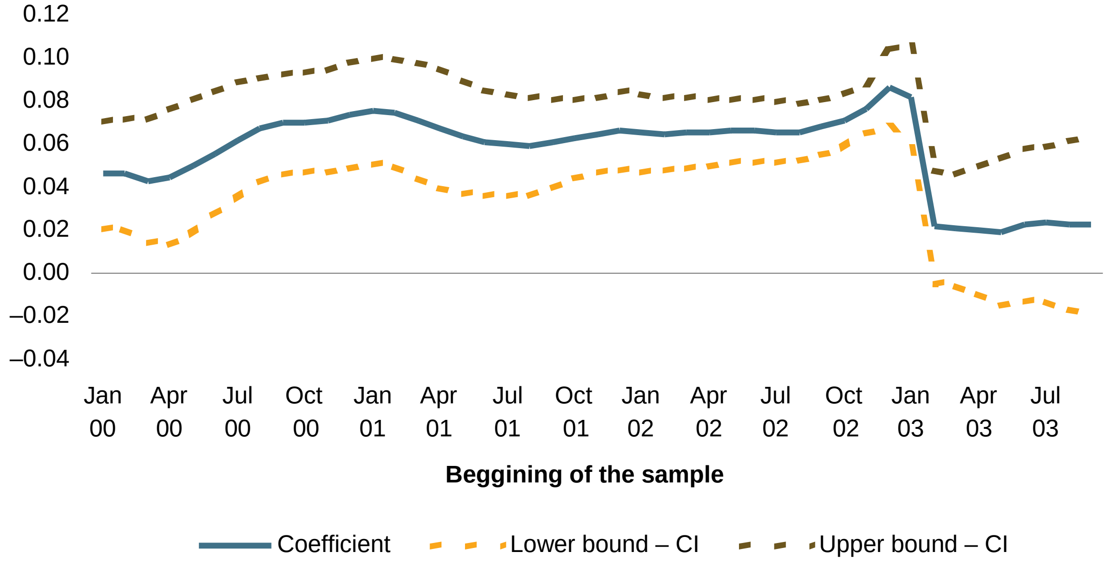


Figure 14

36-month rolling window regression – coefficient on exchange rate change



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The "great moderation" and the monetary transmission mechanism in Chile[1]

Cristina Betancour, José De Gregorio and Juan Pablo Medina[2]

I. Introduction

Chile has undergone important changes to its macroeconomic framework within the last twenty years, in particular since the recovery from the debt crisis of 1982. These changes include the granting of independence to the central bank in 1989, among others. In late 1999, after years of managed exchange rates and capital controls, and after inflation had been sharply reduced and stabilized at low levels, Chile announced the adoption of an inflation targeting regime to be put in place by 2001, the removal of capital controls, and the implementation of a flexible exchange rate regime in which official intervention is regarded as an exceptional occurrence. Finally, in August 2001 monetary policy was "nominalized": whereas previously the rate on the monetary policy instrument had been set on the basis of an ex post interest rate on inflation-indexed bonds, a nominal rate is now used instead.[3] On the fiscal front, Chile has had persistent surpluses since the mid-1980s, except during the period immediately surrounding the recession of 1999, and in 2001 a policy of achieving a structural fiscal surplus of 1 percent of GDP was implemented.

Over the same period, the Chilean economy has gone through several important structural changes. The financial sector has deepened, and the degree of openness to external economic influences has increased, with unilateral tariff reductions and the signing of many free trade agreements, most notably with the United States and the European Union. The 1990s proved to be the Chilean economy's best decade for growth in its history. Although growth has moderated in the present decade, it is still very high from both a historical and a regional perspective. Inflation has declined to levels comparable to those in the industrial economies, and the volatility of both output and inflation has fallen significantly.

With these achievements, Chile can be considered a good example of what has been called the "great moderation", a phenomenon seen in many countries in recent decades in which not only the level of inflation but also the volatility of both inflation and output have declined sharply. But whereas in many industrialized countries this phenomenon had started already in the 1980s, in Chile it began in the 1990s and has been consolidated only in recent years.

This paper examines how the macroeconomic framework developed in Chile since the early 1990s has affected the monetary transmission mechanism and economic performance, in particular regarding the volatility of some important variables. The paper looks at various performance measures, including changes in the volatility of output growth and inflation, focusing on the effects of monetary policy. The paper also reports estimates of a reduced-form vector autoregression (VAR) model to assess whether the transmission mechanism has changed over the period 1990–2006. The results suggest that changes in the transmission mechanism play an important role in explaining Chile's "great moderation". Moreover, these

1 This paper was prepared for the Bank for International Settlements meeting on "Transmission Mechanisms for Monetary Policy in Emerging Market Economies: What Is New?" Basel, December 2006. The views expressed in this paper are those of the authors and do not necessarily reflect the opinions of the Central Bank of Chile.

2 Central Bank of Chile.

3 Bonds were indexed to inflation using the unidad de fomento (UF), an indexed unit of account.

changes in the propagation of shocks are related to a large extent to the improvements in macroeconomic policies.

The paper is organized as follows. Section II describes the framework of macroeconomic policy in Chile and presents some stylized facts concerning the first two moments of inflation and output growth. It tries to explain those facts in light of the changes in policies experienced by the Chilean economy during that period. Section III addresses some preliminary background issues concerning the monetary transmission mechanism, and section IV presents the VAR model. Section V concludes.

II. The Chilean macroeconomic framework and the reduction of output and inflation volatility

The Chilean macroeconomic framework has undergone several changes in fiscal, monetary, and exchange rate policies since the beginning of the 1990s, which in turn have determined certain characteristics of the economy, especially concerning output and inflation. In this section we document some basic stylized facts of these two variables and review them in the light of recent experience.[4]

Two basic facts underlie this discussion. The first is that inflation fell persistently from the 1990s until 2000, when the full inflation targeting regime was implemented. The second is that the volatility of both output growth and inflation has declined in recent years. These facts are consistent with a “great moderation” in Chile, characterized by sharp declines in the volatility of output and inflation and in the level of inflation. A large body of research documents this “great moderation” across a number of countries and considers possible explanations.[5] In the case of Chile, some important changes in policies can be identified as having contributed to these achievements.

After a long history of high inflation, Chile experienced a downward trend in inflation during the 1980s. During the 1990s annual inflation continued to decline gradually and persistently from 27 percent in 1990 to 2.3 percent in 1999 (figures are as of December in each year). The granting of independence to the Central Bank of Chile in 1989 supported this important achievement. During 1991–99 the central bank for the first time defined an explicit target for inflation based on yearly objectives and forecasts. The first target range for inflation, announced in September 1990, was set at 15 to 20 percent for December 1991. This short-term inflation target embodied Chile’s commitment to reducing inflation and reflected the need to generate credibility for the new regime in a country used to high inflation. Although the economy remained highly indexed, and monetary policy continued to seek other objectives such as real exchange rate targets within a band, a high rate of productivity growth kept wage indexation from binding and allowed the real exchange rate to strengthen, placing downward pressure on inflation (De Gregorio (2004)).

During the current period, exchange rate policies have continued to evolve: from a currency band with discrete adjustments allowed when pressures were excessive, Chile has moved to a freely floating system since late 1999. This, in turn, reduced incentives for capital inflows, which in previous years exacerbated the business cycle.[6] It is worth noting that the band was

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4 We do not perform formal tests to discriminate among them because of lack of data, but the VAR estimation later in the paper helps to highlight the effects of macroeconomic policy.

5 See, for example, Blanchard and Simon (2001), Stock and Watson (2003), Cecchetti, Flores-Lagunes, and Krause (2005) and Kent, Smith, and Holloway (2005). For a discussion on global disinflation see Rogoff (2004).

6 See De Gregorio (2006).

established in the context of a gradual real appreciation, following the massive inflow of foreign capital that began in 1990. Consequently, implicit targets were set for the current account, and regulations on capital account transactions, including the famous non-remunerated reserve requirement for capital inflows (encaje), were imposed as well.

Fiscal policy has been solid since the mid-1980s, but during the 1990s it became more stringent, with the objective of keeping the rate of growth of current government expenditure below that of GDP. Because such a policy involves some degree of procyclicality, since 2001 fiscal policy has been based on a rule of achieving a structural surplus of 1 percent of GDP. In computing the structural surplus, adjustments are made on the revenue side only. Tax revenue is computed on the basis of a zero output gap, and revenue from copper, Chile's most important export, is computed using an estimation of its long-run price. As a consequence, given recent high copper prices, government saving has been high. Although few studies of the international business cycle have looked kindly on the hypothesis that improved fiscal policy can reduce the volatility of output growth, in Chile it has probably been a very important factor.[7]

Figure 1 traces output growth and its volatility in terms of quarterly, seasonally adjusted GDP, using five-year rolling windows (where period t refers to the window starting in quarter $t - 19$ and ending in t).[8] Homogeneous data on GDP are available only since the first quarter of 1986, and hence the first window for output growth is that for the second quarter of 1991. The standard deviation of output growth declined gradually during the early 1990s and then rose for the next couple of years. The reason for this rise in volatility was the recession of 1999, which started with a decline in output in the third quarter of 1998. Volatility has declined steadily since then. After several years of rapid growth following the recession of 1999, the average rate of growth in five-year windows declined until 2004.

The experience with strong monetary tightening in the late 1990s, together with continuing exchange rate rigidities, led the monetary policy authorities to embark on a substantial improvement of the macroeconomic framework. In 2001 the central bank implemented a full-fledged inflation targeting regime in which control of inflation is the central policy objective, with no other explicit targets. Currently, annual inflation is expected to be around 3% most of the time, with a tolerance range of ±1 percent, and a policy horizon around 2 years.[9] The move toward such a regime was seen as the natural step after reaching a low steady-state level of inflation and establishing sufficient monetary policy credibility.[10] To control for the persistent decline in inflation, each window of Figure 2 shows the variance in detrended inflation. The figure shows that inflation itself as well as its volatility declined all through the 1990s and then stabilized.

Other policies adopted during that period were a free-floating exchange rate regime, nominalization of the monetary policy instrument, deepening of the foreign exchange derivatives market, and a much more open capital account. Since then important efforts have been made to improve transparency and enhance credibility.

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[7] See Medina and Soto (2006), who simulate the impact of the fiscal rule in a dynamic general equilibrium model.

[8] The results are presented as annualized rates. The seasonal adjustment is done using X12-ARIMA.

[9] See details in Banco Central de Chile (2006).

[10] Strictly speaking, this is a flexible inflation target, since it allows the central bank time to adjust to deviations of inflation from the target range. This, in turn, is done because the definition of the objective implicitly weights the deviations of inflation from the target and output fluctuations. We refer to a full-fledged inflation target to indicate that this is also accompanied by all the communications requirements, and no other explicit objectives.

An alternative measure of volatility can be gauged from output gap measures. This allows us to check the robustness of the finding that the reduced volatility of output is not due to a decline in average growth. Figure 3 presents the output gap and its volatility, using a Hodrick-Prescott filter to estimate trend output. The results are similar to those in Figure 1, since volatility has declined, although in this case it has remained relatively stable since 2003.

Some other hypotheses that might explain the decline in output and inflation volatility are important to consider. For example, improved inventory management, resulting from advances in information technologies, has received support in international studies as a cause of declining volatility. Chile, however, lacks a good long-term data series on inventories that would allow us to verify this hypothesis. Chile has also gone through a process of financial deepening, which has likewise been hypothesized to reduce volatility, as consumers as well as firms have greater opportunity to smooth consumption and production when facing adverse shocks.[11]

Recent work by Kent, Smith, and Holloway (2005) emphasizes the role of structural reform in reducing output volatility. Here the most important development in the Chilean economy has been the increase in trade and financial openness, which, by allowing greater geographical diversification of trade and increased portfolio diversification, may have helped to reduce volatility.

Finally, yet another possible explanation for the decline in volatility is that the recent shocks to the economy may have been smaller than in previous periods (Stock and Watson, 2003). If this were so, it would imply that a renewed increase in the magnitude of shocks could once again increase volatility. In fact, Chile's experience in recent years has not been free of large shocks. One particularly important positive shock has been the surge in copper prices: from very low levels at the beginning of this decade, copper prices have increased to unprecedented heights, yet have not resulted in a large expansion of economic activity. Nor, for that matter, did the low copper prices of the early 2000s result in a recession, as had happened before when copper prices were low. Indeed, the years 2000–02 witnessed the lowest real copper prices since the Great Depression, and Chile did not have the recession that many could have predicted. Hence it is difficult to argue that the reduction in volatility has been the result of good luck in the external environment. However, as we report later on, there has been some reduction in the volatility of external shocks, but not enough to explain the significant reduction in volatility. Section IV will return to this issue, to investigate whether the reduction in volatility is attributable to changes in the transmission mechanism associated with macroeconomic policy developments.

III. The monetary transmission mechanism

Here we discuss various aspects of the monetary policy transmission mechanism in the Chilean economy and how they might have changed in recent years, given the new setting described in the previous section. In a context of inflation targeting, an examination of the transmission mechanism is crucial, since monetary policy decisions are based to a large extent on formal estimates and forecasts of the impact of policy on inflation.

[11] During the large expansion of consumer credit of the 1990s, and the subsequent slow growth in consumption, it is possible that an excessive debt burden, due probably to optimistic expectations about the long-term prospects of the Chilean economy by the mid-1990s, contributed to the slow recovery from the recession. But even if this behavior did retard the recovery, it is not obvious that it could have increased volatility.

Monetary policy in Chile has traditionally worked via the interest rate-aggregate demand channel, influencing market interest rates indirectly through short-term instruments, with a special focus on the overnight rate. The central bank also has a large stock of medium- and longer-term debt. This debt is auctioned in fixed amounts, so that the market determines the yield curve. The interest rates thus determined, both nominal and real, affect consumer and investment spending, aggregate demand, and output (Mishkin, 1996).

Other channels of monetary transmission have been identified, such as the exchange rate channel, the asset prices channel, the credit channel, and the expectations channel,[12] but only the first of these has figured importantly in the monetary policy debate in Chile. During most of the 1990s, with monetary policy based on annual inflation targets, changes in interest rates had little impact on current-year inflation, so that pressures were felt on the exchange rate instead. These pressures collided with the objective of maintaining export competitiveness, and this led to the implementation of capital controls and the policy of allowing the peso to appreciate gradually by adjusting the exchange rate band.

Monetary policy can also affect aggregate demand through the wealth effect derived from the asset price channel. In Chile the private pension system has an important influence on stock market prices, through which it can affect agents' wealth and, in turn, aggregate demand (Eyzaguirre (1998)). Although the asset price channel does not seem to be an important channel of transmission of monetary policy in Chile, in fact its importance depends upon the concentration of particular assets in agents' portfolios and the impact of market fluctuations on those assets. Therefore this channel is also worth analyzing in the Chilean context.

Also worthy of comment are the credit channel and its role in the evolution of monetary policy transmission over the last decade. The Chilean financial sector has evolved into a relatively free and sophisticated system, with deep markets. Chile's capital market is mostly based on banks, which have been allowed to expand their activities and invest overseas, following the improvement of supervision and prudential regulation and the introduction of capital adequacy requirements in line with Basel standards. These improvements, together with the development of private pension funds, have increased the supply of long-term funding. In fact, banks and firms have developed new forms of financing such as bond financing.[13]

Although consensus is lacking, the literature seems to support the hypothesis that the development of Chile's financial sector has diluted the effects of monetary policy on output: firms today are less dependent on banks, whose capital costs rise directly in response to monetary policy tightening. Additionally, the credit channel is an alternative monetary transmission mechanism to the aggregate demand channel that could give rise to a financial accelerator (Bernanke, Gertler, and Gilchrist (1996)), which could increase the persistence of the business cycle. Firms that are credit constrained will be affected by the availability of lending and changes in the cost of borrowing, while firms that are unconstrained will be affected only by the latter. Therefore, as credit restrictions diminish, one could expect that investment becomes less sensitive to overall financial conditions. On the other hand, as argued by Roldós (2006), the responsiveness of aggregate demand to changes in monetary policy could rise with the increase in disintermediation, due to the fact that bank lending could become less sensitive to interest rates than market financing, because the long-term relationship with firms would make them avoid the transfer of short-run changes in the monetary policy rate to customers.

As Alfaro et al (2003) have argued, the credit channel had a significant impact on macroeconomic activity in Chile during the 1990s, through the bank lending channel.

[12] See Mies, Morandé, and Tapia (2002).

[13] See details in Betancour, De Gregorio, and Jara (2006).

Focusing on the ratio of low- to high-quality lending (specifically, the ratio of consumer credit to large corporate credit), they analyze how banks respond to increases in their capital costs. However, given financial development and firms' expanding options for financing after 2000, there seems to be no evidence of a flight to quality, and consequently the volatility of credit has diminished. In fact, the issuance of bonds by banks and firms has risen, giving them more financing opportunities. As a result, the volatility of output growth has also diminished, as documented above. Thus, with the development of the financial sector, firms have become less dependent on bank financing, and this has contributed to the reduction in output volatility.

In 2001 the Central Bank of Chile replaced its monetary policy instrument, shifting from a real interest rate to a nominal rate. This change provided a better nominal anchor for the economy, thus expanding the options for monetary policy. Nominalization also resulted in a deepening in nominal financial asset markets, helping to reduce the volatility of monetary aggregates and nominal interest rates.

Understanding the dynamics of inflation is a fundamental step to analyze the transmission mechanisms. In Chile, inflation has historically displayed a significant degree of persistence. Related to this was the poor performance of inflation until the end of the 1980s that promoted a widespread indexation and high inflation expectations. The independence granted to the central bank together with the consequent inflation targeting framework implemented in Chile, achieved a gradual reduction of inflation during the 1990s and the transition to full-fledged inflation targeting has produced stable and low inflation since 2000. These developments have affected the dynamics of inflation. For instance, the perceived increase in the credibility of monetary policy in its commitment to price stability has made inflation expectations more anchored. Thus, exploring whether the persistence and inertia of inflation have changed helps us to understand the role of monetary policy in shaping the dynamics of inflation and how these modifications feed back into the policy decisions of the monetary authority.

The Phillips curve has provided a route to comprehend the behavior of inflation and its connection with real activity. New Keynesian models have introduced a Phillips curve where the nominal rigidities are controlled by parameters that determine the fraction of firms (or workers) that are able to adjust prices (or wages) optimally every period. In order to generate the observed inertia of the inflation, the New Keynesian Phillips curve has been modified to allow for a lagged inflation term. This term may be obtained if a fraction of firms (or workers) follow a passive rule that adjusts prices (or wages) automatically based on a weighted average between past inflation and the inflation target. The higher the weight on past inflation, the more persistent the inflation will be. Along these lines, Céspedes and Soto (2006) estimate the structural parameters of a New Keynesian Phillips curve for Chile using a GMM methodology. They find a structural break of the parameters of the Phillips curve around 2001. Moreover, they show that the point estimates indicate that the fraction of firms not optimally adjusting prices together with the weight of the inflation target in automatic price adjustments have both increased over time since 1997. Caputo, Medina and Soto (2006) complement this evidence estimating the structural parameters in a full New Keynesian general equilibrium model for the Chilean economy using Bayesian techniques. They assume a regime change in 2000 that potentially affects the value of the parameters that govern the Phillips curves of nominal prices and wages. Their results show that the fraction of workers who are not optimally adjusting wages every period has increased since 1999. They also find that the weight given to the announced inflation target by automatic updating of nominal wages has increased. The posterior distributions obtained by them indicate that the values of these parameters are in fact statistically higher since 2000. The stability and low level of inflation and the credibility of monetary policy may have reduced the incentive of firms and workers to optimally adjust nominal prices and wages. Moreover, since inflation expectations are more anchored to the inflation target, automatic adjustment of prices and wages tends to be based more on the inflation target.

The magnitude of exchange rate pass-through to inflation is also important to determine the propagation of shocks and monetary policy on inflation. There is a consensus that the transmission of the exchange rate to domestic prices is incomplete in the short-run. Empirical evidence on the deviations from the law of one price for tradable goods has favored this consensus. It has been argued that an incomplete exchange rate pass-through in the short run is due to distribution and transportation costs, segmentation of markets and the presence of nominal rigidities in the domestic price of imported goods. In particular, when the domestic currency prices of imported goods are sticky, then the transmission of the exchange rate to import prices will not be complete in the short run. Hence, changes in the degree of nominal rigidities of import prices will affect the magnitude of exchange rate pass-through: the greater the nominal rigidities, the smaller the exchange rate pass-through. Using this rationale to explain the incomplete exchange pass-through in the short run, both Céspedes and Soto (2006) and Caputo, Medina, and Soto (2006) present evidence that the parameter that controls the magnitude of the nominal rigidities of imported goods increases after the late 1990s, reducing the exchange rate pass-through. The latter work reports that exchange rate pass-through has in fact been statistically lower since 2000. This evidence is also consistent with alternative estimations of the decline of exchange rate pass-through (see García and Restrepo (2002) and De Gregorio and Tokman (2005)). The reduction of exchange rate pass-through has reduced the concern that big swings in the nominal exchange rate may be a source of instability in the inflation rate.

Finally, the central bank has made important efforts to enhance its credibility and transparency so as to minimize the impact of expectations on any of the other channels (an impact that can be described as a channel itself). Publication of a Monetary Policy Report in January, May, and September each year, and publication of the minutes of Monetary Policy Committee meetings only three weeks after each one of the twelve yearly sessions, are some examples of these efforts.

IV. Analyzing the transmission mechanism: evidence from a VAR

To assess whether the monetary transmission mechanism in Chile has changed over the period 1990–2006, we use a reduced-form vector autoregression (VAR) model. The main advantage of VAR models is that they impose a minimum of structure. Starting with Sims (1980), VAR models have been developed as a means of analyzing quantitatively the impact of monetary policy innovations on a set of endogenous variables. One difficulty with VAR models, however, is associated with the criteria for identifying shocks.

Many studies have addressed the issue of how to identify monetary policy shocks for the case of the United States.[14] For open economies, Kim and Roubini (2000) have proposed restrictions for identifying the effects of monetary policy shocks on the exchange rate in order to obtain responses consistent with theory. In the case of Chile, several studies based on VARs have been used to describe the effects of monetary policy.[15]

IV.1 Specification of the VAR model

The base VAR model has the following representation:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + u_t,$$

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[14] See, for example, Bernanke and Blinder (1992), Bernanke, Gertler, and Watson (1997), Christiano, Eichenbaum, and Evans (1999) and Leeper, Sims, and Zha (1996).

[15] See, for example, Valdés (1998) and Parrado (2001).

where $A(L)$ and $B(L)$ are matrix polynomials in the lag operator L, Y_t is a vector of endogenous variables, X_t is a vector of exogenous variables, and u_t is a vector of innovations. These innovations are serially uncorrelated, with zero mean and a variance-covariance matrix $E(u_t u_t') = \Sigma_u^2$. The behavior of the endogenous variables depends both on unexpected disturbances, u_t, and on the systematic component, captured by $A(L)Y_{t-1} + B(L)X_t$, which determines how the shocks are transmitted to the rest of the economy.

The endogenous variables that we include in Y_t are the short-run interest rate, output, the money supply, the consumer price index, and the real exchange rate. This set of variables is used to identify the shocks in the impulse-response experiment analyzed below.[16] The short-run interest rate is the indexed monetary policy rate, the rate used by the Central Bank of Chile as the policy instrument until 2001, when nominalization began and it was replaced by the interbank nominal interest rate. For the measure of output we use the IMACEC (a monthly index of activity), for the money supply we use M1, and for prices we use the consumer price index. The last three variables are expressed in log terms and are seasonally adjusted. The real exchange rate is the standard multilateral measure of the price of foreign goods relative to that of domestic goods (in log terms), so that an increase in this ratio represents a real depreciation. The exogenous variables are copper and oil prices and the foreign interest rate, the latter measured as the US federal funds rate. We use monthly data from January 1991 through July 2006. The preferred specification considers two lags for both endogenous and exogenous variables.

IV.2 Stability of the estimated VAR

The stability of the estimated parameters governing the relationship among macroeconomic variables has been analyzed for the United States by Stock and Watson (1997), who find evidence of instability in the bivariate relationship among seventy-six macroeconomic variables. Bernanke, Gertler, and Watson (1997) also report evidence of instability in a monetary VAR. In the case of Chile, evidence of a reduction in output and inflation volatility, as reported above, also suggests the possibility of a modification in the propagation of shocks associated with the changes in macroeconomic policies of recent years, as documented in the following subsection.

Using the VAR estimation procedure, we can perform a stability investigation to analyze whether the observed changes in the volatility of output and inflation reflect a deeper modification in the dynamics of the endogenous variables. For each equation of the VAR, we test jointly for the stability of all coefficients using the cusum-square test. The results, shown in Figure 4, suggest that the output and short-term interest rate equations have a remarkably high level of instability. The equations for the price index, the money stock, and the real exchange rate show moderate instability. These results provide evidence of changes in the dynamic relationship among macroeconomic variables in the case of Chile. Moreover, as described above, several different macroeconomic policies were implemented during the period under analysis, and therefore the instability that we find might be capturing the role of these policies in shaping the transmission of shocks in the Chilean economy.

[16] This order is arbitrary and can be criticized as an imprecise way of identifying underlying shocks. However, the purpose of this paper is to analyze whether the propagation of shocks has changed over the sample period. Although some shocks are not clearly identified with this ordering strategy, changes in the mechanism by which reduced-form shocks are transmitted can be used to understand how modifications in the macroeconomic environment have affected the dynamic relationships among variables.

IV.3 Changes in the transmission mechanism

The previous subsection suggests the presence of breaks in the estimated VAR. In principle, one could estimate the dates of these breaks using the information from the cusum-square test. However, the exact timing of the breaks is not necessarily the same for each equation. Hence this test does not clearly identify the timing, although the test for output and interest rates suggests that a break occurred in the late 1990s. We could use more formal tests to establish the break, but on the basis of the discussion above, we consider a break occurring at the end of the 1990s. As we have documented above, several macroeconomic policy changes were carried out in and around 1999. Since then monetary policy has been conducted within a full-fledged inflation targeting framework, and since August 2001 the instrument of monetary policy has been a nominal interest rate. Also since 2001, fiscal policy has explicitly followed a rule that requires it to behave in a countercyclical manner. Thus our first sample covers the period from January 1991 to December 1999, and the second sample starts in January 2000.

Using the VAR estimation, we can evaluate the variance of the shocks to each endogenous variable and the conditional volatility of the endogenous variables. Regarding the shocks to each equation, the last row in each panel of Table 1 reports the standard error of each equation for the indicated subperiod. This evidence shows that indeed the volatility of shocks has declined in the present decade: the volatility of output and that of prices declined by a third. Therefore one could expect that a reduction in the volatility of shocks explains some of the "great moderation" effects in Chile. However, since the model is not a structural VAR, the volatility of shocks could also be the result of a more stable macroeconomic environment.

To get additional evidence on volatility, we compute the conditional volatility of the endogenous variables. To do this, we compute the forecasting standard errors of each endogenous variable for horizons ranging from 1 to 3 years. Table 1 also presents the results for the two subsamples analyzed. All variables except the real exchange rate show a smaller conditional volatility for the second subperiod (2000–06) than for the first. This conclusion is robust to the different horizons considered. These values confirm the evidence of a reduction in the magnitude of shocks after 1999.

One is thus tempted to conclude that the reduction in the conditional volatility of macroeconomic variables is explained by a reduction in the size of the shocks hitting the Chilean economy. However, when we compare the reduction in the standard deviation of exogenous shocks (the last row of each panel in Table 1) with the standard deviation of the forecast errors, we see that the decline of the latter is much larger. Moreover, the decline in the volatility of forecast errors is the combined result of the reduction in the volatility of shocks and the stabilizing effects of the transmission mechanism. Therefore the transmission mechanism of the current policy framework plays a crucial role in the "great moderation".

To shed more light on this issue, we compare the responses of the variables for both subsamples. To isolate the changes in the transmission mechanism, we consider impulses of the same magnitude in both samples in our VAR instead of the usual practice of using a shock equal to 1 standard deviation of the estimated innovations. This allows us to analyze the dynamic responses of variables while controlling for the size of the shocks.

Exchange rate shock

Figure 5 displays the responses of the short-term interest rate, output, prices, and the real exchange rate to an innovation of 1 percent in the real exchange rate equation. A comparison of the responses confirms a reduction in the pass-through of the exchange rate change to domestic prices. Several studies have analyzed this pass-through in Chile and elsewhere. As documented above, the evidence has shown that, in Chile, the pass-through has declined since the exchange rate has been allowed to float, in a manner consistent with Taylor (2000). Despite the rise in the volatility of the exchange rate since the free floating regime was introduced in 1999, the stability and low level of the inflation has reduced the persistence of changes in inflation and costs, and therefore it is likely that firms will have less incentive to pass to domestic prices the fluctuations in the exchange rate.

Shocks that generate a real depreciation are associated with a contraction in output in both samples. This cannot be interpreted as the contractionary effect of the depreciation, but rather as a negative correlation stemming from a shock that induces both a depreciation and a decline in output, such as a negative shock to productivity or the terms of trade. However, the fall in output in the first subperiod is larger and more persistent, despite the fact that the short-term interest rate declines in this subperiod whereas it rises in the second. This may be due to the fact that firms and banks have tended to be less vulnerable to exchange rate fluctuations since 2000, due to the substantial derivatives market deepening as the result of greater exchange rate flexibility (De Gregorio and Tokman (2005)). In a related work, Caputo, Medina, and Soto (2006) present evidence that the exchange rate has acted as a shock absorber since 1999, making the economy less prone to external fluctuations.

Price level shock

The responses to an innovation of 0.25 percent in the price index are shown in Figure 6. In the first subperiod, the price level remains high: it is still above the initial level after 3 years. In contrast, in the VAR for the second subperiod, prices return to their original level within a little less than two years. The output response associated with this shock implies a contraction for the first subperiod but a moderate expansion for the second.

These differences in behavior may reflect the role of the inflation targeting regime in Chile. The successful reduction of inflation during the 1990s and the implementation of a full-fledged inflation targeting framework in the second subperiod increased the credibility of the monetary authority's commitment to price stability. Additionally, the implementation of such a framework in an environment of low and stable inflation has made monetary policy more forward looking. Hence inflation expectations have become more anchored, and price shocks should have exerted a less persistent effect. During the previous period, as noted above, monetary policy was based on an indexed interest rate, and there were partial targets on the exchange rate. These developments can explain a less persistent behavior of price shocks since 2000. Moreover, the return of prices to their original level has been achieved at no cost in terms of output since 2000. This result may reflect the fact that the greater credibility with respect to the price stability objective reached at the end of the 1990s has reduced the cost associated with subduing inflation pressures. Also, as has been already mentioned, inflation targeting has gained credibility and thus automatic adjustment of nominal prices and wages based on past inflation has become a less frequent practice. Therefore the inertia of inflation dynamics might have fallen as well.

Copper price shock

Figure 7 presents the responses of the variables to an innovation of 8 percent in the copper price. This shock is exogenous for the variables in the VAR model and has an autoregressive coefficient of 0.99. The response of output within the first year is a little higher in the second subperiod than in the first. However, output keeps rising significantly in the first subperiod, during the second and third years after the shock. Hence the same shock in the copper price has medium-term consequences in output that are smaller and less persistent in the second subperiod than in the first, consistent with the more informal discussion above. In other words, this result confirms that output has become less sensitive to copper price fluctuations. The responses of short-term interest rates also show differences in behavior across the two subsamples. In the first subperiod the interest rate rises initially but then declines. In contrast, the reduction in the interest rate is slow after the first month in the sample that starts in 2000. However, the fall in the interest rate is less prolonged in this subperiod than in the first.

The short-run real appreciation caused by this shock tends to be somewhat larger in the first subperiod than in the second. In a medium-term horizon, the real appreciation caused by a copper price increase is larger in the 2000–06 sample than in the earlier sample. More dramatic differences are found in the responses of the price index: the price level increases in the first sample but falls in the second, and the absolute magnitudes of the deviation of the price level with respect to its initial value are larger in the first sample than in the second. Hence our estimations suggest that copper price increases generated inflation pressures during the 1990s but that these are no longer present after 2000.

Differences in the transmission of copper price movements to the aggregate economy might reflect the implementation of macroeconomic policies aimed at reducing the amplitude of the business cycle in Chile. In particular, the fiscal commitment, established in 2001, to spend the "structural" part of fiscal revenue has better insulated the economy from copper price fluctuations.[17] Under this fiscal rule, as structural revenue is computed with a long-run copper price, it is less sensitive to current copper price movements. The adoption of a floating exchange rate regime since late 1999 has also promoted the role of this variable as a relative price to absorb changes in external conditions. Thus the flexibility of the exchange rate in response to copper price fluctuations may have helped to reduce the response of output to copper price shocks.

V. Conclusions

Chilean macroeconomic policies have changed significantly in recent years. Chile has also seen important changes in macroeconomic performance: the volatility of both output growth and inflation has been reduced, consistent with the "great moderation" observed in other countries, and inflation has declined and remained at levels unprecedented in Chile with its tradition of high inflation. Although the volatility observed in the 1990s was already below that of previous years, the present decade has seen a further significant decline, coincident with the changes in the macroeconomic policy framework. The reduction in the size of shocks partly explains the reduction in volatility, but the response to the large swings in the copper price in the last few years lends support to the hypothesis that macroeconomic policy has also played a significant role in reducing volatility.

This paper has reported a time-series analysis, based on a reduced-form VAR, of how the mechanisms by which macroeconomic shocks are transmitted have changed in Chile. The VAR estimations provide evidence on how the monetary transmission mechanism has evolved, given the important changes in macroeconomic policies and the development of the financial sector. The VAR results confirm that only a part of the reduction in volatility is potentially due to less volatile exogenous shocks. After controlling for the size of shocks, the VAR estimations do suggest that modifications in the propagation of shocks are important in explaining the reduced volatility of output and inflation. In fact, credibility, together with the implementation of a full-fledged inflation targeting framework, has made inflation expectations more anchored and therefore the inertia of inflation dynamics has fallen. Additionally, the development of the derivatives market has made firms and banks less vulnerable to exchange rate fluctuations, reducing the exchange rate pass-through. Thus, changes in the transmission mechanisms are responsible for the bulk of Chile's "great moderation".

Some recent studies of the Chilean economy have attempted to disentangle the different factors explaining the changes in the transmission mechanism. In addition to the effects of

[17] However, one has to be careful in avoiding overemphasizing the role of current fiscal policy framework, since during the 1990s there was a de facto stable structural surplus around 1 percent of GDP (De Gregorio (2006), Figure 4). The difference with the current framework is that expansion of fiscal expenditure was procyclical since it was set around the forest of annual GDP growth.

macroeconomic policies, one also has to consider the increased degree of openness, the deepening of the financial system, and the more stable external environment, all of which have contributed to greater stability. On this broader assessment the jury is still out, but certainly the most important changes in recent years have been those in the macroeconomic framework.

Although Chile's financial sector has witnessed important advances in recent years, there is as yet no evidence on how this development has impacted the monetary transmission mechanism. Certainly a more sophisticated financial system should have contributed to the recent reduction in output volatility, as the greater access of consumers and firms to financing has increased their ability to stabilize expenditure when faced with fluctuations in income. An interesting topic for future research would be a deep analysis of the role played by the financial sector in changing the transmission mechanism.

Table 1

Forecasting standard errors

	Variable				
Subperiod and horizon	**Short-term interest rate**	**Output**	**Price index**	**Money supply**	**Real exchange rate**
1990–99					
1 year	0.86	1.69	0.63	3.62	3.32
2 year	1.01	1.84	1.09	4.13	4.32
3 year	1.07	1.85	1.49	4.38	4.79
SEE	0.45	1.35	0.31	2.15	1.43
2000–06					
1 year	0.40	1.04	0.49	2.81	3.64
2 year	0.55	1.18	0.69	3.62	4.28
3 year	0.56	1.21	0.73	3.73	4.37
SEE	0.14	0.87	0.22	1.79	1.87

Source: Authors' calculations.

SEE = standard error of the equations.

Figure 1

Level and volatility of GDP growth, five-year windows

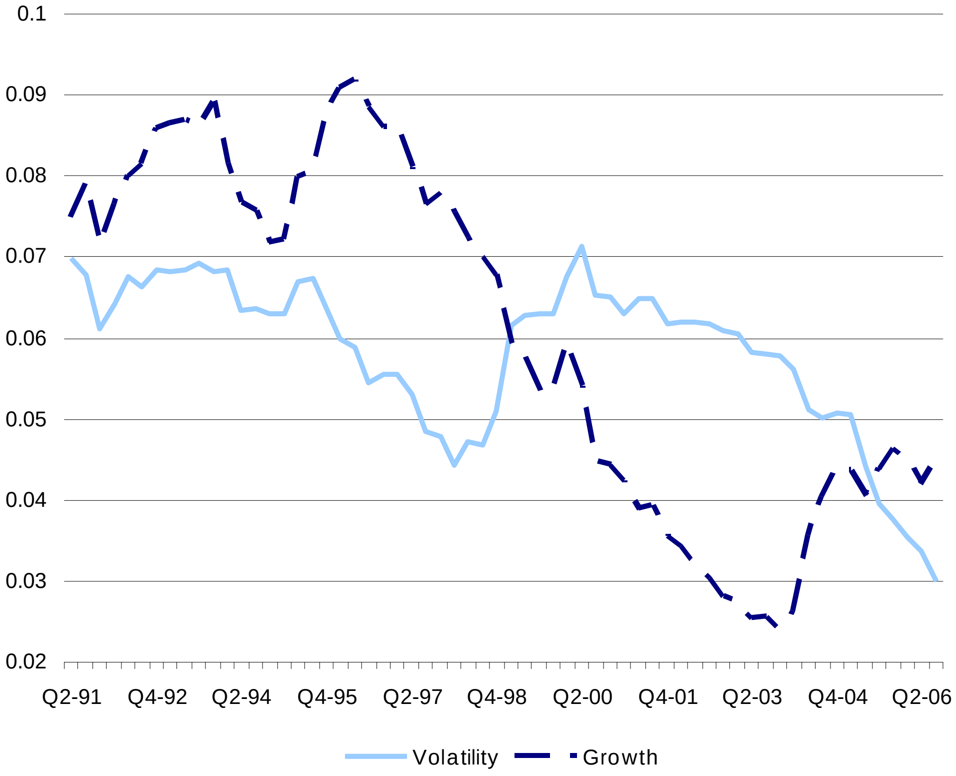


Figure 2

Inflation level and volatility, five-year windows

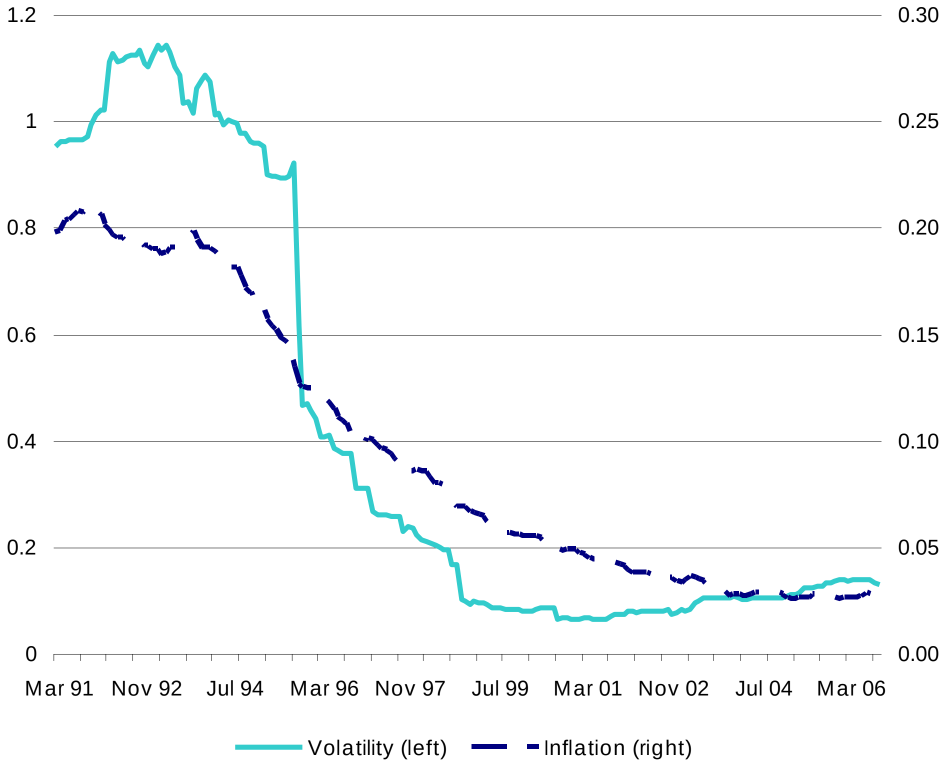


Figure 3

Volatility and level of the output gap, five-year windows

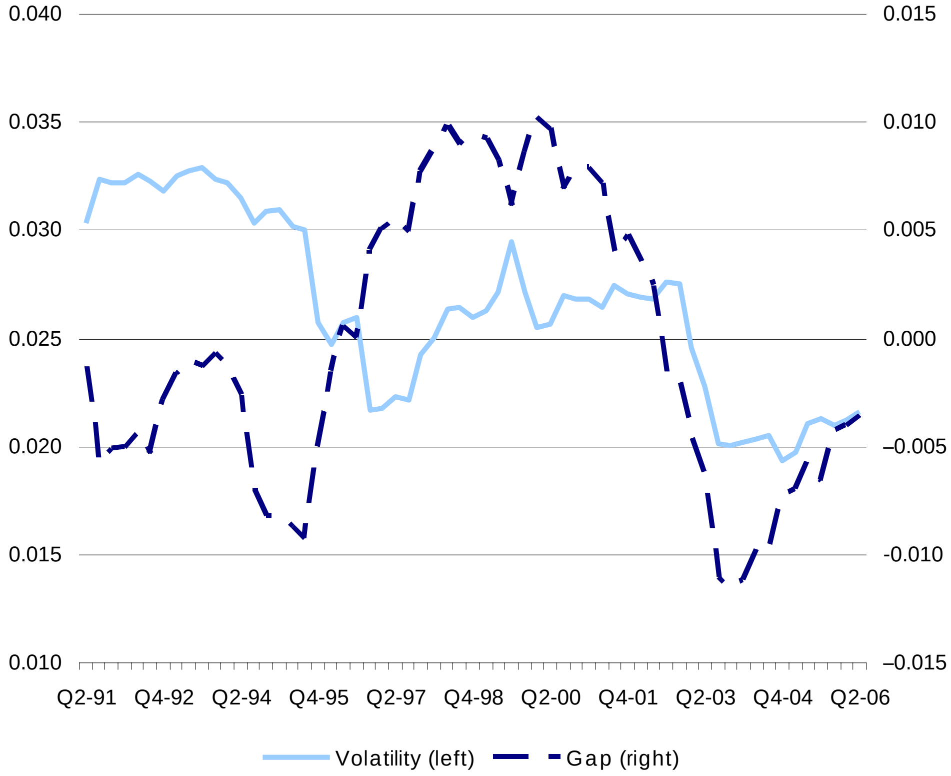


Figure 4

Stability of equations of the VAR

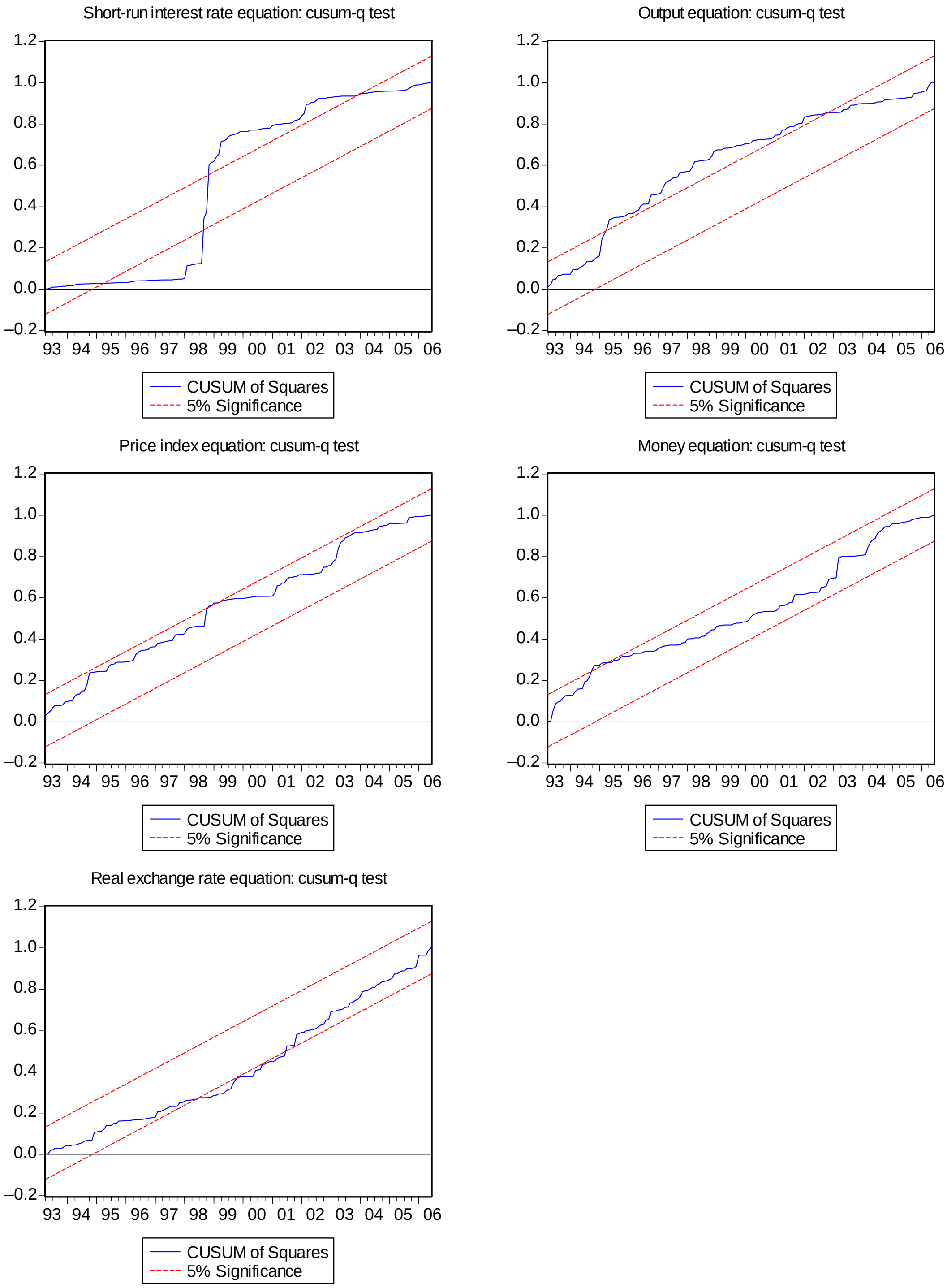


Figure 5

Responses to a real exchange rate shock

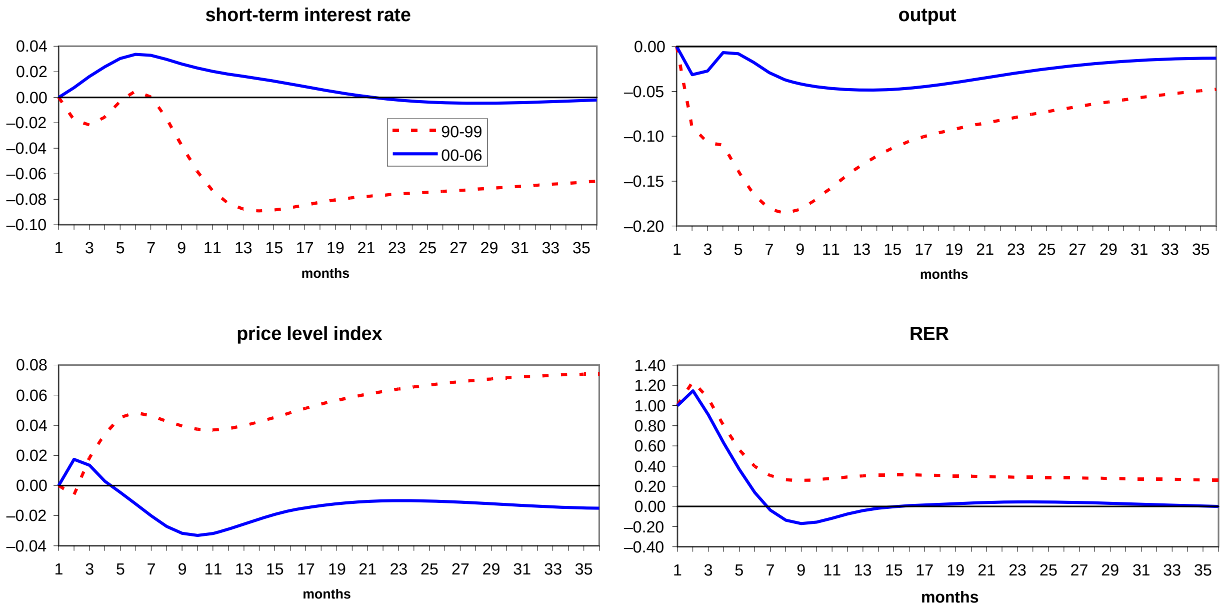


Figure 6

Responses to a price level shock

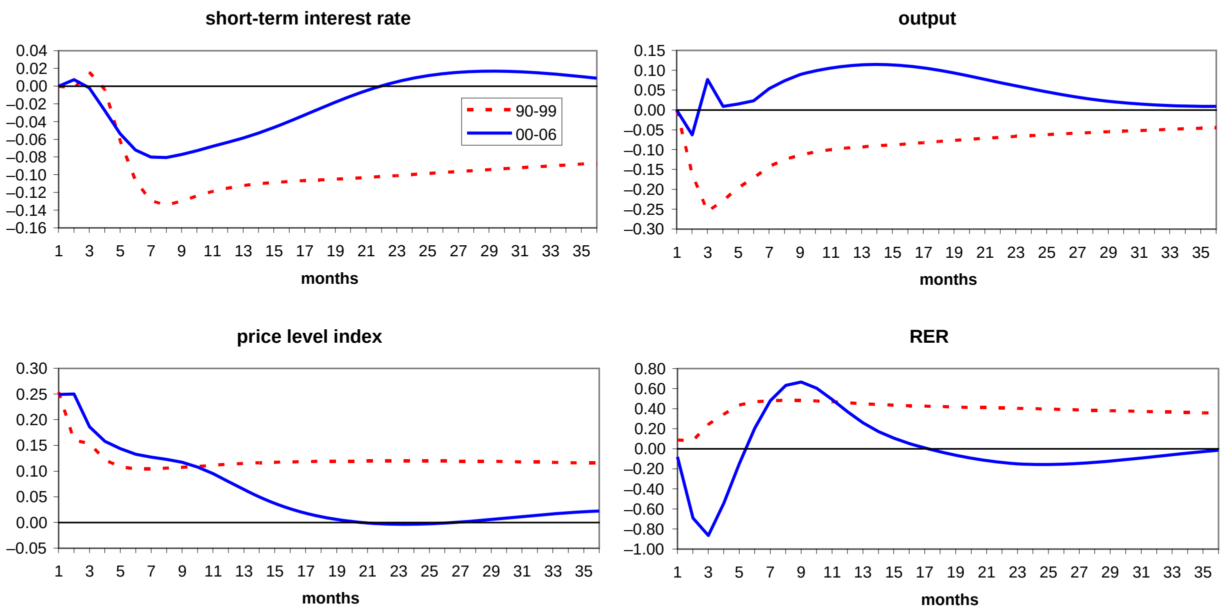
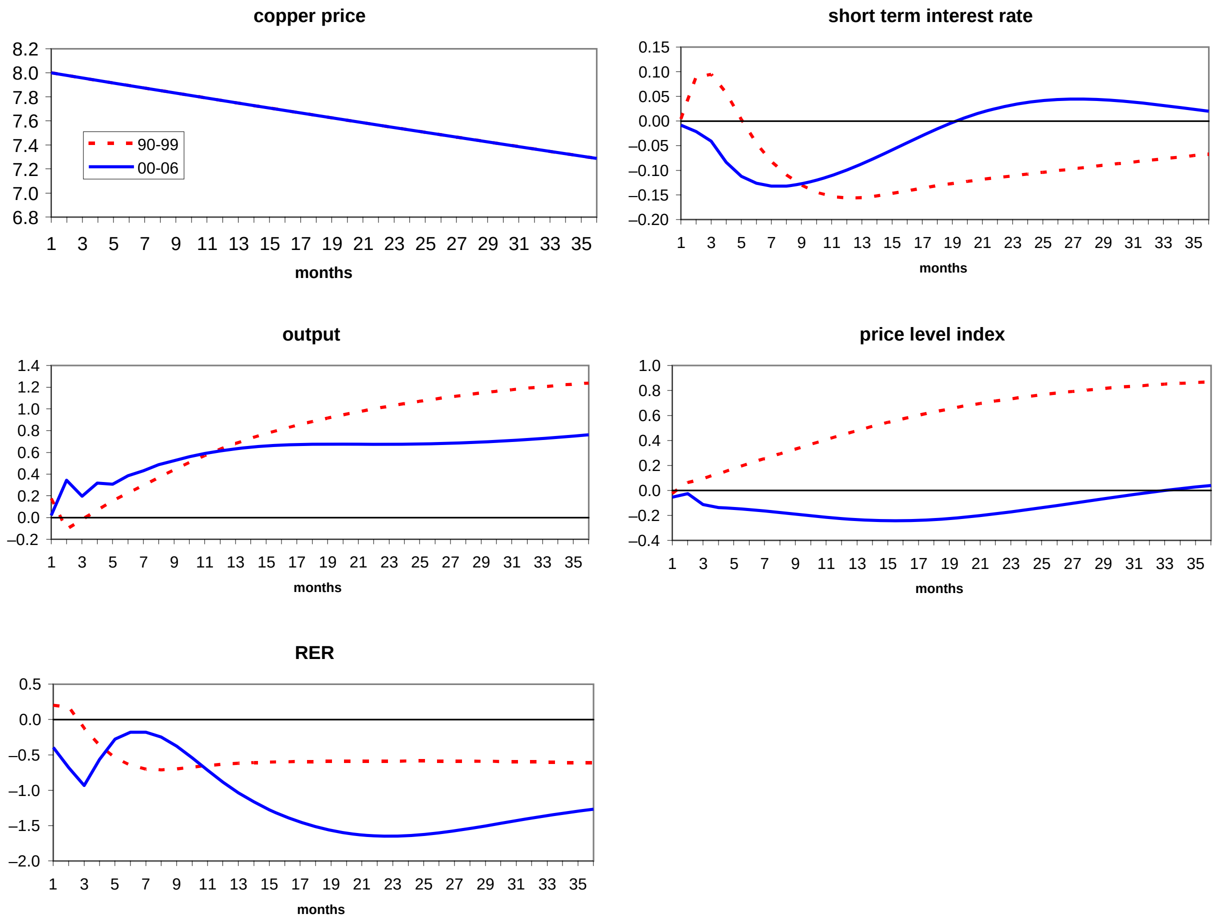


Figure 7

Responses to a copper price shock



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The monetary policy transmission mechanism in China

Yi Gang

I. Evolution of monetary policy transmission mechanism

The People's Bank of China (PBC) began functioning as the central bank in 1984, and since then monetary policy has been used to balance the aggregates. At the time, direct credit controls were used in the conduct of monetary policy, ie direct controls on credit and cash were relied upon to manage and adjust the economy, to prevent inflation and to promote economic growth.

Since the 1990's, the method of financial macro-management has gradually changed. With the abolition of credit ceilings on January 1, 1998, and the expansion of open market operations, monetary policy operations also moved from direct credit control to indirect measures. During this transition, the intermediate and operational targets also switched to money supply and base money, with the adoption of a combination of monetary policy instruments, such as open market operations, reserve requirements, central bank discount, central bank lending and interest rates. An indirect management system has been set up, with stabilizing and promoting economic growth as the final goal and money supply as the intermediate target, through the usage of multiple monetary policy instruments. At the same time, with the development of a money market, a "central bank → money market → financial institutions → enterprises (individuals)" transmission system is taking shape, and progress has been made in developing an indirect transmission mechanism, using monetary policy instruments to influence operational target, and in turn to influence the intermediate target and eventually to achieve the final goal. As a result, the monetary policy management system has also been improved.

II. Monetary policy transmission relies mainly on an indirect management mechanism

Recent years have seen the transformation from direct control through administrative measures, such as quotas, to indirect controls through economic measures, while greater priority has been given to building a mechanism for macro-management.

First, monetary policy instruments have been further improved. A framework has been set up in which a combination of open market operations and other instruments such as reserve requirements, central bank lending and rediscount, are used to adjust base money and to manage credit aggregates. The role of open market operations has been strengthened in the daily adjustment of base money and they have become a major instrument.

Second, interest rate system reform has been pushed forward, with the role of interest rates strengthened. The band of deposit and lending rate floating has been further widened, and the lending rate ceiling and deposit rate floor have been abolished. With this improvement of the central bank interest rate system, the central bank is now better able to guide the market interest rate using monetary policy instruments. Financial institutions can make better pricing, and market participants are more sensitive to interest rate changes. This shows that the importance of the interest rate in resource allocation and in transmitting monetary policy has become more apparent.

Third, the flexibility of the RMB exchange rate has increased as market supply and demand have played a bigger role in the formation of the RMB exchange rate. On July 21, 2005, China adopted a managed floating exchange rate regime based on market supply and demand with a reference to a basket of currencies, putting an end to a basically fixed RMB exchange rate. The experience in the past year indicates that following a self-initiated, controllable and gradual principle in exchange rate regime mechanism reform is the right approach, and the reform has produced good results. Risk management tools such as forward sales and purchases of foreign exchange and swaps have been developed rapidly. Economic agents have increased their awareness of and capacity to manage exchange rate risks and become adaptive to the managed fluctuation of the RMB exchange rate. The growth of exports declines while that of imports goes up. The utilization of foreign capital continues to increase. Economic growth and employment have not suffered any shocks.

Fourth, financial markets have developed stably and the monetary policy transmission mechanism has further improved. The development of financial markets not only directly impacts the transmission of monetary policy but also to a large extent determines the transition toward indirect approaches. In recent years, financial markets have developed rapidly thanks to a number of innovations. A monetary policy transmission process has developed which flows from central bank to financial markets and financial institutions in turn, and impacts real sectors. The financial system continues to develop and improve so that a financial market system with diversified trading locations, products and mechanisms has gradually been formed. Functions of financial markets have been deepened continuously. Participation of market players has increased and more channels are available now. In addition, with financial products and tools multiplying and market size expanding, the efficiency of resource allocation has improved significantly. Institutional building of financial markets has been increasingly strengthened. Major achievements have been made in infrastructure, legal and supervisory framework construction. The openness of financial markets has been enhanced continuously as well. The policy of attracting foreign capital and participation has achieved significant results, while domestic institutions have quickened their paces to go to the overseas market.

Fifth, there has been a breakthrough in financial institution reforms, resulting in heightened incentives for profit maximization and sensitivity to the indirect approach of monetary policy. Overall, the microeconomic foundation of monetary policy transmission has been further reinforced. The reform of state-owned commercial banks has evolved smoothly. After the introduction of strategic investors, state-owned banks have achieved diversification in ownership and clarification in property rights, and a modern corporate governance framework has gradually emerged, along with significant improvement in balance sheets. The pilot reform of rural credit cooperatives has achieved significant progress. Their non-performing loans have declined greatly and capital adequacy ratios increased gradually. Meanwhile, by steadily promoting the reform of the property rights system and transforming the operating mechanism, rural credit cooperatives have also conducted some meaningful experiments in strengthening internal management information disclosure and the legal person governance structure. Reform of other financial institutions has accelerated, with that of postal saving institutions pushed forward steadily. Reform of insurance companies has seen a breakthrough, with the ownership restructuring of state-owned insurance companies largely finished. Reform and restructuring of policy banks, shareholding banks, urban commercial banks and other non-bank financial institutions has also accelerated appreciably.

III. A further improvement of the monetary policy transmission mechanism

Although improvements have been made in China’s monetary policy transmission mechanism in recent years, some problems still remain. First, the independence of monetary policy in macroeconomic management has been constrained to some extent. In recent years, with widening imbalances in international payments and intensified structural imbalances in the Chinese economy, monetary policy has had to face weakened pre-emptiveness and effectiveness in maintaining internal equilibrium. Second, it is more difficult for monetary policy to be conducted with money supply as the intermediate target. Although price instruments have had a strengthened role in monetary policy, monetary policy operations still rely heavily on quantitative management aimed at adjusting money supply. With further enhancements in financial innovation and the introduction of financial derivatives, a monetary policy transmission mechanism with money supply as its intermediate target will face more challenges.

In order to solve the existing problems in monetary policy transmission, in addition to domestic economic structural adjustment, on the part of the monetary policy, we need to promote a shift from quantitative instruments to price instruments, further improve the exchange rate regime, and continue to push ahead steadily with market-based interest rate reform, so as to enable price instruments such as the interest rate and exchange rate to play a sufficient role in monetary policy transmission.

First, improving the RMB exchange rate formation regime. Based on the need of China's economic and financial development and stability, market demand and supply will be given a fundamental role in RMB exchange rate regime formation, according to the principle of a self-initiated, controllable and gradual approach, to improve the managed floating exchange rate regime and maintain RMB exchange rate basically stable at an adaptive and equilibrium level. In addition, the reform of the foreign exchange management system will be speeded up by establishing and strengthening the market mechanism and management system for international payments so as to promote BOP equilibrium and support balanced and sustained growth of the overall economy.

Second, steadily advancing market-based interest rate reform. We will enhance the leverage role of interest rates in monetary policy transmission, further harmonize the relationship among central bank policy interest rates, financial market rates and deposit and lending rates of commercial banks, encourage financial institutions to promote liquidity management capability, improve their sensitivity to macro management measures by the central bank, and gradually set up an interest rate transmission mechanism through which financial institutions price their loans with reference to market rates and market rates move in response to central bank benchmark rate adjustments. The recent development of Shibor (Shanghai interbank offer rate) is an encouraging sign for interest rate liberalisation

Third, pushing forward the reform of state-owned commercial banks and rural credit cooperatives. We will continue to promote share-holding reform of state-owned commercial banks, and turn them into modern financial institutions with adequate capital, strict internal control, secure operation and good services and profitability. The rural financial services system will be improved by developing rural credit cooperatives into local financial institutions with a clearly established ownership structure, scientific management, strengthened disciplinary mechanism and financial sustainability, providing services to the rural economy on a commercial basis.

Fourth, promoting further financial market development. We will improve the existing financial products, standardize operational procedures for financial instruments, and increase the width and depth of the financial market through financial innovation. We will also implement a supervisory policy that encourages financial innovation, establish fair market rules for such innovation, and actively foster a social environment in favor of financial innovation under the precondition of risk prevention. Efforts will be made to develop direct financing, broaden linkages between the money market and the capital market, improve the efficiency of monetary policy transmission in the capital market, further promote the resource allocation function of the financial system and foster the formation of real capital price signals.

The transmission mechanism of monetary policy in Colombia: major changes and current features

Hernando Vargas[1]

Introduction

The Colombian economy underwent substantial changes over the last decade that affected the transmission mechanism of monetary policy in significant ways. After a protracted recession and a financial crisis, the economy, characterized by moderate, slowly declining inflation, a complex monetary regime, incipient financial asset markets and a credit surge, as depicted by Carrasquilla (1998), transformed into a low inflation economy with an inflation targeting regime and a relatively deep public bond market. This paper seeks to describe the main elements of this process. In the first part, an account of some of the major changes experienced by the Colombian economy is presented. In the second part, these changes are linked to the current features of the transmission mechanism.

1. Main changes in the Colombian economy affecting the transmission mechanism

In 1997 CPI inflation in Colombia was 17.7% and had come down from 25.1% in 1992 (Graph 1). The monetary policy strategy consisted of a system of "bands" for the exchange rate, the monetary aggregates and the interbank interest rate that were supposed to be consistent with an inflation target announced for the year. Since there could be conflict between the bands, an ordering of priorities was established, but it was not always followed in the face of some of the shocks that hit the economy later on.

Aggregate expenditure had risen fast since 1992, following large capital inflows and low real interest rates between 1992 and the first half 1994. As a result, the current account deficit was 4.7% of GDP on average between 1993 and 1997, while financial system credit growth was above 16% in real terms between 1992 and 1995. The increase in mortgage credit was a considerable part of total credit growth and real estate real values climbed between 1992 and 1995. Non-interest public expenditure also rose as a percentage of GDP from 17.4% in 1990 to 30.6% in 1997.

As a consequence, the Colombian economy was highly vulnerable to external shocks in terms of both income/expenditure flows and domestic/external stocks of debt. Private external debt went up from 6.6% of GDP in 1992 to 18.4% of GDP in 1997, while the ratio of financial system loans to GDP reached 43.1% in 1997, a large number when compared to an average of 30.5% between 1980 and 2006.

In these circumstances, the terms of trade deteriorated in 1998 and private capital flowed out of the country between 1998 and 1999. There were strong pressures for currency depreciation. The exchange rate target zone was defended in 1998, but was finally devalued

[1] Banco de la República Colombia. The ideas and opinions expressed in this document are the sole responsibility of the author and do not necessarily represent the views of Banco de la República or its Board of Directors. The author is grateful to Julián Pérez and Franz Hamann for their comments and their help with the econometric exercises presented in the second section of the paper.

in August of that year, following the Russian crisis. Renewed pressures on the currency occurred in mid 1999. The target zone was devalued again and widened. Finally, in September 1999 the currency was allowed to float and the monetary policy regime converged to a full fledged inflation targeting strategy. A program was agreed with the IMF to stabilize the public debt ratios and to grant access to the scarce external funding.

The external shock to such a vulnerable economy also produced a sharp drop in output and employment. GDP fell by more than 4% in 1999 and growth did not recover significantly until 2003. Given the high degree of indebtedness of the private sector and the fragility of some segments of the financial system, a financial crisis ensued. All these events changed the transmission mechanism in substantial ways. In the remainder of this section, three key events will be described in some detail to provide an understanding of their influence on the current transmission mechanism.

(a) The fall of inflation

Graph 1 shows that CPI inflation fell rapidly in 1999. It went from 16.7% in December 1998 to 9.2% in December 1999, decreasing more in that year alone than in all the five previous years. This abrupt disinflation came as a surprise for the markets and the public (Table 1) and was associated with the recession that occurred in 1999 (Graph 2). In that year, investment fell by 38.6%, consumption decreased by 3.2% and the unemployment rate rose by 4.2 percentage points. Short term real interest rates had increased since early 1998, reaching record levels (17.3%) in November 1998, as a result of the rise in the country risk premia, as well as the efforts by the central bank to defend the exchange rate target zone.

Since a real depreciation of the currency was required by the changing external conditions, non-tradable price annual inflation fell by 8.8 percentage points in 1999, while the price increases of the tradable sub-basket fell by 6 percentage points in that year. Rents, a large component of the non-tradable sub-basket, were particularly hard hit, with real decreases of 5.1, 7.4 and 5.6 percentage points in 1999, 2000 and 2001, respectively. The financial crisis and the burst of a real estate bubble were behind such a drop in real rents.

Between January 1998 and December 2000 the currency depreciated by 44.5% and 28.9% in nominal and real terms, respectively. As mentioned, inflation fell throughout the period, so the impact of depreciation on headline CPI inflation was insignificant. This reflected the need for a real depreciation, the reaction of the central bank and the response of the economy to increased external and domestic interest rates in the context of large imbalances.

After 1999 the Central Bank followed a policy of gradual disinflation, setting decreasing annual targets that have been met most of the time (Graph 1). Some authors have argued that the disinflation of 1999 and beyond was “fortuitous” because the Central Bank took advantage of the considerable negative output gap that has prevailed throughout most of the present decade (Graph 2) (Clavijo, 2000). However, the very fact that the Central Bank did not try to set low interest rates in the midst of the crisis (with rising sovereign risk premia) or to increase inflation afterwards to stimulate the depressed economy sent a strong signal about the preferences and the long run targets of the policymakers. In particular, they showed the Central Bank’s willingness to achieve and keep low levels of inflation, indicating that the disinflation had been permanent. This was an important message, given Colombia’s long history of moderate inflation and the timid pace of disinflation before 1999.

(b) The adoption of an inflation targeting strategy

Some elements of an inflation targeting (IT) regime were present in Colombia before 1999. Quantitative inflation targets had had to be announced by law since 1992. An internal Inflation Report was produced to guide the decisions of the Board of Directors. This report included several statistical and single-equation models to forecast inflation, and some effort was made in order to understand the short run determinants of inflation. The Inflation Report started to be published in December 1998.

After the currency was allowed to float in September 1999, the decision was made to follow an IT strategy. Nevertheless, the limited knowledge of the transmission mechanism and the lack of instruments to predict or simulate the behavior of the economy over horizons longer than one year represented serious restrictions on the application of IT. In addition, money demand seemed to be stable, so initially, the IT strategy was accompanied by "reference paths" for M3 and the monetary base, like the ones used in the ECB. The idea was that the signals about the future course of inflation were to come from both the IT analysis and forecasts, and the deviations of the monetary aggregates from their "reference paths".

With time, however, the relationship between money growth and inflation changed (as illustrated below) and some demand functions turned unstable. Simultaneously, knowledge of the transmission mechanism was developed (Gómez et al, 2002), as well as instruments to forecast and simulate the behavior of the economy over longer horizons, conditional on monetary policy. Hence, the deviations of monetary aggregates from their "reference paths" were abandoned as a strong criterion for policy action and the monetary policy strategy converged to a full fledged IT regime.

Within the IT framework, the main instrument of the Central Bank is its overnight repo interest rate. At the policy rate, the Central Bank provides (withdraws) all the liquidity demanded (supplied) by the financial system. The aim is to guide the overnight interbank rates and the banks' deposit and loan interest rates toward levels deemed as consistent with the achievement of the inflation target 18–24 months ahead. The immediate effect of this change was the stabilization of the overnight interbank interest rates (Graph 3) and the production of a clear signal on the stance of monetary policy. Before, the interbank rates fluctuated widely because the Central Bank tried to set paths for the monetary aggregates or defended the exchange rate at the ends of the target zone.

Up until 2002 the Central Bank set annual point inflation targets. Since 2003, it has set a ±0.5% range target for the year ahead and has announced a wider range for the mid-point of the target two years ahead. This is consistent with the estimated horizon in which monetary policy has the largest effect on inflation (18–24 months). Also, the Central Bank announced a long term target of inflation between 2% and 4%. The successive announced ranges have been decreasing toward the long run target, as the Bank has explained to the public that it intends to gradually converge to it. As long as the credibility of the Central Bank's inflation targets is enhanced, the policy described above may have implications on formation of prices and wages, altering the persistence of inflation, anchoring inflation expectations and making the accomplishment of the targets less costly.

(c) The financial crisis

Some sectors of the financial system presented fragilities during the 1990s (Uribe and Vargas, 2003). Regulation and supervision of public owned banks and some financial cooperatives were weak. Risk management practices at those institutions were poor and many of them eventually failed when interest rates increased, unemployment rose and income fell.

The mortgage banks were not sufficiently capitalized to reflect the credit risk associated with large increases in unemployment or falls in the real value of collateral (real estate). There was a mismatch between long run loans (partially indexed to the short run interest rate) and short term liabilities (interbank loans and CDs). Thus, mortgage banks' profits were vulnerable to sharp shifts in short run interest rates. In addition, even though it was partial, the indexation of mortgage loans to the short run interest rate made the disposable income of indebted households quite sensitive to movements in interest rates.

In this context, the external shocks that led to skyrocketing foreign and domestic interest rates produced a marked deterioration of the financial situation of households and mortgage banks. All the abovementioned risks were realized, collateral values plummeted and many households stopped paying their debts. One large mortgage bank went bankrupt and required intervention by the Government.

The financial crisis was to have important consequences for the transmission mechanism:

- The credit channel of transmission of monetary policy was severed, as the demand for credit was cut by highly indebted individuals and firms, while credit supply was restricted by a financial system that had an increased risk perception of the economy and whose capital had been hit by large losses (Echeverry and Salazar, 1999, and Barajas and Steiner, 2002, among others). In this situation, the expansive monetary policy that followed the crisis had a limited impact on aggregate demand. At some point, its effect may have been restricted to the income effect on borrowers. This may be one of the reasons for the protracted recession of the Colombian economy (Graph 2).
- Given the increased credit risk perception and the deterioration of their capital, banks and other financial institutions turned to domestic public bonds as an alternative investment. The rapid growth of the private pension funds portfolios also contributed to the increase in the demand for public bonds. At the same time, the Government's rising financial requirements, the restrictions in access to external funding and the need to reduce the Government's foreign exchange exposure induced an increasing supply of public domestic bonds throughout the decade. The development of the public bond market has allowed the formation of a zero coupon curve, a key element for the pricing of financial assets. The importance of this change will probably be greater in the future, as the fixed rate, long run, private loan and bond markets expand (especially the mortgage loan market). More recently, the upsurge of public bond holdings by financial intermediaries has exacerbated their exposure to market risk (Vargas et al (2006)), making their asset portfolio adjustment an important element of the transmission mechanism in the short run.[2]
- Securitization of mortgage loans emerged, encouraged by income tax exemptions on earned interest. There was a deliberate policy to develop this market, with the idea of better diversifying credit risk. Today the size of mortgage backed securities is around 38% of non-securitized mortgage loans. Most of these securities are held by banks.
- Mortgage loans were de-linked from short run interest rates, so a strong and fast connection between policy rates and household expenditure was broken. Today, mortgage loans are made at fixed rates or indexed to CPI inflation. Their importance in the transmission mechanism is still subdued, because of the process of debt reduction started by households after the crisis.

[2] For example, after some turbulence in April–July 2006, banks reduced their holdings of public bonds and shifted to loans (especially consumer loans). This implied a reduction in lending rates at a time when the Central Bank was raising its interest rates.

2. Main features of the transmission mechanism

The events described in the foregoing section had some effects on the responses of inflation to its macroeconomic determinants, the behavior of aggregate demand and the reaction of market interest rates to shifts in monetary policy.

(a) Determinants of inflation

The permanent fall of inflation and the adoption of an IT regime had some consequences for the determination of inflation over short term horizons (two years or less):

- Expectations of sustained single-digit inflation and improvements in the credibility of the Central Bank's targets have partially reduced inflation persistence and helped to anchor expectations.
- Falling inflation expectations and supply shocks have shifted the short-run Phillips curve. At the same time, lower and more stable inflation may have changed the sensitivity of the short-run aggregate supply to inflation surprises.
- Exchange rate flexibility and the credibility of a low inflation regime could have decreased pass-through from imported goods prices to CPI inflation. However, an increased degree of competition in the economy may have raised the pass-through from the exchange rate and foreign prices to imported good prices.
- Finally, the fall of inflation, some exogenous shocks and the new policy regime have blurred the short and medium term relationship between money growth and inflation.

(i) Inflation persistence and anchoring of expectations

The literature on IT argues that one of the main advantages of this regime is the reduction of inflation persistence and the anchoring of expectations. If the inflation target is credible, indexation mechanisms and adaptive expectations should be weakened, as agents put more weight on the inflation target in the formation of prices and wages. Hence, shocks do not have permanent effects of inflation (Capistrán and Ramos-Francia (2006a)).

Inspection of the Colombian survey data indicates that the credibility of the inflation targets and the anchoring of expectations gradually improved after the fall of inflation and the adoption of IT (Table 2). Capistrán and Ramos-Francia (2006b) also show that the consensus inflation expectations for 18–24 months ahead inflation have become closer to the inflation target since 2003, even though current inflation may have been higher than the future target.

With respect to inflation persistence, typically two methods are used to assess its changes (Bergljot et al (2006)):

- Changes in the sum of the coefficients of past inflation in a simple autoregressive specification:

$$\pi_t = a + \sum_{j=0}^{p} b_j \pi_{t-j} + \varepsilon_t$$

- Changes in the coefficients of "backward" and "forward" looking components of a Hybrid New Keynesian Phillips Curve (HNKPC) (γ_b and γ_f):

$$\pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \lambda mc_t + \mu_t$$

Here, persistence is attributed to inertia ("intrinsic persistence"), expectations ("expectation-based persistence") or the persistence of the deviations of marginal costs from their steady state value ("extrinsic persistence").

Regarding the first method, three studies find mixed results, depending on the price index used (Table 3). According to these estimates, after 1999 persistence declined for the GDP deflator and CPI food and non-tradable inflation. Persistence remained high for CPI headline inflation as well as for tradable and regulated price inflation.[3] González and Hamann (2006) argue that the apparently still large degree of persistence in CPI inflation might be due to imperfect credibility and information, and a slow process of learning by the public about the "permanent component" of the inflation target.[4] They link this interpretation to the gradual pace of disinflation that has taken place in Colombia.

On the other hand, estimates of the HNKPC coefficients seem to support the hypothesis that intrinsic persistence lost importance in favor of expectations-based persistence after 1999 (Table 4).

In sum, there is some evidence that the permanent fall of inflation and the adoption of an IT regime may have helped to anchor inflation expectations. The latter seem to have become more important in price formation, but persistence remains high for some price indices. It is worth recalling that inflation is not at its long run target yet, and that disinflation has been slow. Thus, obtaining all the benefits of low inflation and IT in terms of low "sacrifice ratios" will take more time in Colombia.

(ii) Shifts and "slope" of the short-run aggregate supply

Decreasing inflation has led to decreasing inflation expectations and this has shifted the short-run Phillips curve in Colombia since 2000 (Graph 4).[5] More recently, supply shocks and the increased degree of competition in some sectors have also contributed to this movement. This is confirmed by the behavior of non-tradable prices inflation, presumably the component of the CPI that is most sensitive to the output gap. Graph 5 shows that the relationship between non-tradable inflation and the output gap breaks after 2000, as the output gap closes and inflation remains stable. However, when the relationship is corrected for inflation expectations,[6] the association becomes apparent (Graph 6).

The "slope" of the short run aggregate supply (the response of inflation to the output gap) seems to have declined with the fall of inflation, although the evidence is less conclusive in this regard:

- Recursive OLS estimation of an aggregate supply equation points to a reduction of the output gap coefficient since the start of the disinflation process (1991), with an additional downward shift after 1997 (Graph 7).
- The estimations of the HNKPC presented above indicate a greater sensitivity of inflation to deviations of marginal costs from their steady state values after 1999

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[3] González and Hamann (2006) use a Kalman filter to estimate a structure in which a smooth trend and persistence of inflation are modeled simultaneously. In this case, persistence is understood as the speed of reversion to the trend. Their results show that for the 1990–2005 sample, persistence is high for the core inflation measures and tradable goods inflation. Persistence is low (negative in some cases) for non-tradable and regulated price inflation, as well as for headline inflation.

[4] The evidence found by González and Hamann (2006) favors this explanation over a simple ad-hoc indexation hypothesis.

[5] Some studies suggest that the long run component of the unemployment rate rose in the first part of the nineties due to increasing non-wage labor costs (eg Arango and Posada (2006)). This would have implied an upward shift in the Phillips curve presented in Graph 4. Slowly falling inflation expectations at that time could have (partially) offset this movement.

[6] Inflation expectations are taken from the core simulation/forecast model of Banco de la República and correspond to a weighted average of future and past inflation.

(Table 5). Since a positive relationship is expected between the output and the marginal cost gaps,[7] this result does not seem consistent with the previous one.

Several stories can be told around both results. On the one hand, the opening of the Colombian economy during the early 1990s and the effects of globalization may explain the first finding (reduced sensitivity of inflation to the output gap), in line with the interpretation given to similar results in industrialized countries (Helbling et al (2006)). The idea is that with increased integration, domestic factors have become less important in explaining domestic prices, relative to global or external factors. On the other hand, the larger response of inflation to the marginal cost gap may indicate greater price flexibility in Colombia after 1999 (among other things). This could be the result of a higher degree of competition in several sectors. However, this hypothesis would have to be validated by microeconomic data.

An alternative, more "classical" interpretation of the diminished reaction of inflation to changes in the output gap has to do with the reduction of inflation and inflation volatility. The classic paper by Lucas (1973) suggests that the response of aggregate supply to nominal shocks depends on the ratio of the volatilities of individual relative prices and aggregate prices.[8] Table 6 shows that the ratio of the volatility of relative price changes to the volatility of inflation has increased for several sectors, as inflation and inflation volatility decreased in Colombia.

(iii) Exchange rate pass-through

Graph 8 shows a decreasing recursive OLS coefficient of PPI imported goods price inflation in a core CPI inflation (aggregate supply) equation, suggesting a declining pass-through since 1991. Similar results are obtained from a Kalman filter estimation of a system comprising an equation for core CPI inflation and an equation for imported good prices (Graph 9, second panel). In contrast, the pass-through from exchange rate depreciation and foreign prices to imported good prices has apparently increased in the same period (Graph 9, first panel).

The decreasing size of pass-through to CPI has been observed in many economies (eg Baqueiro et al (2003)) and has been attributed to a credible, low inflation environment (Taylor (2000)), among other things. Graph 8 suggests that it started to fall in Colombia with the beginning of the disinflation process (1991). However, given the slow speed of this process, a more plausible explanation of the decaying pass-through could be the adoption of a more flexible exchange rate arrangement.[9] In this context, shifts in the exchange rate are transferred to prices only if they are perceived to be persistent. A floating regime introduces uncertainty about the duration of a shock, hence moderating the pass-through.

Curiously enough, according to Graph 8, the pass-through coefficient did not experience significant changes after 1999, when the currency floated, IT was adopted and inflation fell. Nonetheless, Graph 9 indicates that the pass-through has continued to fall throughout the past ten years.

In contrast to the previous result, Graph 9 (upper panel) shows that the pass-through from the exchange rate and foreign prices to imported good prices has almost continually increased since 1991. Using sectoral data, Rincón et al (2005) find evidence of incomplete

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[7] This relationship holds with fixed prices and flexible wages.

[8] Intuitively, in the context of imperfect information, the smaller the volatility of the money supply and aggregate prices, the more informative are the individual price changes about shifts in relative prices.

[9] Before 1991, a crawling-peg regime with capital controls had been in place for about 25 years. From 1991, an "implicit" target zone allowed the currency to fluctuate within a rather wide band. Between 1994 and 1999 the bands were explicitly set and announced. After September 1999, the currency was allowed to float.

pass-through from the exchange rate to manufactured imported goods, supporting the existence of non-competitive market structures. They also find unstable and non-decreasing pass-through coefficients for most of the sectors considered between 1995 and 2002. Interestingly, these coefficients rise after 1999 (some revert later, other do not), when a persistent depreciation of the currency took place.

Non-decreasing pass-through coefficients to imported prices in a falling inflation, flexible exchange rate environment may signal an increasing degree of participation of imported goods suppliers in the manufactured goods markets. This is consistent with the opening of the economy in the 1990s.

(iv) Money and inflation in the short run

The short-run relationship between money and inflation weakened in Colombia after the disinflation (Graph 10). Non linear effects of the reduction of inflation and nominal interest rates, as well as exogenous shocks (like an increasing debit tax) may help explain the real expansion of the monetary base. The dramatic increase of the real money demand has been accommodated by the Central Bank, given the policy regime. At the policy interest rate, all the money demanded is supplied, so the changes in the demand for money show up in the observed quantity of money.

In addition, some money demand functions have turned unstable in their parameters. The effect of these events has been a reduced usefulness of money to understand or predict inflation developments.[10] More recently, however, González et al (2006) have found evidence of a greater contribution of money gaps (relative to the output gap) in the explanation of the deviation of inflation from its targets.

(b) Behavior of aggregate demand

(i) Sensitivity of aggregate demand to the interest rate

The debt build-up and the ensuing financial crisis of the 1990s had some consequences for the behavior of aggregate demand. Interest rate sensitivity of aggregate expenditure rose with the increase in debt and was apparent during the recession of 1999. Graphs 11 and 12 show that the debt ratios of households and firms reached their peaks around 1998. This made the private sector highly sensitive to interest rate shocks.

When external conditions changed in 1998–1999 and interest rates went up, the effect on private demand was relatively large. In addition to the increased debt burden, real estate relative prices had been falling since 1996. Private consumption and investment fell sharply as interest rates climbed (Graphs 13 and 14). The recursive OLS coefficient of the real interest rate deviation from trend in an "IS curve" equation illustrates the enlarged sensitivity of aggregate demand to interest rate changes after 1999 (Graph 15).

After 1999 real interest rates came down fast, while expenditure recovered slowly (Graphs 13 and 14), reflecting the fragile financial situation of the financial and private sectors. As

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[10] For example, when the Central Bank sets the interest rate, an interpretation of a negative correlation between money growth and inflation, like the one shown in Graph 10, could be the succession of exogenous money demand shocks and the presence of a negative output gap that reduces inflation. Alternatively, higher demand for domestic assets could simultaneously raise money demand and appreciate the currency, putting downward pressure on inflation. Yet a third interpretation could be an expansion of productivity that explains both the decline of inflation and the rise of money demand. So, difficulties arise when interpreting the money-inflation relationship in the same way that understanding the inflation-output relationship may be complicated at times.

mentioned in the previous section, firms and households entered in a process of debt reduction, while banks turned to public debt bonds as an alternative investment. Today, private sector indebtedness is lower and the recent expansion in investment has been financed mostly with internal savings (Table 7).[11] Since 2002, banks' profits have recovered. Macroeconomic conditions and the stronger financial situation of both the private sector and financial intermediaries have allowed an acceleration of credit growth (especially consumer loans). Thus, a change in the trend of the private sector's debt indicator has been observed (eg Graph 11).

(ii) Sensitivity of aggregate demand to the exchange rate

Throughout the 1990s there were some changes that could have affected the "reduced form" relationship between output and the exchange rate (the "IS curve"):

- Capital controls were relaxed and the exchange rate regime was made more flexible. As a result, the short-run reaction of the economy after a shock could have changed, as well as the relevant types of shocks facing the economy. For example, an improvement in the terms of trade would no longer imply an expanding economy and pressures on inflation. Or deliberate policies to increase net exports through devaluations could have become less relevant in explaining the output-exchange rate relationship, as other shocks (eg capital account shocks) happen to be more important in the determination of the exchange rate and output dynamics.
- The upsurge of private external debt in the 1990s (Graph 16) made the balance-sheet effects more relevant. Thus, a positive response of output to a (real) depreciation of the currency could have been weakened, as the expenditure-switching channel could have been (partially) offset by the balance sheet effects.

Graph 17 shows that the recursive OLS coefficient of the real exchange rate gap in an "IS curve" decreases and becomes less significant with time. This may be an indication of the two factors just mentioned.[12] Beyond the inspection of the "reduced form" relationship, some studies have found mixed results on the importance of balance sheet effects.

On the one hand, using firm-level information, Echeverry et al (2003) find that investment responds negatively to a devaluation of the currency (although positively to the level of the exchange rate). Also, in their estimations larger firms and importing (more than exporting) firms are more prone to use external funding. On the other hand, Echavarría and Arbeláez (2003) also use firm-level data, but they find a positive effect of devaluations on sales, investment and profits, both in the aggregate and in different sectors of the economy. This is attributed to a competitiveness effect that is stronger than the balance-sheet effects. Moreover, according to their results, most of the firms that use external funding are currency-matched (they are either exporters or foreign-owned). Tovar (2006) uses a DSGE model to show that the expenditure-switching effect is stronger than the balance-sheet effect for Colombia, so devaluations by the Central Bank have expansionary effects. However, a sudden stop both depreciates the currency and reduces output. This highlights the importance of the source of the shocks to the economy in explaining the (general equilibrium) relationship between output and the exchange rate.

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[11] This raises the question about what interest rate is relevant for the determination of aggregate demand. It has been argued that, given the expansion of the domestic public bond market, the prices of these securities are now important as opportunity cost indicators or as measures of wealth. However, Jalil and Amaya (2006) show that public bond rates are positively related to economic activity variables.

[12] For example, in the first half of the nineties there were large capital inflows. Some real appreciation occurred in the context of higher exchange rate flexibility, but Central Bank purchases of reserves were important. The observed outcome was an appreciation of the currency, lower interest rates and an expansion of output.

The reduction in the levels of private foreign debt (Graph 16) suggests that balance-sheet effects are now less important than before. Further, there is evidence in the sense that larger firms with foreign indebtedness tend to use the forward market to hedge exchange rate risk (Kamil et al (2006)).

(c) Reaction of market interest rates to shifts in monetary policy

The adoption of IT implied a dramatic smoothing of the overnight interbank rate (Graph 3). In principle, this enhanced the signals about the monetary policy stance and objectives. Given the financial structure of households and firms, and the development of the securities markets in Colombia, the financial system is still a particularly important component of the transmission mechanism. Hence, interest rate pass-through is a key issue. Graph 18 shows that financial market interest rates generally follow the policy rate.

Studies for Colombia have found that, although there is a long-term relationship between policy and bank interest rates, interest rate pass-through is incomplete. Using descriptive statistics, Huertas et al (2005) estimate that a 1% change in the monetary policy rate produces a change of 0.26% in the 90-day CD rate in one week and a change of 0.6% over longer horizons. Further, using VAR models they found that commercial short term lending rates react one-for-one to the deposit rate, while the short-run pass-through is just 42% for the “preferential” short term lending rate. The authors suggest that the low transmission of the monetary policy interest rate to market interest rates can be explained by the weakening of the credit channel discussed above. Betancourt et al (2006) argue that, under imperfect substitution between foreign and domestic loans and deposits, interest rate pass-through may vary depending on macroeconomic conditions (external interest rates, risk premia, expectations of depreciation and output). They find some evidence that supports this hypothesis in Colombia.

3. Summary

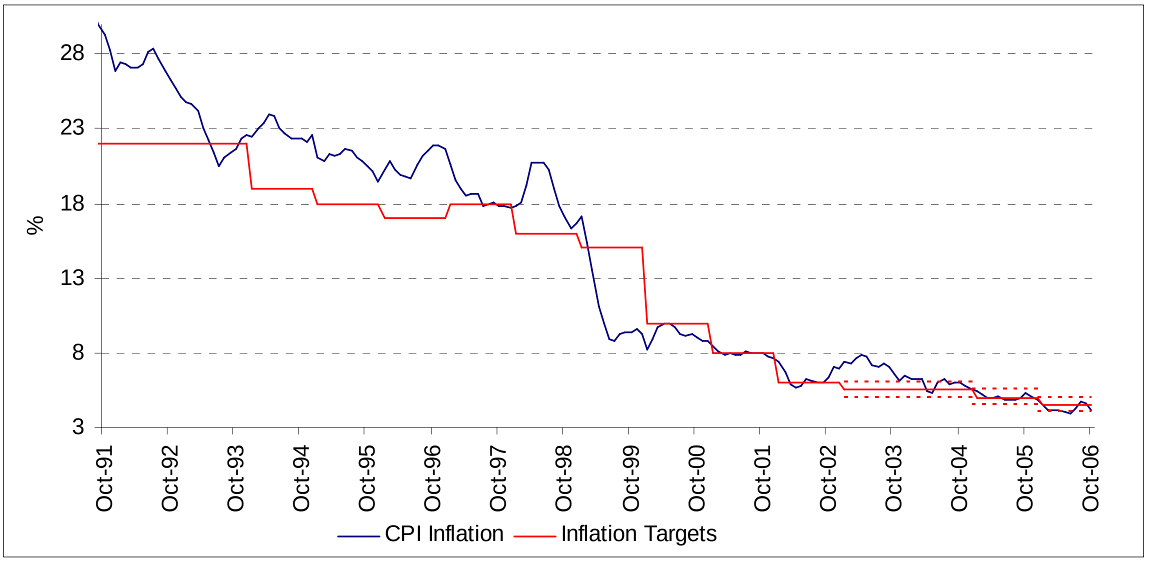
The Colombian economy experienced several shocks in the past ten years. The permanent fall of inflation, the adoption of inflation targeting (IT) and a financial crisis altered the transmission mechanism of monetary policy. Low inflation and IT reduced inflation persistence and helped to anchor inflation expectations, although the full effects in this regard are still to be observed. The evidence is less conclusive with respect to the changes of the responsiveness of inflation to domestic conditions (output or marginal cost gaps). Increased competition may have encouraged a higher degree of price flexibility, but a more stable inflation environment may have raised the sensitivity of aggregate supply to inflation surprises. Exchange rate pass-through to imported good prices rose, possibly due to a higher degree of trade openness. In contrast, imported good prices pass-through to CPI fell in response to exchange rate flexibility and a low inflation environment. The short-run money-inflation relationship was broken in the presence of low inflation, exogenous shocks to the demand for money and a policy regime that stabilized short-run interest rates

The sensitivity of aggregate demand to the interest rate varied with the indebtedness of private agents and the credit channel was severed after the financial crisis. The development of the domestic public bond market is expected to have important consequences for the transmission mechanism, as the use of long term financial instruments expands in the context of a low inflation environment. The private external debt build-up of the 1990s could have raised the importance of balance-sheet effects in the relationship between the exchange rate and economic activity variables. However, the reduction of external indebtedness and the increasing use of derivatives markets by real sector corporations have probably reduced the relevance of balance-sheet effects in recent years.

Finally, the IT regime implied a stabilization of short-run interest rates, making the monetary policy stance and objectives clearer to the public. Interest rate pass-through appears to be incomplete and seems to respond to the varying importance of the credit channel and the general state of the macro economy.

Graph 1

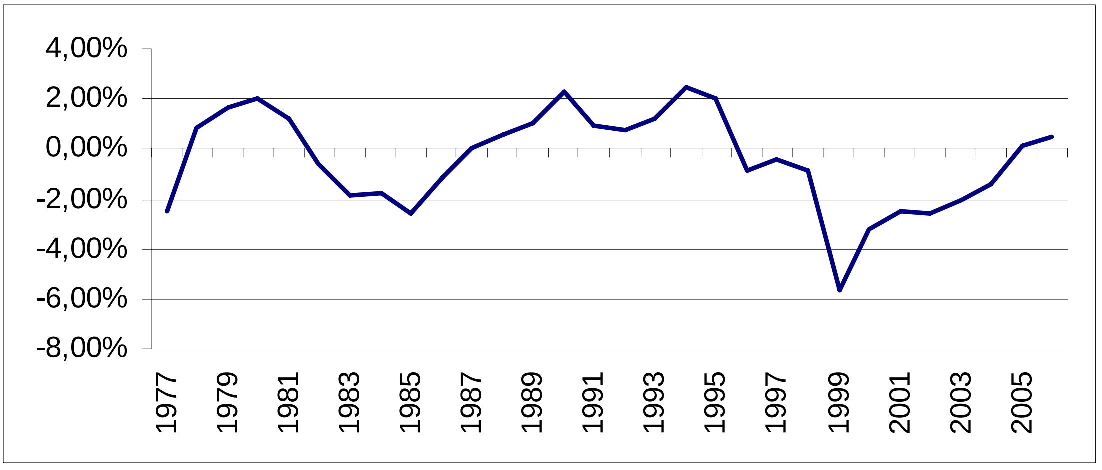
Total CPI inflation and inflation targets



Sources: DANE; Banco de la República.

Graph 2

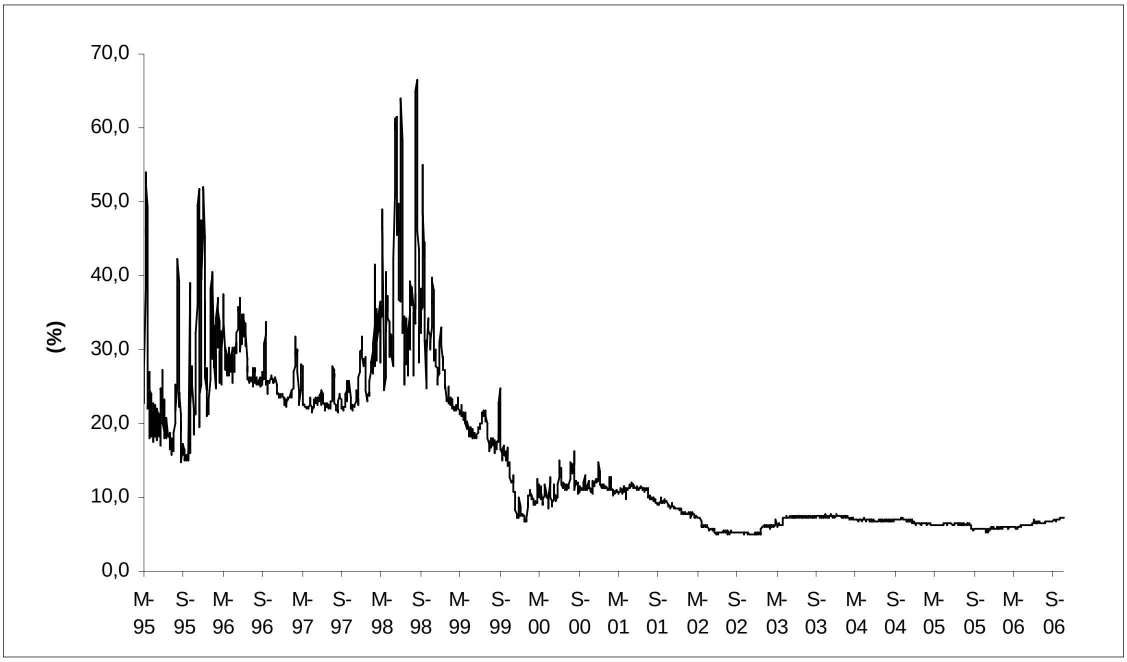
Colombia – output gap



Source: Banco de la República.

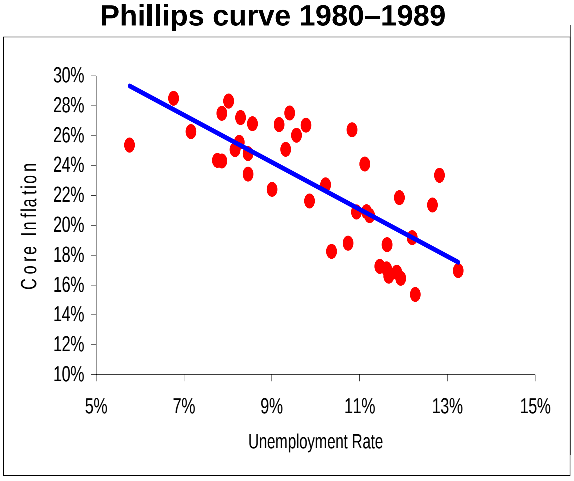
Graph 3

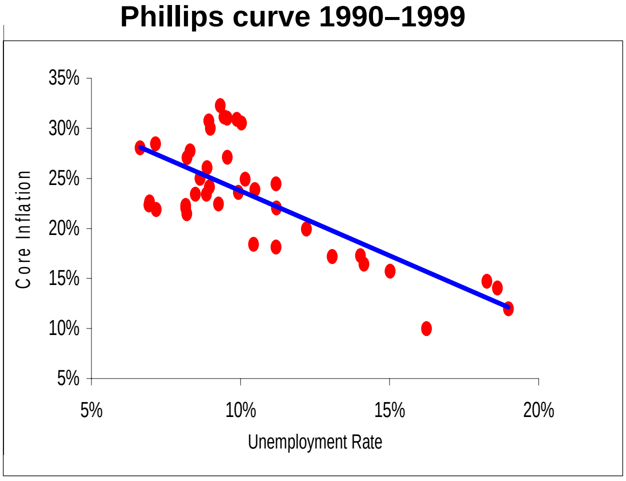
Interbank interest rate

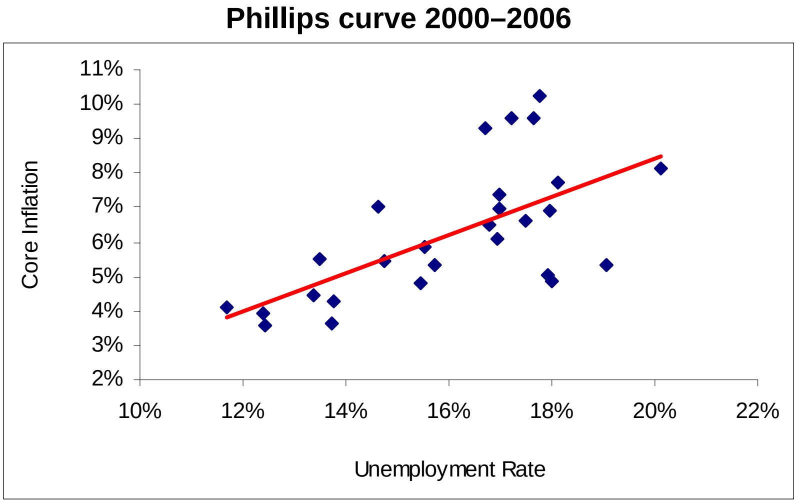


Source: Banco de la República.

Graph 4

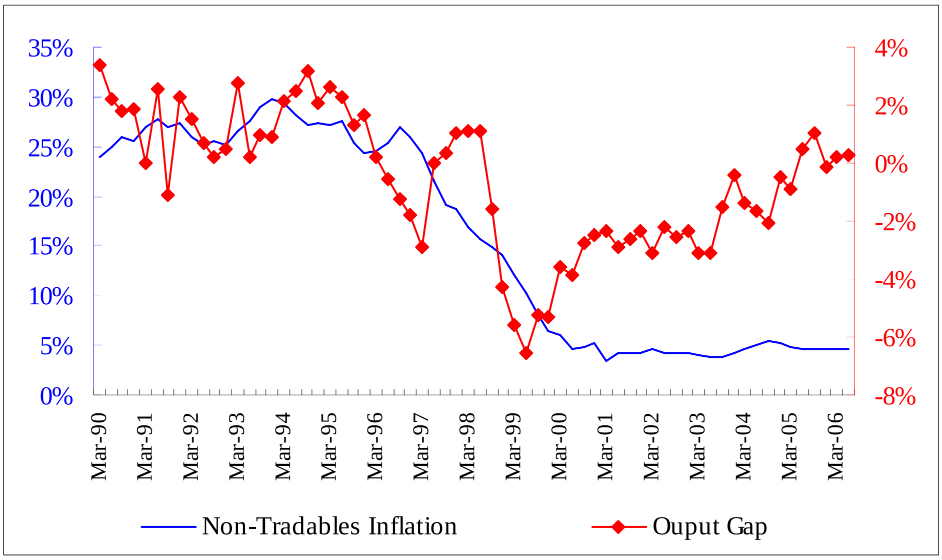






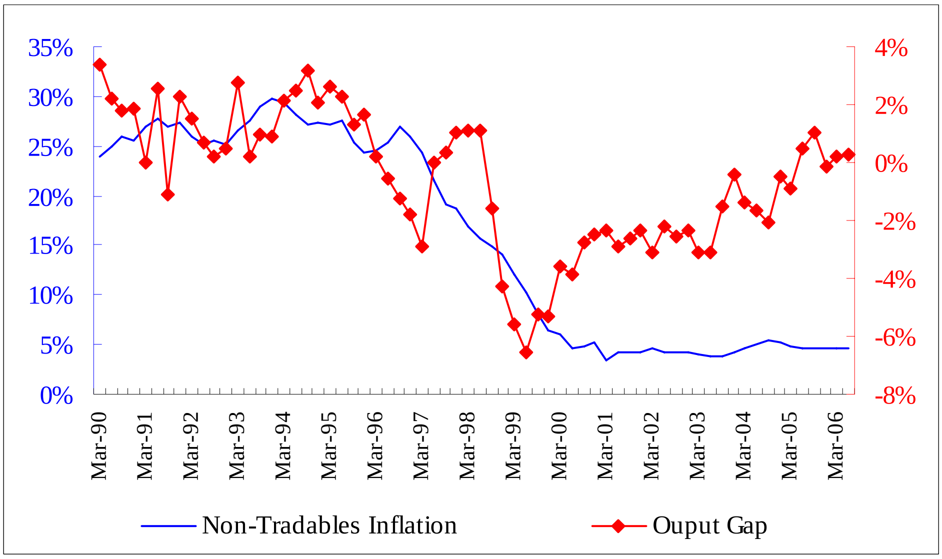
Sources: DANE; Banco de la República.

Graph 5



Source: Banco de la República.

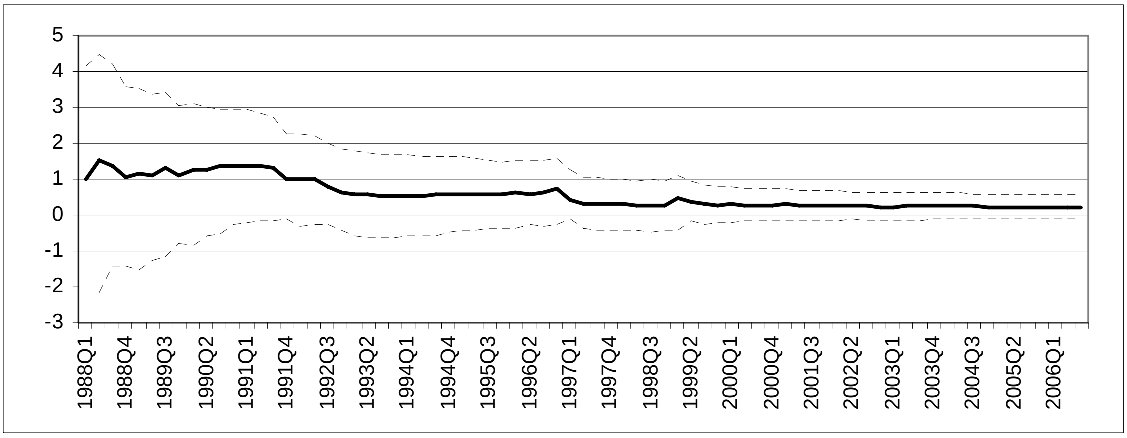
Graph 6



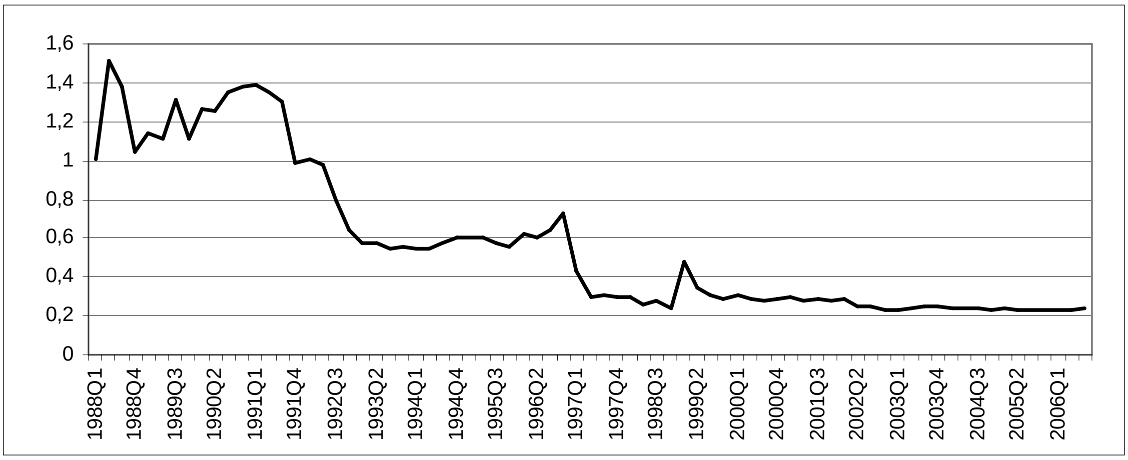
Source: Banco de la República.

Graph 7

Output gap coefficient



Output gap coefficient (enlargement)



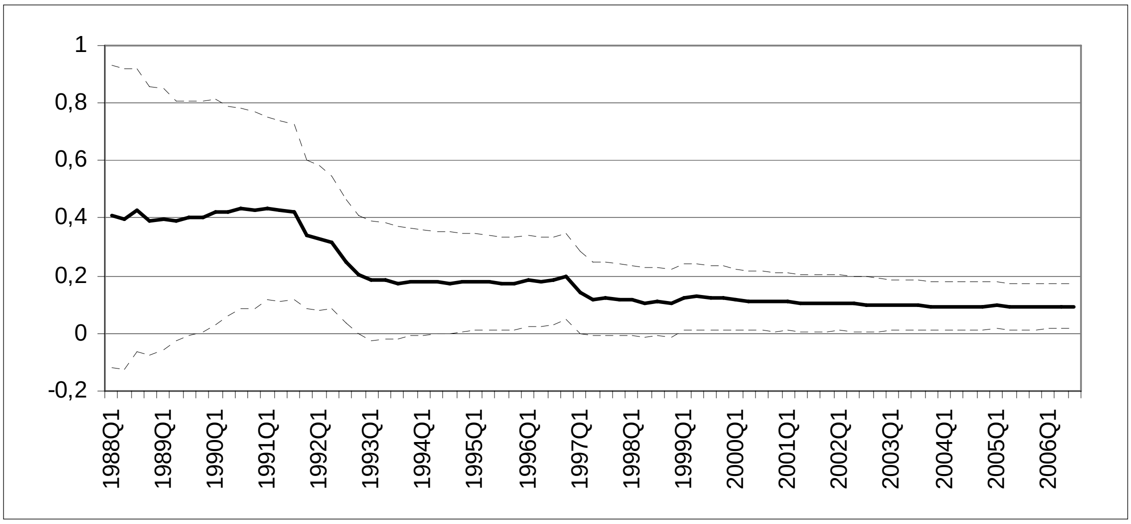
Recursive OLS output gap coefficient of the equation $\pi_t = c_1\pi_{t-1} + c_2\pi^M_{t-2} + c_3\hat{y}_{t-1} + \varepsilon_t$

$\hat{y}_t$ is the output gap (Hodrick and Prescott with priors), π_t is annualized quarterly CPI inflation (excluding food items) and π^M_t is annualized quarterly PPI imported goods inflation. Sample: 1981Q1–2006Q3.

Source: Estimation by Julián Pérez, Banco de la República.

Graph 8

Imported goods prices – CPI pass-through



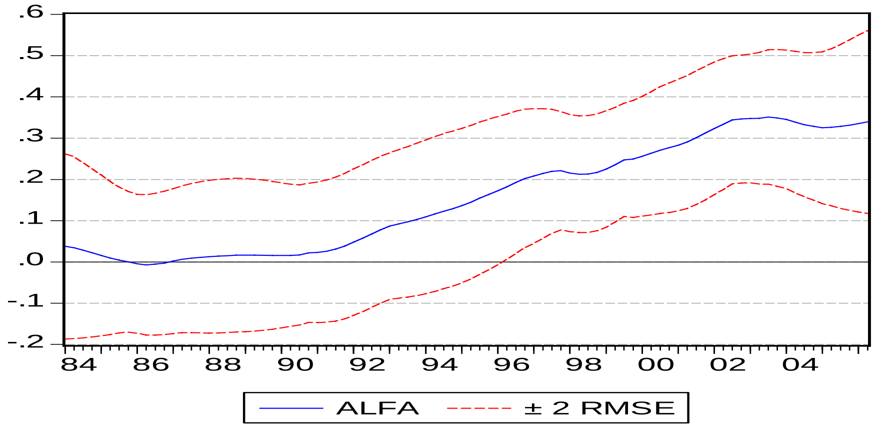
Recursive OLS output gap coefficient of the equation $\pi_t = c_1\pi_{t-1} + c_2\pi^M_{t-2} + c_3\hat{y}_{t-1} + \varepsilon_t$

$\hat{y}_t$ is the output gap (Hodrick and Prescott with priors), π_t is annualized quarterly CPI inflation (excluding food items) and π^M_t is annualized quarterly PPI imported goods inflation. Sample: 1981Q1–2006Q3.

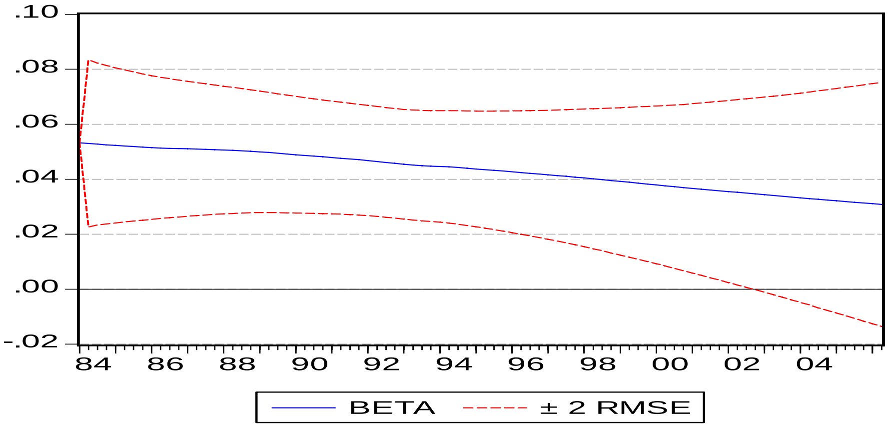
Source: Estimation by Julián Pérez, Banco de la República.

Graph 9

Smoothed ALFA state estimate



Smoothed BETA state estimate



Kalman filter estimation of:

$$\pi_t^M = (1-\alpha_t)\pi_{t-|}^M + \alpha_t(\Delta S_{t-1} + \pi_{t-1}^*) + c_3\hat{y}_{t-1} + \varepsilon_t^M \tag{1}$$

$$\pi_t^B = (1-\beta_t)\pi_{t-1}^B + \beta_t\pi_{t-2}^M + c_3\hat{y}_{t-1} + \varepsilon_t^B \tag{2}$$

$$\alpha_t = \alpha_{t-1} + \delta + \varepsilon_t^\alpha \tag{3}$$

$$\beta_t = \beta_{t-1} + \delta + \varepsilon_t^\beta \tag{4}$$

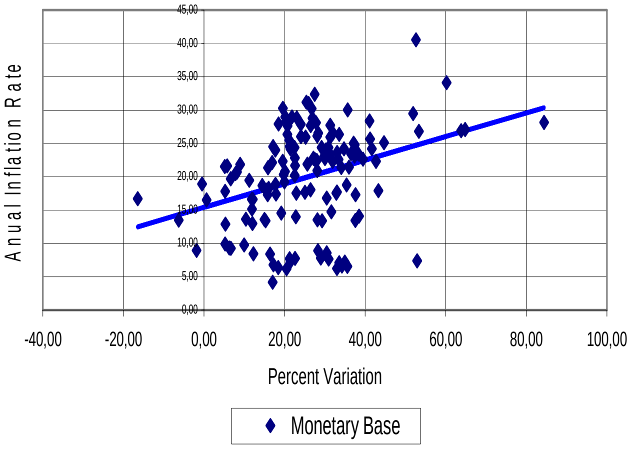
Where: π_t^M is annualized quarterly PPI imported goods inflation, π_t^* is annualized quarterly CPI US inflation, ΔS_t is the annualized quarterly depreciation rate of the Colombian peso against the US dollar, α_t is the *pass-through* from depreciation to imported goods prices, π_t^B is annualized quarterly CPI inflation (excluding food items and some services) and β_t is the *pass-through* from imported goods prices to CPI core inflation, and $\hat{y}_t$ is the output gap (Hodrick and Prescott with priors).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 10

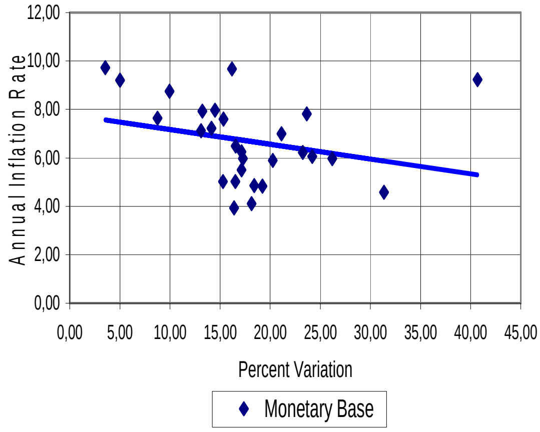
Monetary base
Quarterly monetary aggregates
(June 1964–September 1999)

Annual percentage variation



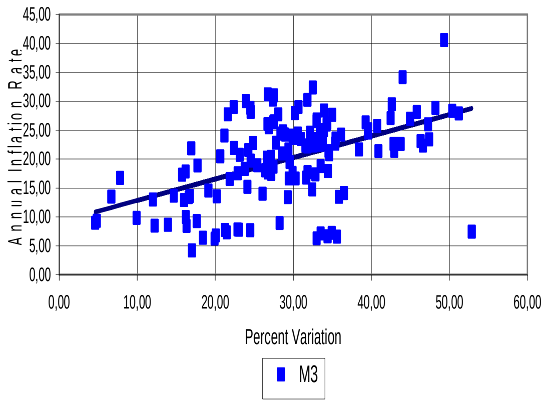
Monetary base
Quarterly monetary aggregates
(December 1999–September 2006)

Annual percentage variation



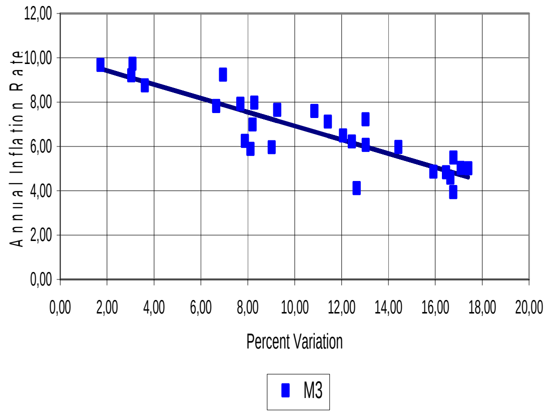
M3
Quarterly monetary aggregates
(June 1964–September 1999)

Annual percentage variation



M3
Quarterly monetary aggregates
(December 1999–September 2006)

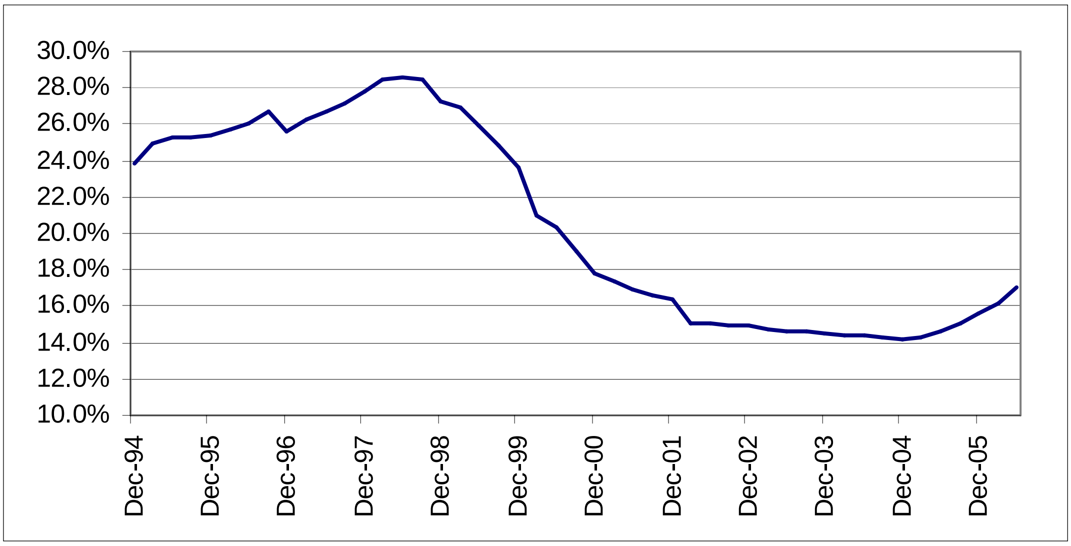
Annual percentage variation



Source: Banco de la República.

Graph 11

Household financial debt/consumption



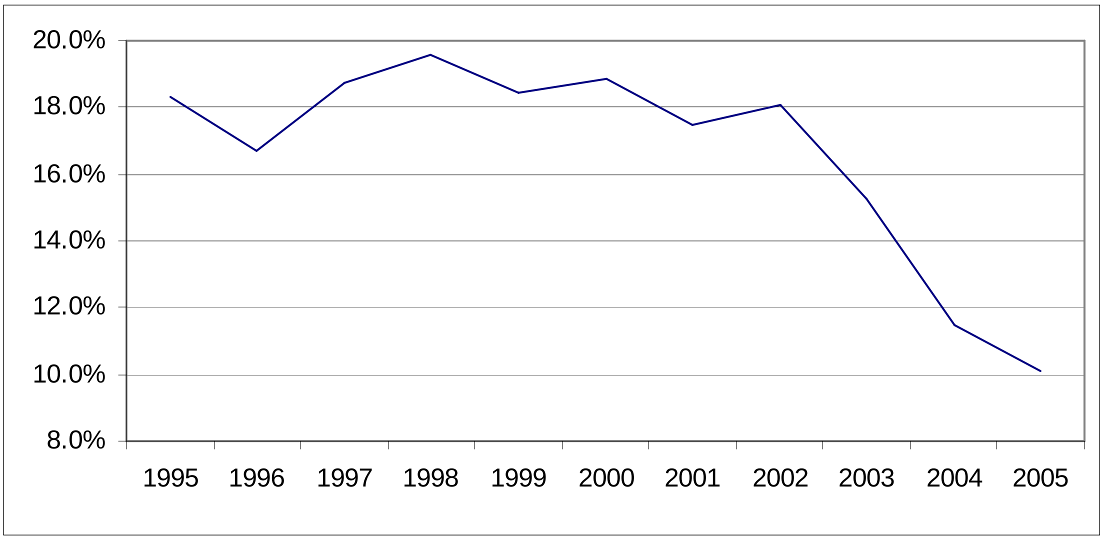
(Consumer loans + mortgage loans)/consumption

Source: Calculations of Banco de la República based on data from DANE and Superfinanciera.

Graph 12

Firms

Debt/Assets

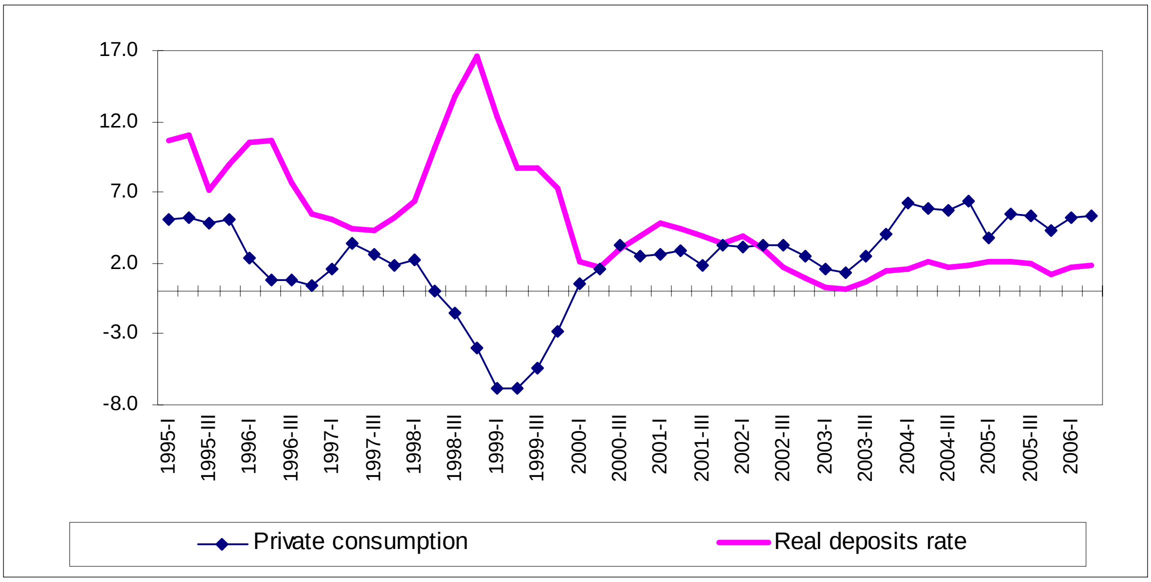


Source: Calculations of Banco de la República based on data from DANE and Superfinanciera.

Graph 13

Real private consumption and real deposit interest rate

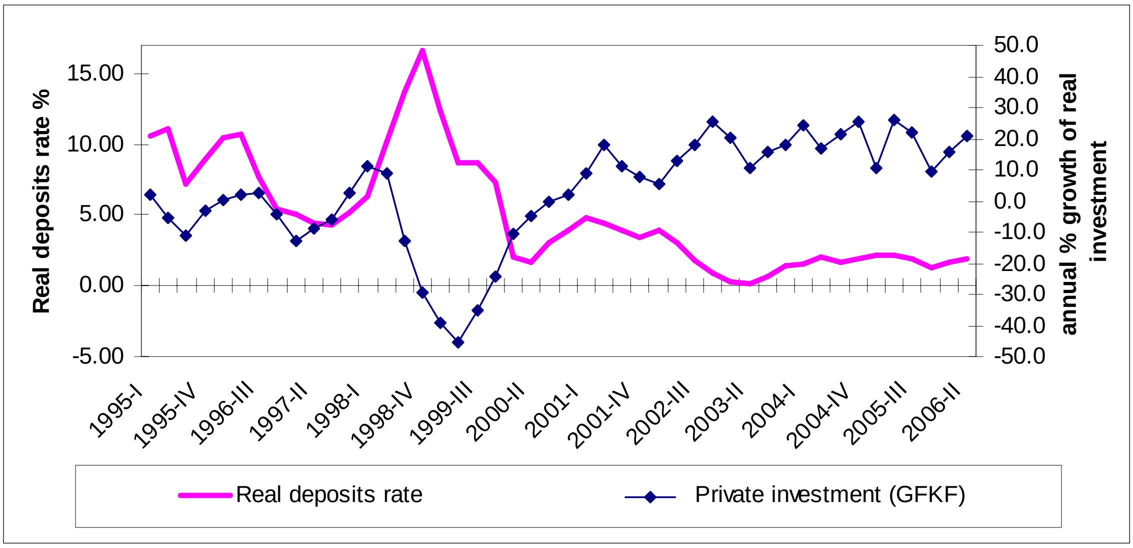
%



Sources: DANE; Banco de la República.

Graph 14

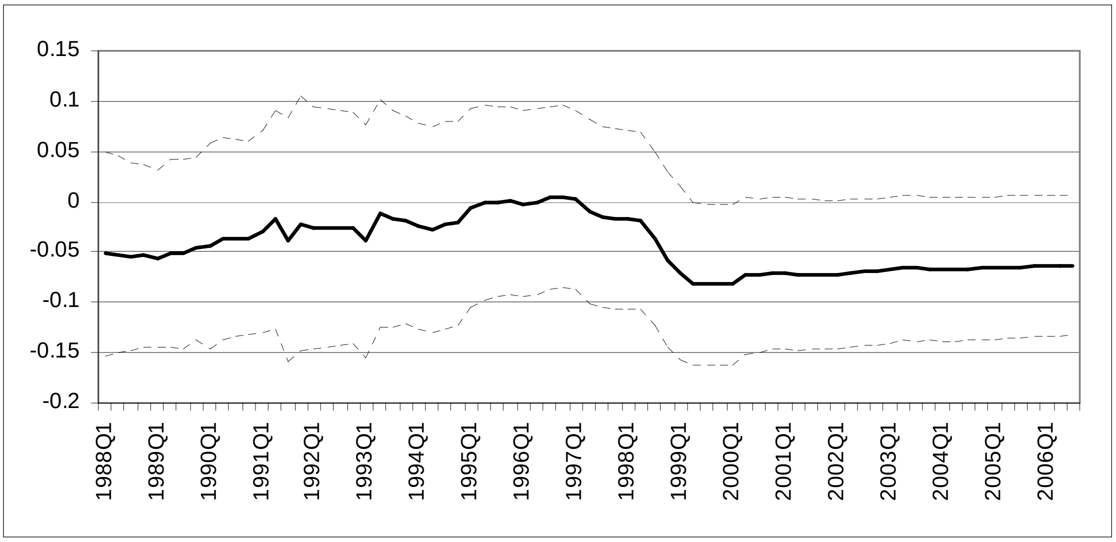
Real private investment and real deposit interest rate



Sources: DANE; Banco de la República.

Graph 15

Interest rate coefficient in an "IS curve"



Coefficient of the real interest rate deviations from trend in: $\hat{y}_t = c_1\hat{y}_{t-1} + c_2\hat{r}_{t-1} + c_3\hat{z}_{t-1} + \varepsilon_t$

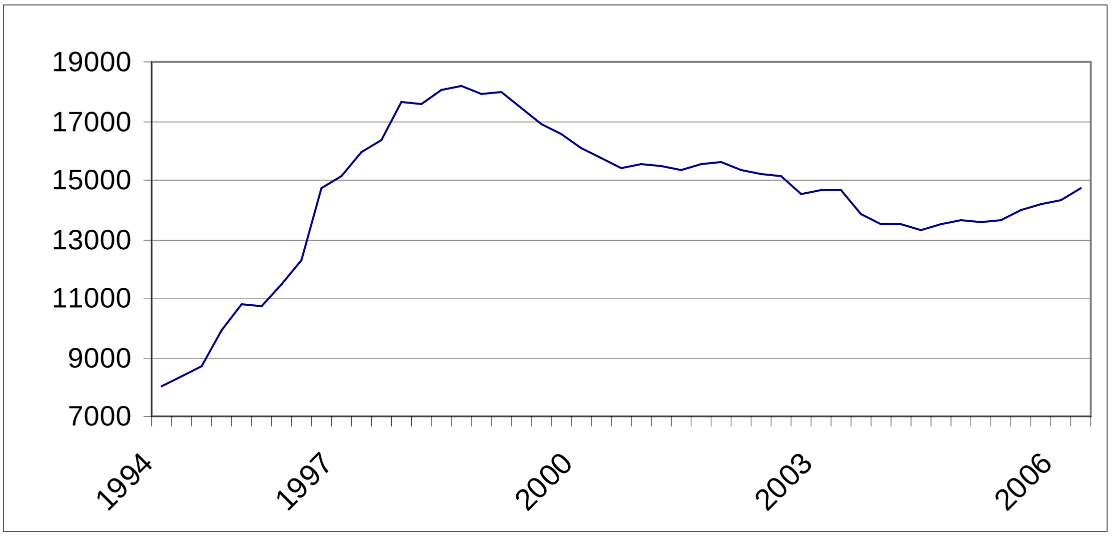
Where $\hat{y}_t$ is the output gap (Hodrick-Prescott with priors), $\hat{r}_t$ is the 90 day real interest rate gap (HP) and $\hat{z}_t$ is the bilateral (US) real exchange rate gap (HP).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 16

Private external debt

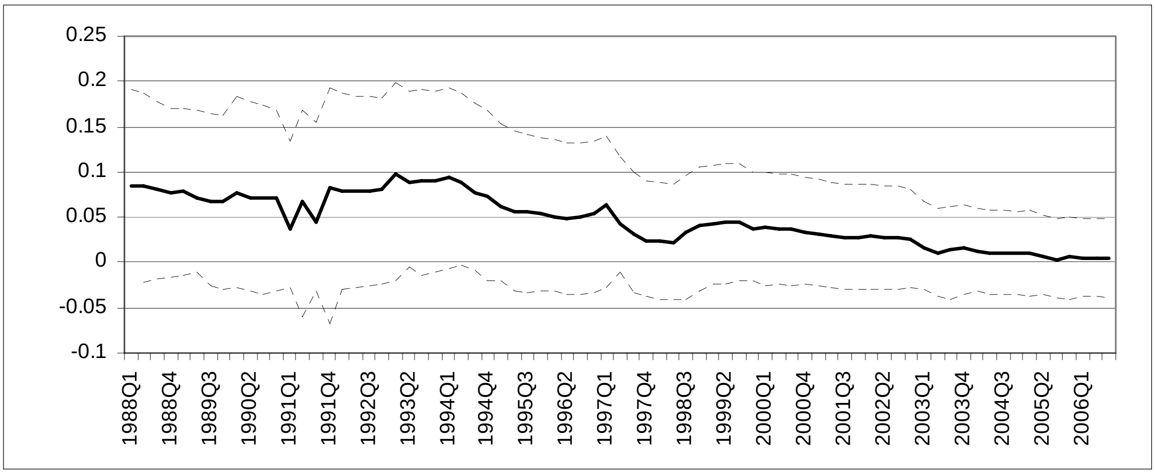
US$ millions



Source: Banco de la República.

Graph 17

Exchange rate coefficient in an "IS curve"



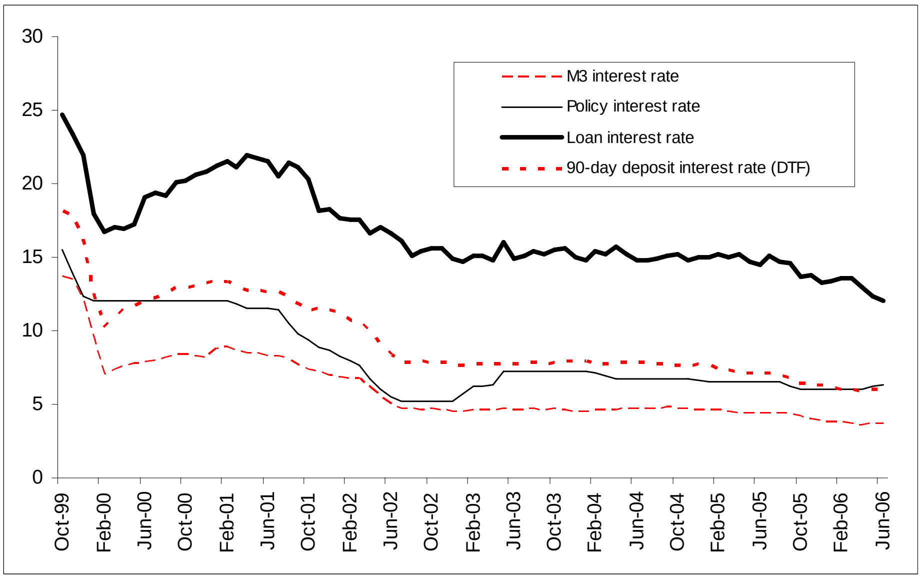
Coefficient of the real exchange rate deviations from trend in: $\hat{y}_t = c_1 \hat{y}_{t-1} + c_2 \hat{r}_{t-1} + c_3 \hat{z}_{t-1} + \varepsilon_t$

Where $\hat{y}_t$ is the output gap (Hodrick-Prescott with priors), $\hat{r}_t$ is the 90 day real interest rate gap (HP) and $\hat{z}_t$ is the bilateral (US) real exchange rate gap (HP).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 18

Nominal interest rates in Colombia



Source: Banco de la República.

Table 1

Inflation and inflation expectations 1999

	Observed annual inflation	Inflation expectations for December 1999
December 1998	16.7%	15.9%
March 1999	13.5%	13.5%
June 1999	8.9%	12.2%
September 1999	9.3%	9.9%
December 1999	9.2%	

Memo item: Inflation target for 1999: 15%.

Sources: DANE; Banco de la República. Inflation expectations are obtained from surveys presented in the Inflation Reports.

Table 2

Inflation expectations and credibility of inflation targets in Colombia

Year	Observed (1)	Expectation (2)	Target (2)	Error (1)–(3)	Surprise (1)–(2)	Anchoring (2)–(3)	Credibility
1997	17.68	18.45	18.0	–0.3	–0.8	0.4	
1998	16.70	17.95	16.0	0.7	–1.2	2.0	
1999	9.23	15.789	15.0	–5.8	–6.6	0-8	
2000	8.75	9.89	10.0	–1.3	–1.1	–0.1	33.0
2001	7.64	8.85	8.0	–0.4	–1.2	0.8	46.9
2002	6.99	6.95	6.0	1.0	0.0	1.0	35.0
2003	6.49	6.58	5.5	1.0	–0.1	1.1	42.0
2004	5.50	6.13	5.5	0.0	–0.6	0.6	69.1
2005	4.85	5.41	5.0	–0.2	–0.6	0.4	77.8
2006	4.19	4.6	4.5	–0.3	–0.4	0.1	90.1

Expectation: refers to the expected value of the end of year inflation measured at the beginning of the year. Credibility: refers to the percentage of people who believed (at the beginning of the year) that the target would be met for that year. Inflation expectations for the year 1997 correspond to the June Survey.

Observed inflation for 2006 corresponds to annual yoy inflation until October 2006.

Source: González and Hamann (2006).

Table 3

Inflation persistence: sum of autoregressive coefficients

Study	Specification	Price index	Samples	Persistence before	Persistence after
Capistrán/Ramos-Francia (2006a)	Monthly AR (12) or modified AIC	CPI headline	Before (2 samples): 1980.01–1989.12 1990.01–1999.12 After: 2000.01–2006.06	0.58, 0.58[1]	0.67
Bergljot et al (2006)	Quarterly AR (5)	GDP deflator	Before: 1986Q1–1999Q2 After: 1999Q3–2006Q2	1.03	0.803
García-Saltos (2006)	Quarterly AR (5)	GDP deflator	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.83	0.42[2]
García-Saltos (2006)	Quarterly AR (5)	CPI headline	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.96	0.93
García-Saltos (2006)	Quarterly AR (5)	CPI non tradable	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.96	0.37
García-Saltos (2006)	Quarterly AR (5)	CPI tradable	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.92	0.97
García-Saltos (2006)	Quarterly AR (5)	CPI food	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.55	0.28[3]
García-Saltos (2006)	Quarterly AR (5)	CPI regulated	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.70	0.88

[1] These coefficients refer to the estimation that controls for time-varying means of inflation. [2] Standard error of 0.51. [3] Standard error of 0.5.

Table 4

Inflation persistence: HNKPC estimates

Study	Price index	γ_b Before 1999	γ_b Complete sample	γ_f Before 1999	γ_f Complete sample
Bergljot et al (2006)[1]	GDP Deflator	0.05–0.42	–0.01–0.04	0.53–0.8	0.91–1
García-Saltos (2006)[2]	GDP Deflator	0.047–0.074	–0.01– –0.007	0.801–0.926	0.9–1.01
García-Saltos (2006)[2]	CPI Headline	0.31–0.344	0.29–0.297	0.57–0.656	0.688–0.703

Numbers reported correspond to minimum and maximum values of the estimated coefficients under different econometric specifications and estimation methods.

[1] Samples: 1987Q1–1999Q2 and 1987Q1–2005Q4. [2] Samples: 1986Q2–1999Q2 and 1986Q2–2006Q1.

Table 5

Inflation response to marginal costs gap: HNKPC estimates

Study	Price index	λ Before 1999	λ Complete sample
Bergljot et al (2006)[1]	GDP deflator	0.06–0.1[4]	0.12–0.14
García-Saltos (2006)[2]	GDP deflator	0.101–0.19	0.13–0.136
García-Saltos (2006)[2]	CPI headline	0.01–0.021[3]	0.042–0.044

Numbers reported correspond to minimum and maximum values of the estimated coefficients under different econometric specifications and estimation methods.

[1] Samples:1987Q1–1999Q2 and 1987Q1–2005Q4. [2] Samples:1986Q2–1999Q2 and 1986Q2–2006Q1. [3] Standard errors of 0.03. [4] The 0.1 estimate has a standard error of 0.14.

Table 6

Ratio of relative price change volatility to inflation volatility

	1982–1988	1989–1998	2000–today
Variance of SA quarterly headline CPI inflation	**3.15**	**1.31**	**0.22**
Food (subset)	0.64	2.53	3.55
Rents	0.91	1.22	2.67
Housing – tradable	1.79	1.51	5.26
Housing – non tradable	0.96	0.78	1.79
Clothing – tradable	0.85	0.92	0.88
Clothing – non tradable	1.06	1.12	9.92
Health – tradable	2.66	4.24	2.85
Health – non tradable	2.18	0.88	1.87
Education – tradable	1.83	5.57	1.90
Education – non tradable	2.22	4.19	1.81
Culture and recreation – tradable	3.07	1.40	6.91
Culture and recreation – non tradable	30.12	9.91	18.48
Transportation – tradable	7.37	4.66	15.16
Other expenses – tradable	1.84	1.53	3.67
Other expenses – non tradable	1.31	1.72	5.95

Ratios = variance of quarterly SA price changes/variance of quarterly SA CPI headline inflation. Each sector includes only the items present in the CPI baskets of all periods. Sectors with heavily regulated prices are excluded.

Source: Calculations by the Research Department, Banco de la República.

Table 7

Sources of funding of corporations

	2000	2001	2002	2003	2004	2005
A. Debt	63.0%	63.9%	63.2%	56.3%	51.6%	47.3%
Financial system	41.8%	43.0%	41.0%	33.8%	29.7%	24.9%
Suppliers	17.6%	17.2%	17.3%	16.6%	16.3%	16.2%
Bonds	3.6%	3.7%	4.9%	6.0%	5.6%	6.2%
B. Own resources	37.0%	36.1%	36.8%	43.7%	48.4%	52.7%
Capital	23.4%	22.6%	22.3%	27.4%	26.9%	25.5%
Reserves	14.3%	14.6%	13.8%	14.2%	14.8%	15.6%
Current profits	4.4%	4.1%	5.3%	7.0%	9.3%	11.8%
Previous periods profits	–5.1%	–5.2%	–4.7%	–5.0%	–2.6%	–0.2%
Total A + B	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Superintendencia de Sociedades y Superintendencia Financiera.

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Notes on the monetary transmission mechanism in the Czech economy

Luděk Niedermayer[1]

This paper discusses several empirical aspects of the monetary transmission mechanism in the Czech economy. The introduction briefly describes the evolution of monetary policy in the Czech Republic since the early 1990s. Section I discusses the forecasting model used currently by the Czech National Bank (CNB). Section II describes the development of the financial system in the Czech economy, focusing on the importance of changes in this system for monetary policy transmission. Section III looks at some empirical characteristics of the Czech monetary transmission mechanism.

Introduction

At the beginning of 1998, the CNB joined the group of inflation targeting central banks. The switch from a regime based on monetary targeting and a fixed exchange rate to inflation targeting and a floating exchange rate was the consequence of a currency crisis of the Czech koruna (CZK) in May 1997, which was partly related to the currency crises in Southeast Asia. The currency peg had provided the Czech economy with a nominal anchor since the beginning of the economic transformation in 1991. It was a crucial component of economic policies during the early 1990s, but it started to become less helpful as capital account liberalisation progressed in the middle of the decade. In order to address the issue of the "impossible trinity", the peg was gradually relaxed. The most significant change consisted in widening the fluctuation band of the koruna against a basket of the deutsche mark and the US dollar to ±7.5% around a central parity in February 1996.

Monetary transmission during most of the 1990s was heavily influenced by three structural characteristics of the Czech economy at the time. First, the real sector was going through a deep transformation from the centrally planned to a market based economy. Second, the banking sector was also going through a restructuring process. However, this process was not very successful. Commercial banks were still state-owned at the time and restructuring resulted in a massive bail-out: bank loans totalling more than 23% of GDP (at 2003 prices) were transferred from commercial bank balance sheets to the state between 1991 and 2003. Third, the overall degree of monetisation of the economy was very low. The volume of loans to households was negligible and many corporations borrowed abroad in order to avoid the high nominal cost of funds in the domestic currency.

The main instruments of monetary policy at the time were sterilisation via open market operations and minimum reserve requirements. Despite frequent and substantial overshooting of the monetary target, the desired path of inflation was typically achieved, in large measure because the fixed exchange rate minimised the exchange rate pass-through.

After the widening of the exchange rate fluctuation band in February 1996, the role of the exchange rate channel gained greater significance. In theory, the CNB could have continued to pursue monetary targeting under such circumstances. However, it soon became clear that

[1] Czech National Bank.

short-term interest rates would have to be given greater prominence. Even while the exchange rate was fixed, short-term interest rates played a greater role in the monetary policy execution than controlling the quantity of money. In other words, what mattered in practice even before inflation targeting was introduced was the "cost of money" rather than the "quantity of money".

I. Current model of the monetary transmission mechanism

The inflation forecast of the CNB is based on a small calibrated macroeconomic model. While the short-term forecast (for the current and the next quarter) is based on an expert forecast, on a longer time horizon the model-based forecast prevails. The forecast is unconditional, with a Taylor-type reaction function that includes feedbacks from the lagged short-term interest rate, the output gap and the deviation of inflation four quarters ahead from the target. The exchange rate is determined endogenously on the basis of a modified version of uncovered interest rate parity, which takes into account the equilibrium speed of nominal appreciation of the koruna estimated by the Kalman filter.

The transmission of monetary policy actions – changes in nominal interest rates – to economic developments occurs through three main channels in this model.

The first channel is the direct exchange rate channel based on the modified uncovered interest rate parity condition. An increase in the nominal interest rate leads to an appreciation of the exchange rate; this decreases the price of imported goods and services and leads, via a version of the Phillips curve, to lower domestic CPI inflation. And vice versa: a cut in the nominal interest rate leads to a depreciation of the exchange rate, higher prices of imported goods and services and higher inflation.

The second channel is the indirect exchange rate channel. In this case, real economic developments are influenced by the exchange rate indirectly, via the so-called real exchange rate gap. This gap is defined as the deviation of the actual real exchange rate from its equilibrium level, ie, the level consistent with long-run differentials in productivity growth between the Czech Republic and its main trading partners. For instance, a strengthening of the real exchange rate above its equilibrium level slows output growth, which leads, via the Phillips curve, to lower inflation.

The third channel is the direct interest rate channel. It is based on a relationship between the real interest rate gap and domestic demand (consumption and investment). The real interest rate gap is defined as the deviation of the actual real interest rate from its equilibrium level, which is determined by the long-run characteristics of the economy such as the marginal product of capital, country risk premium, etc. When the real interest rate is higher than its equilibrium level, the negative output gap widens (the positive output gap narrows), and the rate of inflation decreases.

The model is closed by the monetary policy reaction function. This equation represents a forward-looking monetary rule for setting interest rates in order to minimise deviations of expected inflation and the actual output gap from their target or equilibrium levels, subject to maintaining a desired level stability of the nominal interest rate.

There is an ongoing discussion on the calibration of the model and its features. As the part of the regular verification of model properties, the strength of the direct exchange rate channel, as well as some other channels, is tested by sophisticated Bayesian estimation methods. The results of these tests have basically confirmed earlier assumptions on calibration ranges.

II. Development of the banking sector and monetary transmission

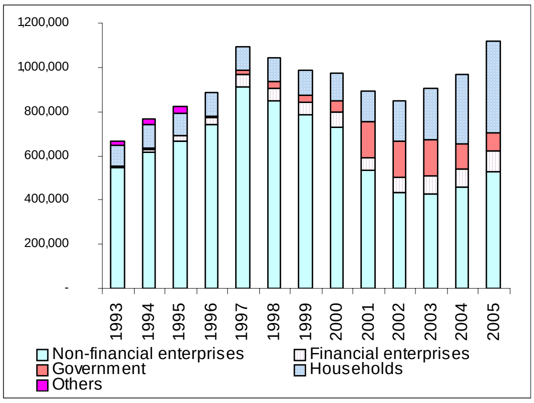
There were three main periods in the development of the Czech banking sector over the past 15 years: the early transformation period, which ended with the currency crisis in May 1997; the consolidation period, during which commercial banks were restructured and total credit contracted; and the period of expansion, especially of household credit, which started in 2002 after privatisation and restructuring of the major banks had been completed.

In the early years of the economic transformation there was very strong corporate demand for credit (Graph 1). The CNB used credit ceilings to avoid an expansion of credit above the monetary plan. In addition, because of the fixed exchange rate – and, hence, absence of exchange rate risk – as well as lower foreign compared to domestic interest rates, corporate demand for foreign currency loans was relatively strong (Graph 2). This demand was partly accommodated by foreign banks supplying direct cross-border credit to entities with relatively high credit ratings, and partly by domestic banks making loans denominated in foreign currencies to their Czech customers.

Graph 1

Bank loans by sector

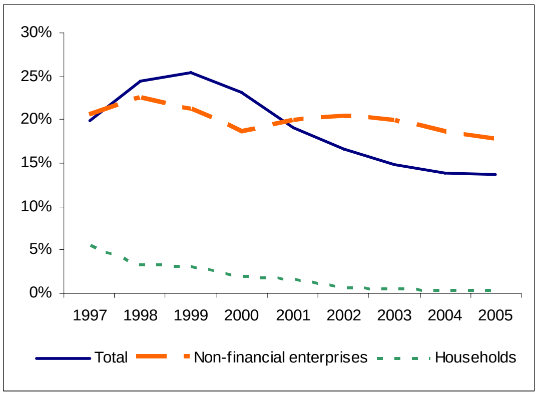
Millions of CZK



Graph 2

Foreign currency loans

Percentage of total loans



Source: Czech National Bank.

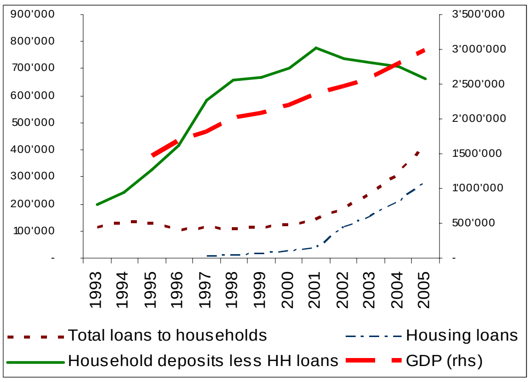
Households were a net source of funding for the Czech commercial banks during this period, given that the volume of loans to households was negligible (Graph 3). One reason was that interest rates were high and the purchasing power of households was low. In addition, because of a weak institutional and legal framework, the housing market was underdeveloped and banks did not market retail products such as consumer or mortgage credit.

Household deposits were for the most part held in the Czech koruna. Although there was some increase in foreign currency deposits related to the gradual liberalization of foreign currency transactions for households, the proportion of foreign currency deposits quickly levelled off. Following the currency crisis in May 1997 the proportion of foreign currency deposits declined sharply to about 10% of the total, where it has remained since (Graph 4). The share of foreign currency deposits in the Czech Republic is thus low in comparison with other CEE economies.

Graph 3

Household loans and deposits

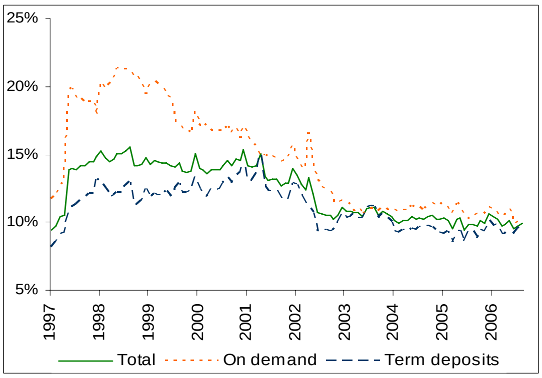
Millions of CZK



Graph 4

Household foreign currency deposits

Percentage of total deposits



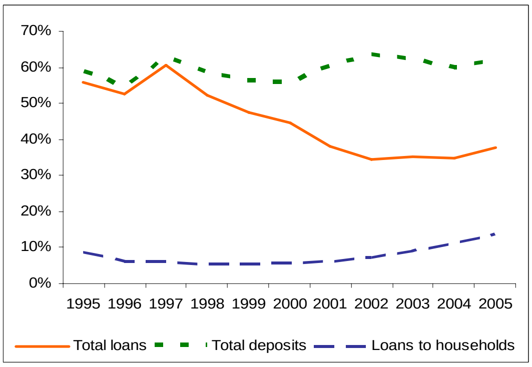
Source: Czech National Bank.

The period of fast credit creation from 1993 to 1996 was followed by a period when major banks got into deep financial difficulties. During this consolidation period (from 1997 to 1999), large state-owned commercial banks received substantial financial support from the government to clean up their balance sheets. As a result, they were very cautious in their lending policies (Graph 5). Even following the privatisation of banks in the late 1990s, new foreign owners focused on internal restructuring. As a result, credit growth was very subdued until 2002.

Graph 5

Total loans and deposits

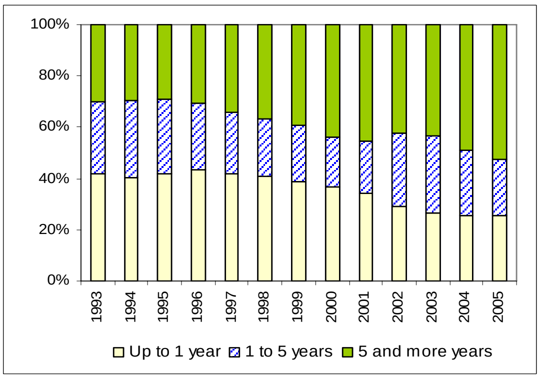
Percentage of GDP



Graph 6

Maturity structure of bank loans

Percentage of total loans



The start of the most recent phase of the banking sector development in 2002 coincided with the onset of a period of very low nominal interest rates. As banks completed restructuring and their capital base was strengthened, they became ready for the credit expansion. The expansion took place predominantly in the area of household lending (Graphs 1, 3 and 5). The growth of mortgage loans and consumer credit has averaged around 30% per annum for the past five years (Graph 3).[2] As a result, the share of household loans increased to 30% of

[2] These data refer to bank loans only. Non-bank financial institutions have also developed rapidly. They have mostly targeted the consumer credit market. In the 1990s, only car leasing loans were relatively developed.

total bank loans in this short period (Graph 1). However, the overall share of bank credit in GDP and the share of household loans in total loans remain very low compared to the euro area average.

Since 2005, corporate credit growth has also accelerated, reaching double-digit growth rates. The demand for foreign currency loans at the retail level has remained negligible and the overall proportions of foreign currency loans as well as deposits have continued to decline (Graphs 2 and 4). Unlike those of other countries in the region, Czech households are not willing to take on foreign exchange risk, despite continuing appreciation of the domestic currency vis-à-vis the euro.

Another indication of household risk aversion is the tendency to fix interest rates on mortgage loans for a relatively long duration (for Czech conditions) of around 3 years. The banks typically offer the possibility to fix the interest rate for 1 to 5 years, with the yield curve being relatively steep. Even though banks offer very low 1-year fixings for advertisement purposes, few households take a relative advantage of such offers. At the same time, fast growth of the residential mortgage market and greater stability in the corporate sector are reflected in a large increase in the share of long-term loans (Graph 6).

The interest rate sensitivity of the corporate sector is difficult to assess because a very liquid swap market has developed, with market-makers being mainly large London-based banks. It can be assumed that the corporate sector often uses the swap market for changing the interest rate profile of its liabilities. Exporters are also active users of foreign exchange derivatives, which can in addition help them to reduce their interest rate exposure.

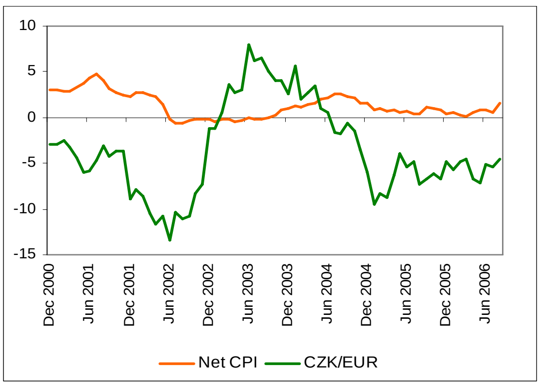
III. Some empirical observations on the Czech monetary transmission mechanism

As noted above, since the introduction of a more flexible exchange rate regime in 1996, the role of the exchange rate channel has gained greater significance in the Czech monetary transmission mechanism. Several estimates of the exchange rate pass-through were made, with the results typically indicating that a 1 percentage point depreciation of the koruna was translated into approximately 0.33 percentage points higher inflation in the late 1990s. The high exchange rate pass-through reflects a relatively high share of imported goods in the production and consumption baskets, as well as a high degree of openness of the Czech economy. As shown in Graph 7, exchange rate developments and inflation have remained correlated in the recent period of flexible exchange rates, although the pass-through seems to have declined somewhat.

Graph 7

Changes in exchange rate and inflation

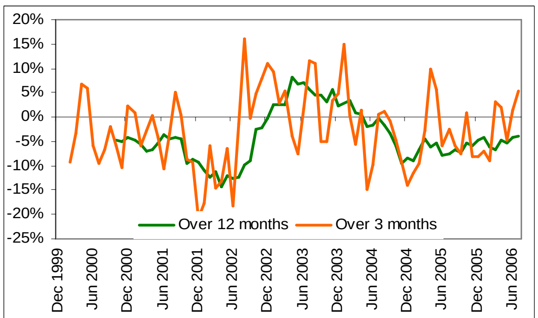
12-month percentage changes



Graph 8

Deviation of exchange rate changes from interest parity condition

In percent



Difference between 3-month (12-month) change in the CZK/EUR exchange rate, and the corresponding interest parity condition (CZK less EUR market interest rate).

Relatively high exchange rate volatility presents a considerable challenge for modelling of the inflation process for forecasting purposes. As shown in Graph 8, the risk premium derived ex-post from the interest parity condition shows considerable volatility in both the short term and the longer term. Moreover, the CNB modelling framework underestimates currency appreciation in the long term, which induces a pro-inflationary bias of the forecast. Capturing the effect of trend appreciation in a modelling framework is very difficult because the observed appreciation seems to be unrelated to capital inflows or interest rate differentials. For instance, there were periods when the koruna appreciated even though interest rates in the Czech Republic were lower than in the euro area. Appreciation thus seems to be driven mainly by unobservable expectations of economic agents.

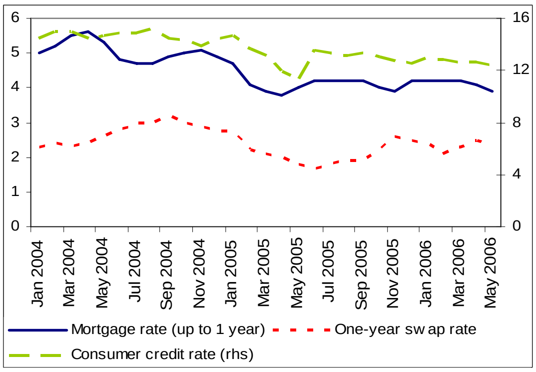
Another challenge for modelling of the inflation process is frequent adjustment of indirect taxes and regulated prices. The CNB modelling framework therefore uses CPI adjusted for changes in indirect taxes and regulated prices as a better approximation of underlying inflation (Graph 7). The monetary policy rule in the model then focuses on the reaction to secondary effects of changes in indirect taxes and regulated prices.

Regarding the interest rate channel, transmission between the policy rate and money market rates is generally quick and complete. However, transmission between money market rates and bank loan rates is slower and less complete. For shorter maturities, especially consumer credit, interest rates adjust with a longer lag and tend to be sticky (Graph 9). For 3-year mortgage loans, which are the most widespread in the Czech Republic, interest rates adjust more quickly to changes in money market rates (Graph 10). This effect is again less pronounced for interest rates on 5- to 10-year loans, which also tend to be sticky.

Graph 9

Short-term interest rates

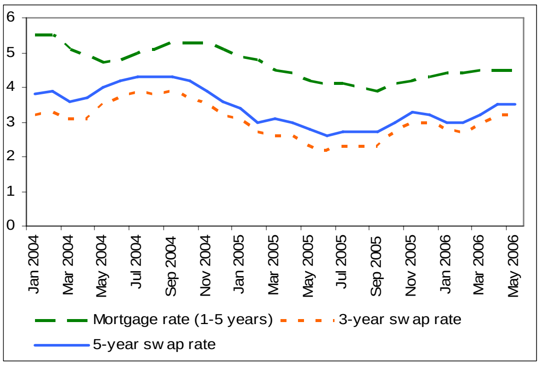
Percent



Graph 10

Medium-term interest rates

Percent



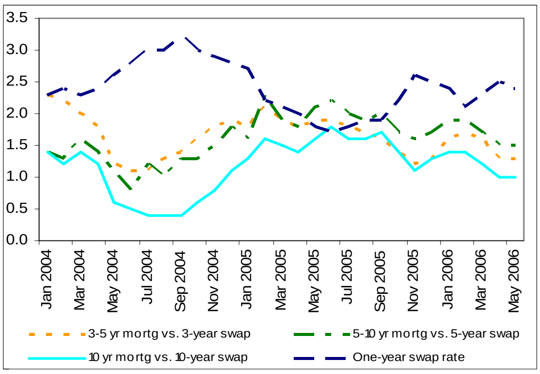
In general, one can notice that the interest rate pass-through is increasing over time. One reason for this improvement is that banks' capacity and willingness to accept risks have increased due to the strengthening of their balance sheets and greater competition and financial innovation in the banking industry. Greater competition has also contributed to a gradual decrease in spreads between money market rates and mortgage rates (Graph 11). In addition, evidence of an occasional negative correlation between changes in money market rates and loan rates, and lower volatility of spreads (Graph 12), points to smoothing of interest rate changes by the banks in order to keep the customers.

One should note that these changes on the supply side of the banking industry occurred at a time when the Czech inflation target was undershot for several years in a row, resulting in very low nominal interest rates. It is far from obvious whether monetary tightening would reduce credit expansion significantly under these circumstances. Apart from mortgage loans, interest rate margins in the Czech Republic are much higher than in the euro area, and the interest rate elasticity of demand is much lower. Banks could thus easily absorb somewhat lower margins if the Czech National Bank raised interest rates, while consumers and firms would not necessarily reduce their demand for loans significantly.

Graph 11

Interest rate spreads

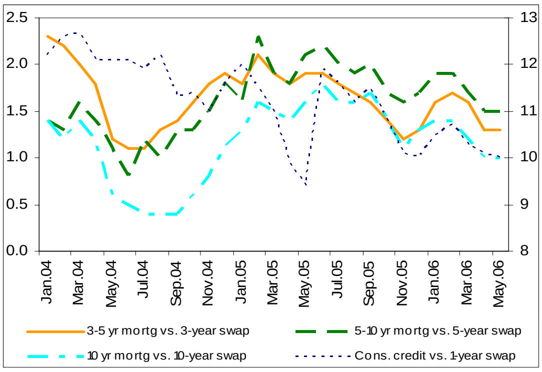
Mortgage rate, less swap rate, in percent



Graph 12

Volatility of interest rate spreads

Standard deviation of interest rate spreads



The housing market channel of the monetary transmission mechanism in Hong Kong

Hong Kong Monetary Authority

Abstract

This paper examines the roles that the property market plays in the transmission of interest rate movements to output growth and inflation in Hong Kong. Theoretically, interest rate-induced property price fluctuations affect private consumption and fixed asset investments through the wealth and balance sheet effects. They are also directly fed through to the rental component of the composite CPI to affect the headline inflation rate, and are indirectly passed to prices of goods and services through their impact on aggregate demand.

Simulation results from a vector autoregression (VAR) model show that the wealth and balance sheet effects of interest rate shocks on real GDP through the property price channel are on average relatively small compared with the direct cost of capital effects through other channels. However, the impact of the property price channel is very significant in affecting property prices and inflation rates.

In the absence of discretionary monetary policy for macroeconomic stabilization under the currency board system, prudential measures that counteract the impact of the property price channel may play a useful role in maintaining macroeconomic and financial stability, particularly in disastrous scenarios of large property price swings. The adoption of a forward-looking strategy in the implementation of the internal ratings-based approach under the Basel II framework – specifically, adjusting capital requirements according to property price misalignments – may help moderate banks' lending to the real estate market when the market is overheated, and provide some boosting effect when the market is unduly weak, thereby stabilizing housing prices to mitigate the impact of the property price channel.

I. Introduction

It is generally agreed that monetary policy shocks have a substantial effect on real economic activities, but there are disagreements on the transmission mechanism through which the impact occurs. The conventional money view contends that monetary policy affects the real economy mainly by altering the cost of capital, which in turn affects spending on fixed asset investment and consumer durables, while the new credit view argues that monetary easing stimulates economic activities by strengthening the balance sheet position of borrowers, thereby improving their overall terms of credit and increasing the supply of intermediated credit to bank-dependent borrowers (Bernanke and Gertler (1995)). Although the money and credit views differ in their interpretation of the transmission mechanism, they share a common recognition of the importance of asset prices, particularly property prices, in the propagation of monetary shocks to the real economy, given that housing wealth accounts for the majority of the net worth of households.

This paper focuses on the role that the property market in Hong Kong plays in the transmission of interest rate shocks to output growth and inflation. This topic is important for two reasons. First, as the real estate market plays a predominant role in the Hong Kong economy, it is useful to quantify the wealth and balance sheet effects associated with interest rate-induced property price fluctuations. Interest rate-induced property price swings can be very destabilizing for the local economy, as the experience during the Asian financial crisis demonstrated. Second, synchronized housing price booms in industrial countries over the past few years have increased the dependence of their economies on the property market. Global monetary tightening has recently started to take its toll on the global real estate market, with housing markets in selected industrial economies showing visible signs of slowdown, posing systemic risks to economic stability. This paper provides a timely study to examine the contractionary effect associated with monetary tightening through the property price channel, which could be of general interest to other economies.

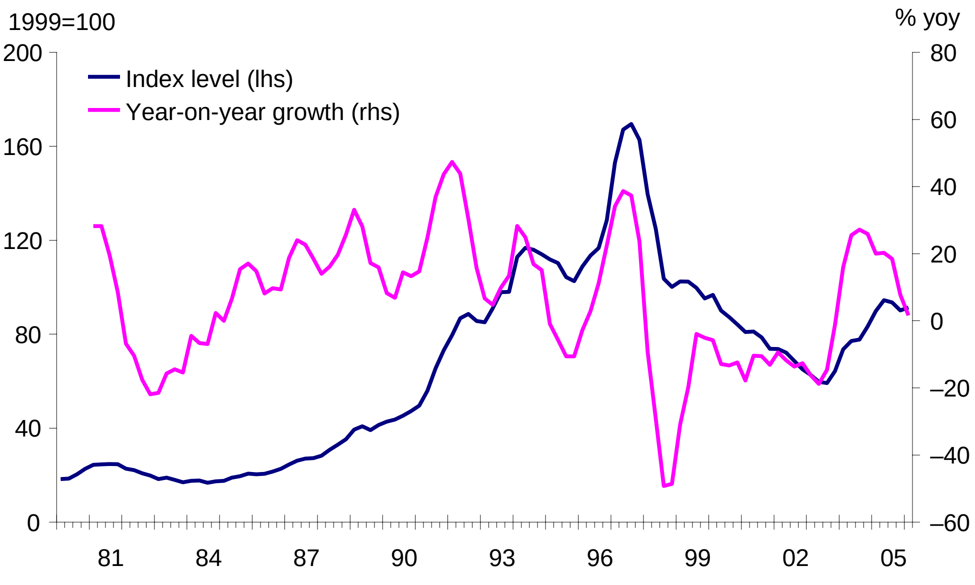
The rest of the paper proceeds as follows. Section II presents some stylized facts on property price swings in Hong Kong and examines the impact of interest rate changes on property prices. Section III outlines the various channels through which developments in the real estate market affect output and inflation. Section IV presents simulation results on the impact of interest rate changes on output growth and inflation through the property price channel using a small vector autoregression (VAR) model. Section V looks at possible measures that an economy with a currency board system can take to counteract the impact of the property price channel to maintain macroeconomic and financial stability. Section VI draws conclusions.

II. Relationship between property prices and interest rates

As documented in Gerlach and Peng (2004), property price movements in Hong Kong have been extraordinarily large and frequent, with numerous instances of price increases of over 20% and at least two occasions of sharp declines of a similar magnitude (Chart 1).

Chart 1

Movements in residential property price

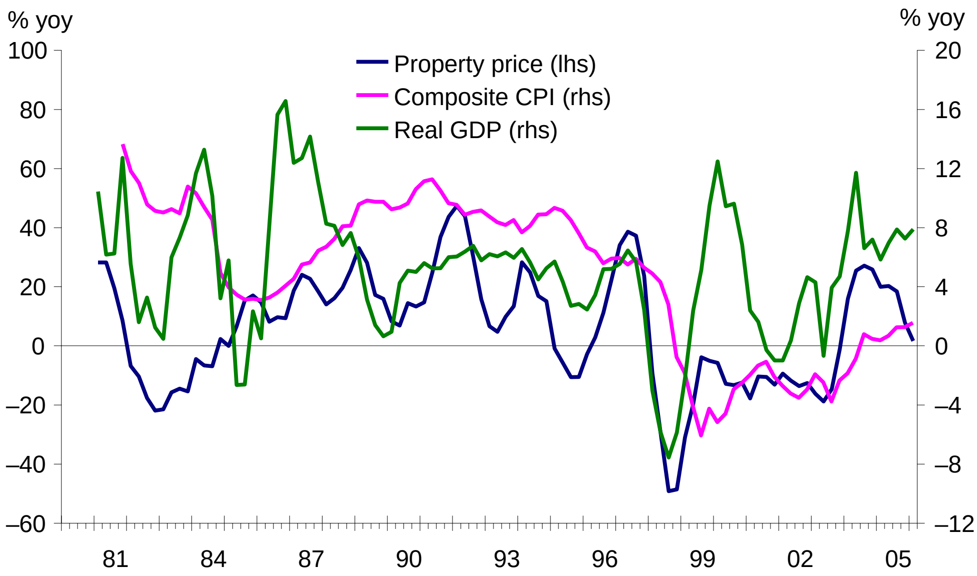


Sources: Rating and Valuation Department and HKMA estimates.

Accompanying the sharp swings in housing prices were gyrations in inflation and economic activities in Hong Kong (Chart 2). The persistent decline in property prices after the Asian financial crisis was associated with a prolonged period of deflation and a notable increase in the unemployment rate, while the subsequent recovery since the middle of 2003 has been accompanied by synchronized rebounds in property price, inflation and GDP growth.

Chart 2

Property price, inflation and output growth



Sources: C&SD, Rating and Valuation Department and HKMA estimates.

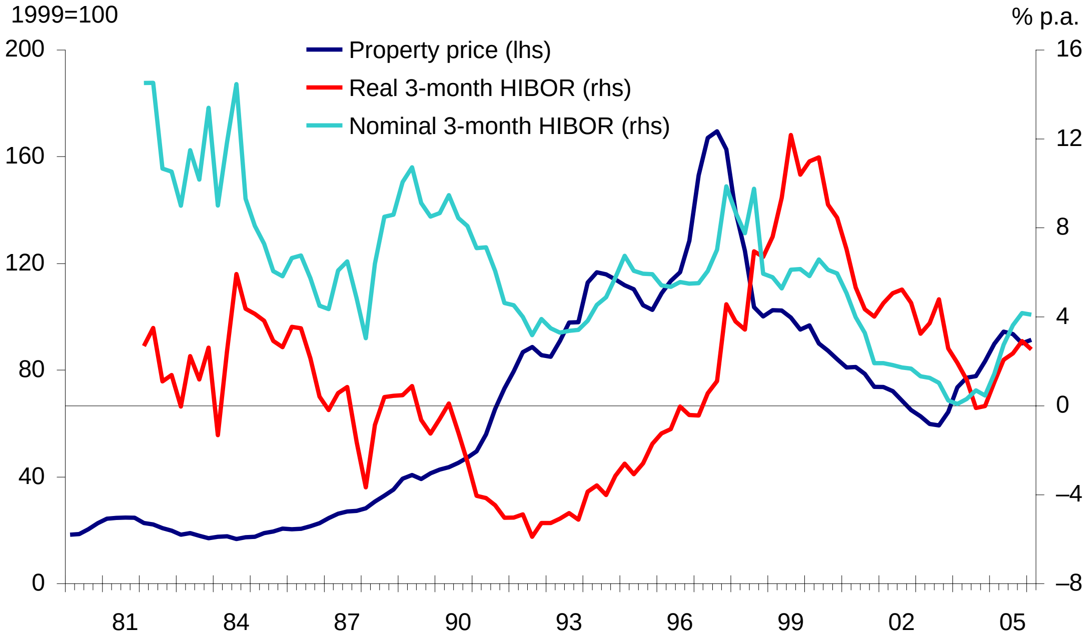
To what extent can the gyrations in property prices be explained by economic fundamentals, particularly changes in interest rates? Previous research at the HKMA suggests that property prices do indeed respond to economic fundamentals but may also be subject to bubble-like processes. Peng (2002) presented a speculative bubble model in which real property prices are determined by macroeconomic conditions and supply and demand factors including the unemployment rate, real interest rate, real rental index, the number of households and private housing stocks, in addition to a bubble-building and a bubble-bursting term. Leung and Liu (2005) adopted a stock-flow approach to model the residential housing market. They showed that long-run property prices are related to the housing stock, real household income, real user cost (interest rate) and population density. Both the speculative bubble model and the stock-flow model suggest that movements in housing prices are negatively related to interest rates. Specifically, the speculative bubble model (stock-flow model) shows that for every one percentage point increase in the interest rate, property price will decrease by 0.32 (0.48) percentage points, ceteris paribus.[1]

Under the Linked Exchange Rate system, Hong Kong dollar interest rates are exogenously determined by US interest rates as well as any risk premium required by investors to hold Hong Kong dollar assets. Consequently, interest rate movements are not tailored to smoothing domestic economic fluctuations, and they may at times even exacerbate property price swings. In particular, as shown in Chart 3, the negative real interest rates in the early part of the 1990s fuelled property price advancement, while the sharp hikes in interest rates on the back of sharp increases in the Hong Kong dollar risk premium during the Asian financial turmoil set off the collapse of real estate prices from their peak in late 1997. Overall, gyrations in property prices in Hong Kong are closely associated with movements in interest rates.

[1] Note that these are the immediate (within one quarter) effects. Second-round changes would occur through the lagged property price term and error-correction term in the models.

Chart 3

Property price and interest rates



Note: Real interest rate is computed by subtracting the headline composite CPI inflation rate from the three-month HIBOR.

Sources: Rating and Valuation Department and HKMA estimates.

III. Housing market channel of monetary transmission mechanism

Interest rate-induced property price fluctuations can affect the real economy via various channels. Changes in property prices affect private consumption and fixed asset investment through the wealth and balance sheet effects, and are passed through to the consumer price index via the rental component. These effects should be distinguished from the direct impact of interest rate changes on output growth and inflation, as discussed below.

1. Interest rate, property price and consumption

Theoretically, interest rate changes affect private consumption directly through an income effect and a substitution effect. A rise in interest rates increases the interest income of households to boost private consumption (the income effect), but also increases the incentive to delay current consumption in favor of savings (the substitution effect), rendering the overall impact ambiguous. On the other hand, interest rate changes directly affect the financing cost of consumer durables, which suggests a negative relationship between consumption of durable goods and interest rates. Empirical results from the HKMA small macro-econometric model show that private consumption expenditure, which includes consumption on both durable and non-durable goods, is negatively related to the interest rate both in the long-run cointegrating relationship as well as in the short-run dynamics (Kong and Leung (2004)).

Interest rate changes also affect private consumption through their effects on property prices. Property price fluctuations are commonly thought to affect private consumption through the so-called wealth effect. According to the life-cycle and permanent income hypotheses, households' consumption expenditure is dependent not only on current income level but also on their lifetime financial resources. As housing wealth usually accounts for a large part of these resources, changes in property prices can affect consumption expenditure. Cutler (2005) estimated a consumption function and found a stable relationship among consumption, labor income and housing wealth in Hong Kong. In addition, there is a "balance sheet channel" through which interest rate-induced property price fluctuations affect consumption. Because of information asymmetry and frictions in the credit market, cash flows and balance sheet conditions of households are important determinants of their capacity to borrow to finance consumption. As property price movements directly affect the market value of households' assets and indirectly influence cash flows of households by affecting mortgage payments, they can have an impact on private consumption expenditure through the balance sheet channel.

It should be noted that the magnitude of the balance sheet effect depends on the initial financial conditions of households (Peng et al (2001)). The balance sheet effect is unlikely to be large if financial conditions of households are initially sound, as households can withstand fairly substantial decreases in property prices without affecting their cash flows or access to credit. However, if the declines in property prices put households into a negative equity position, they are likely to respond by cutting their current consumption and increasing their savings to help repair their balance sheets. Conversely, initially credit-constrained households may increase their consumption significantly if an increase in property prices permits them to obtain credit using property as collateral. Using household survey data in the UK, Disney, Henley and Jevons (2002) showed that the elasticity of consumption with respect to house price shocks is greatest when property prices are rising for households that have zero or negative equity values in their housing stocks.

2. Interest rate, property price and fixed asset investment

Changes in interest rates affect fixed asset investment (including both housing and production equipments) by altering the financing cost of purchases and changing asset values. In particular, in respect of the property market, interest rate cuts reduce the cost of mortgage financing to boost demand for properties, thereby increasing property prices. Higher property prices relative to construction costs make building new houses more attractive and profitable, stimulating building and construction investment.

Furthermore, as in the case of private consumption, there is a "balance sheet channel" through which interest rate-induced property price fluctuations affect investment. As real estate properties are commonly used as collateral for bank credit, a rise in property prices increases the borrowing capacity of companies to finance investment. Experience in Hong Kong during the Asian financial crisis highlighted the importance of the balance sheet channel for bank-dependent corporate borrowers. The HKMA conducted two surveys on the financing situation of small and medium-sized enterprises (SMEs) in late 1999 and March 2000. The survey results suggested that there was a gap between the demand for bank credit by SMEs and the supply of funds by banks because of unfavorable characteristics of the SME loan market, including inadequate financial disclosure, low transparency of operations and a relatively high delinquency ratio. As a result, banks relied heavily on collateral in their lending decisions in the SME loan market. The sharp fall in property prices during the Asian financial crisis eroded the value of real estate collateral considerably, making it difficult for SMEs to obtain adequate bank financing.

3. Interest rate, property price and inflation rate

Interest rate-induced changes in property prices are directly fed through to the rental component of the composite CPI to affect the headline inflation rate, and are indirectly passed to the prices of goods and services through their impact on aggregate demand.[2] The rental component accounts for about 29% of the composite CPI basket in Hong Kong, exerting substantial influence on the headline inflation rate. Experience during the periods of deflation from late 1998 to 2004 confirmed the importance of the rental component in contributing to overall inflation rate. The composite CPI declined by a cumulative 13.3% during the November 1998 – June 2004 period, in which 7.5 percentage points were contributed by the rental component.

IV. Simulated impact of the housing market channel

This section attempts to quantify the impact of an increase in the three-month HIBOR on output growth and inflation through the property price channel. A small vector autoregression (VAR) model consisting of the headline composite CPI inflation rate, quarter-on-quarter growth in real GDP and property prices, and changes in the three-month HIBOR is constructed for this purpose (see Appendix 1 for the details of the VAR model). Similar to the methodology in Ludvigson, Steindel and Lettau (2002) and Giuliodori (2004), a two step approach is adopted. In the first step, the responses of output growth, inflation and property price to a 100 basis point increase in the three-month HIBOR are generated using the VAR model. In the second step, the impact of the same shock is simulated under a counterfactual regime, in which the effects of property price fluctuations on output growth and inflation are shut off by setting the estimated coefficients on the lags of property price in the inflation and output equations to zero. The difference between the responses in the two steps can be taken as the impact of the interest rate shock through the property price channel.

The effects of a 100 basis point hike in the three-month HIBOR on headline inflation rate, GDP and property price with the property price channel turned on and off are shown in Charts 4a–4c below. They show that a 100 basis point increase in the three-month HIBOR led to across-the-board declines in real GDP, property prices and headline inflation rate. The declines are more pronounced in the presence of the property price channel for all variables. The decrease in property prices is more significant in the presence of the property price channel because of the feedback effect of real GDP growth and inflation rate on property prices.

Chart 4a shows that the impact of interest rate shocks through the property price channel on real GDP growth is relatively small, as the responses are similar whether the channel is turned on or off. In other words, the wealth and balance sheet effects on aggregate demand associated with interest rate-induced property price swings are comparatively small versus the direct cost of the capital effect of interest rate shocks on aggregate demand. Chart 4b shows that the importance of the property price channel to the decline in property prices is more noticeable, as the responses are quite different when turning on and off the channel. Chart 4c suggests that the contribution of the property prices channel to the decrease in the headline inflation rate is very significant and is comparable to the effect through other channels, as the responses differ markedly when turning on and off the channel.

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[2] A property price increase will raise the market rental rate, which will eventually increase the rent paid by tenants when they renegotiate or renew their rental contracts. Rental contracts in Hong Kong normally have a duration of two years. Rents are usually fixed during the first year, and may be re-negotiated in the second year.

Overall, the results suggest that the property price channel plays an important role in the transmission of interest rate shocks to property prices and the general inflation rate, but a relatively minor role in the case of output growth. Although the results suggest that the property market does not normally amplify business cycle fluctuations in the face of interest rate shocks, it is possible – and even likely – that in episodes of unusually large property price movements within a short period of time (eg the boom in 1996–1997 and the subsequent bust in 1998–1999), the property price channel can have a great impact on consumption and economic activity. While the low frequency of occurrence of such events and their non-linear nature make it difficult to capture the effects by traditional econometric methods, anecdotal evidence suggests they have been significant in Hong Kong. In particular, the experience of almost six years of deflation after the bursting of the property bubble in late 1997 demonstrated that volatile property prices could still pose significant challenges to macroeconomic and financial stability as the increase in the number of mortgage loans in negative equity was almost certainly a reason behind reduced consumption expenditures at the time. At that time, mortgage delinquency ratios increased sharply, suggesting increased stress on the banking system. Experiences in other countries, as documented in Borio and Lowe (2002), also show that large asset price swings figure prominently in many accounts of financial instability.

In view of the risk to financial and monetary stability posed by sharp swings in property prices, the next section discusses an approach to deal with risks based on prudential measures consistent with the new Basel II approach.

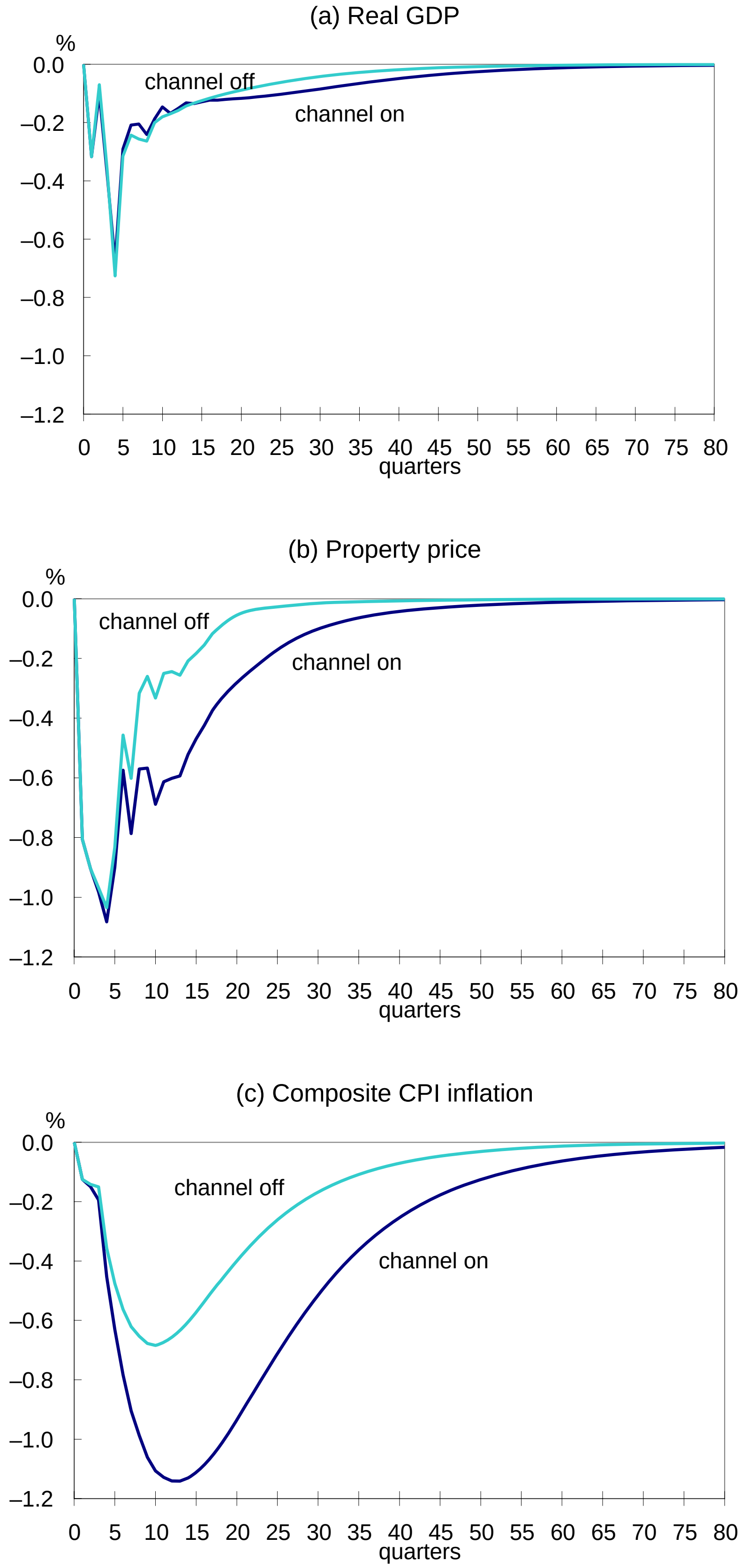
V. Prudential measures to counteract the property price channel

Cecchetti (2006) argues that in analyzing the macroeconomic impact of asset price booms and crashes, it is the disasters that are of true concern. To maintain exchange rate stability under the Linked Exchange Rate System, Hong Kong gives up autonomy to adjust interest rates to respond to disastrous scenarios of economic contractions and asset price swings. In the absence of the interest rate tool, prudential measures that counteract the effect of the property price channel may play a useful role in maintaining macroeconomic and financial stability. This section considers a tool, built on the internal ratings-based approach of Basel II, that varies prudential capital requirements according to the degree of misalignment in property prices to generate some countercyclical effects to dampen boom-bust cycles of property prices.

The tool is a risk management instrument that would be activated when there are signs of significant mispricing of property prices. It is not intended to micro-manage property price fluctuations. The premise of the approach is that the risks of banks' mortgage portfolios are higher when property prices are particularly high relative to their fundamental values and lower when property prices are particularly low. A forward-looking approach to risk assessment therefore implies a need to increase capital requirements in the former case and decrease them in the latter. The variation in capital requirements would affect banks' ability or willingness to lend, thereby contributing to a moderation in the volatility of demand for housing and the consequent volatility of property prices. Monetary and financial stability would be strengthened.

Chart 4

Responses of variables to 100 bp increase in the three-month HIBOR



Source: HKMA estimates.

Under Pillar I of Basel II, banks are required to maintain a capital adequacy ratio (ratio of banks' capital to their risk-weighted assets) of not lower than 8%. For banks adopting the internal ratings-based approach, the calculation of risk-weighted assets for credit exposures is based on three basic risk components: (i) probability of default, (ii) loss-given-default, and (iii) exposure-at-default.[3] These risk components are derived based on banks' internal credit models and they form the major inputs into different risk-weighted assets functions to calculate the capital adequacy ratio.[4] Under the internal ratings-based approach, banks will be required to regularly assess the risks of their portfolios and adjust their capital or portfolios accordingly to satisfy the regulatory requirements.

As real estate is commonly used as physical collateral for securing bank lending, property price fluctuations should be taken into account in the estimation of the risk components of banks' risk-weighted assets. It is widely accepted that the prevailing market price of an asset may deviate from its fundamental value in the short run, but tends to move towards its fundamental value in the long run. The assessed risk for bank lending with property pledged as collateral should reflect such tendencies. If this is the case, the internal ratings-based approach and the treatment of physical collateral under the Basel II framework could give rise to the possibility of introducing some degree of countercyclicality into the capital requirement.[5] In the area of mortgage lending, this would involve the estimation of the fundamental value of properties and banks would assign a higher amount of capital for their property loans, other things being equal, when property prices are above the fundamental value, and vice versa.[6] This would be in agreement with the Basel II framework, as the probability of default is usually higher (lower) when the value of the property used as collateral is above (below) its fundamental value.

Conceptually, it is easy to understand why the risk of a loan is positively correlated with the deviation of the prevailing property price from its fundamental value. Credit risks of collateralized credit exposures in general, and mortgage loans in particular, are closely tied with the values of physical collateral. Credit risk models adopted in banks usually incorporate the current loan-to-value ratio, which measures the leverage ratio of the collateralized loan, as one of the risk drivers. Various studies show that probability of default and loss-given-default are positively correlated with the current loan-to-value ratio.[7] Specifically, the price of a property pledged as collateral has a higher tendency to fall when it is above its fundamental value, increasing the likelihood of the loan having a higher loan-to-value ratio. Similarly, the loss-given-default is also likely to be higher. This suggests that the overall risk of a loan, and thus the capital required, should be positively related to the gap between the prevailing property price and its fundamental value.

To the extent that different levels of misalignment in property prices may represent different levels of risk, the internal ratings-based approach would call for adjustments to the capital

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[3] Probability of default measures the likelihood that a borrower will default over a one-year time horizon, while loss-given-default captures the portion of credit exposures that will be lost if default occurs (after taking the economic value of physical collateral into account). Exposure-at-default measures the credit exposures at the time of default.

[4] For corporate exposures, besides the probability of default, loss-given default and exposure-at-default, effective maturity is an additional risk component.

[5] Strictly speaking, to the extent that the capital requirement of Basel II is procyclical, and tends to amplify economic cycles, the countercyclicality introduced by the internal ratings-based approach as suggested in this paper would more accurately be described as dampening the procyclicality of the capital requirement.

[6] Fundamental property value is defined as the level of property price which is sustainable in the sense of being consistent with economic fundamentals.

[7] See, for example, Campbell and Dietrich (1983), Goldberg and Capone (1998), Jokivuolle and Peura (2003) and Hui et al (2006).

requirement or portfolio structure of banks when such misalignments take place or vary. With this relationship between risks and the property value gap, the adoption of a forward-looking strategy in the implementation of the internal ratings-based approach could introduce some countercyclical effects to smooth the property price cycles, thus enhancing monetary and financial stability.

In practice, the effectiveness of such a tool largely depends on the sensitivities at various stages of the countercyclical mechanism, i.e. how the risk of mortgage loans may respond to the gap between prevailing property prices and their fundamental values (thus affecting the capital requirements), how the changes in capital requirements may impact on credit expansion and how credit growth may affect property prices. In this regard, the case of Hong Kong is being examined, and the empirical evidence will be reported in a separate study when it is completed.

VI. Conclusions

This paper examines the roles that the property market plays in the transmission of interest rate movements to output growth and inflation in Hong Kong. Theoretically, interest rate-induced property price changes affect private consumption and fixed asset investments through the wealth and balance sheet effects. They are also directly fed through to the rental component of the composite CPI to affect the headline inflation rate, and are indirectly passed to prices of goods and services through their impact on aggregate demand.

Simulation results from a vector autoregression (VAR) show that the wealth and balance sheet effects of interest rate shocks on real GDP through the property price channel on average are relatively small compared with the direct cost of capital effects through other channels. However, the property price channel plays a very important role in the transmission of interest rate shocks to the property price and headline inflation rate.

In the absence of discretionary monetary policy for macroeconomic stabilization under the currency board system, prudential measures that counteract the impact of the property price channel may play a useful role in maintaining macroeconomic and financial stability, particularly in disastrous scenarios of large property price swings. Countercyclical capital requirements in the internal ratings-based approach under the Basel II framework may help moderate banks' lending to the real estate market when the market is overheated, and provide some boosting effect when the market is unduly weak, thereby stabilizing housing prices to mitigate the impact of the property price channel.

Appendix 1

Vector Autoregression

A vector autoregression (VAR) consisting of the headline composite CPI inflation rate, the quarter-on-quarter growth in real GDP and property prices, and changes in the three-month HIBOR is estimated. The sample is composed of quarterly data from 1983:Q2 to 2006:Q1. A lag length of four is chosen for estimations based on the Akaike information criterion. The estimated VAR is as follows.

$$
\begin{bmatrix} \pi \\ \Delta ppt \\ \Delta gdp \\ \Delta hibor \end{bmatrix} =
\begin{bmatrix}
\underset{(10.53)}{1.17} & \underset{(0.46)}{0.01} & \underset{(2.30)}{0.11} & \underset{(-1.79)}{-0.13} \\
\underset{(1.97)}{1.21} & \underset{(5.46)}{0.60} & \underset{(0.56)}{0.14} & \underset{(-2.09)}{-0.81} \\
\underset{(0.53)}{0.14} & \underset{(0.81)}{0.04} & \underset{(2.30)}{0.24} & \underset{(-1.96)}{-0.32} \\
\underset{(-0.22)}{-0.04} & \underset{(0.78)}{0.03} & \underset{(1.66)}{0.14} & \underset{(-1.78)}{-0.22}
\end{bmatrix}
\begin{bmatrix} \pi_{t-1} \\ \Delta ppt_{t-1} \\ \Delta gdp_{t-1} \\ \Delta hibor_{t-1} \end{bmatrix} +
$$

$$
\begin{bmatrix}
\underset{(-0.52)}{-0.09} & \underset{(1.26)}{0.03} & \underset{(1.04)}{0.05} & \underset{(0.52)}{0.04} \\
\underset{(-2.43)}{-2.28} & \underset{(0.09)}{0.01} & \underset{(0.18)}{0.05} & \underset{(-0.55)}{-0.22} \\
\underset{(-0.41)}{-0.16} & \underset{(-0.60)}{-0.03} & \underset{(1.19)}{0.13} & \underset{(0.15)}{0.03} \\
\underset{(-0.21)}{-0.04} & \underset{(0.45)}{0.02} & \underset{(-0.71)}{-0.06} & \underset{(-0.56)}{-0.07}
\end{bmatrix}
\begin{bmatrix} \pi_{t-2} \\ \Delta ppt_{t-2} \\ \Delta gdp_{t-2} \\ \Delta hibor_{t-2} \end{bmatrix} +
\begin{bmatrix}
\underset{(0.34)}{0.06} & \underset{(0.33)}{0.01} & \underset{(-0.63)}{-0.03} & \underset{(0.39)}{0.03} \\
\underset{(3.22)}{3.09} & \underset{(0.73)}{0.09} & \underset{(0.65)}{0.17} & \underset{(-1.32)}{-0.50} \\
\underset{(0.07)}{0.03} & \underset{(-1.52)}{-0.08} & \underset{(1.05)}{0.12} & \underset{(-1.90)}{-0.30} \\
\underset{(-1.11)}{-0.35} & \underset{(-1.11)}{-0.00} & \underset{(-0.73)}{-0.06} & \underset{(0.30)}{0.04}
\end{bmatrix}
\begin{bmatrix} \pi_{t-3} \\ \Delta ppt_{t-3} \\ \Delta gdp_{t-3} \\ \Delta hibor_{t-3} \end{bmatrix} +
$$

$$
\begin{bmatrix}
\underset{(-1.83)}{-0.19} & \underset{(0.31)}{0.01} & \underset{(-0.30)}{-0.01} & \underset{(-2.47)}{-0.15} \\
\underset{(-3.08)}{-1.80} & \underset{(-2.31)}{-0.26} & \underset{(-1.38)}{-0.35} & \underset{(-0.03)}{-0.01} \\
\underset{(0.18)}{0.04} & \underset{(1.08)}{0.05} & \underset{(1.40)}{0.15} & \underset{(-4.09)}{-0.59} \\
\underset{(0.14)}{0.03} & \underset{(0.53)}{0.02} & \underset{(-0.05)}{-0.00} & \underset{(0.26)}{0.03}
\end{bmatrix}
\begin{bmatrix} \pi_{t-4} \\ \Delta ppt_{t-4} \\ \Delta gdp_{t-4} \\ \Delta hibor_{t-4} \end{bmatrix}
$$

where π is the headline composite CPI inflation rate, gdp represents real GDP, ppt refers to property prices, and hibor denotes the three-month HIBOR.

A Cholesky decomposition is imposed based on the following ordering: three-month HIBOR, real GDP, property prices and headline composite CPI inflation rate. The impulse response functions and variance decomposition are shown in Chart A1 and Chart A2 respectively.

Chart A1

Impulse response functions

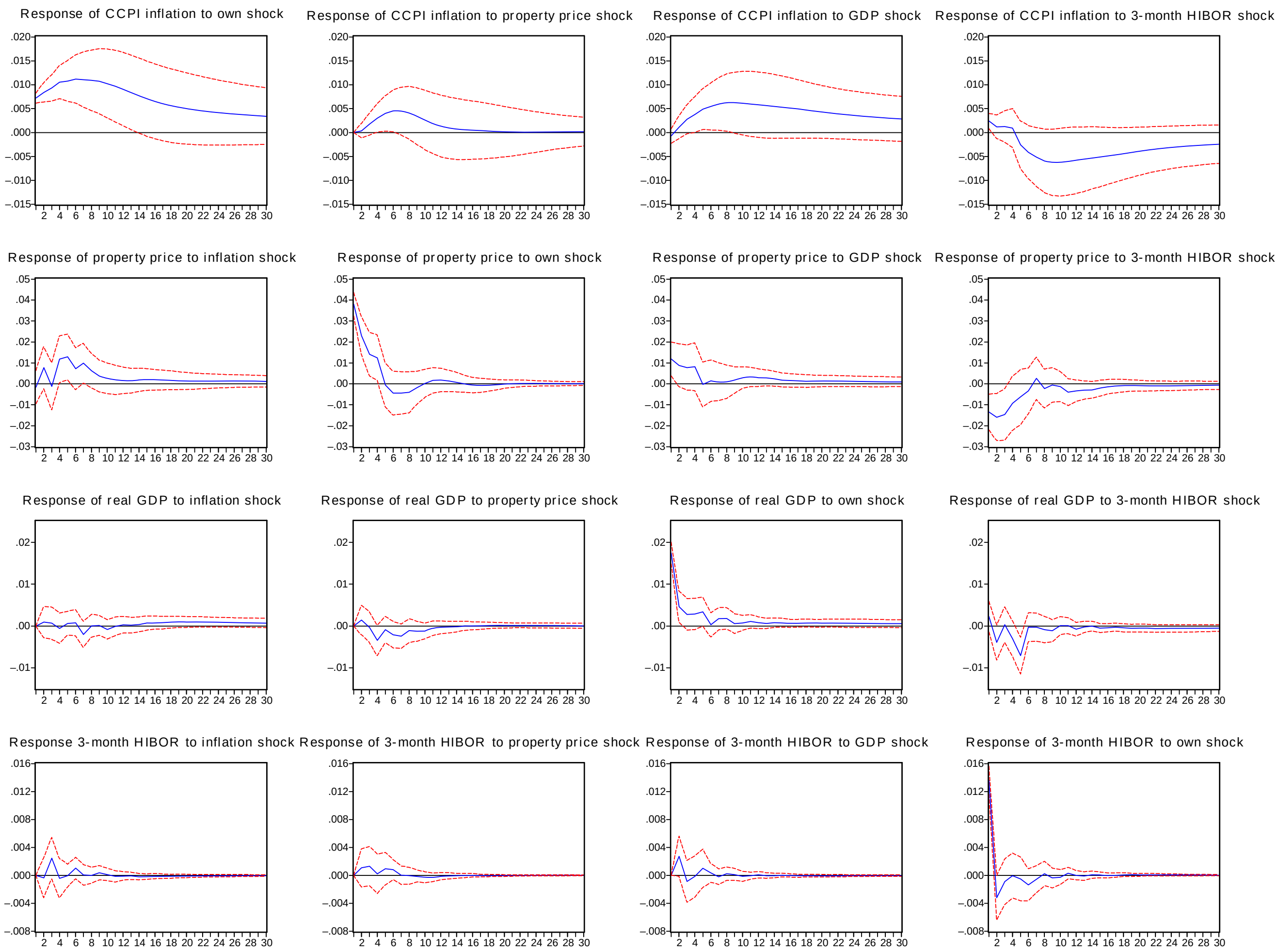
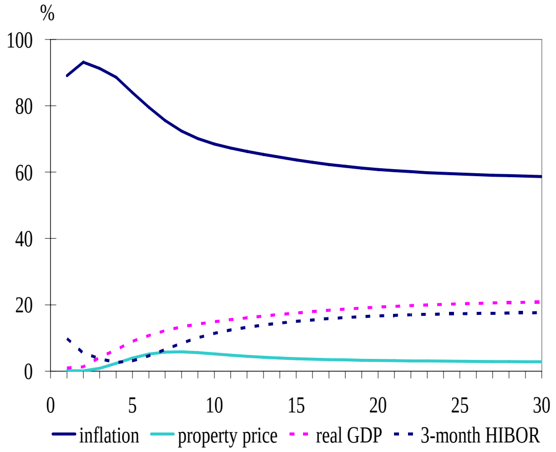


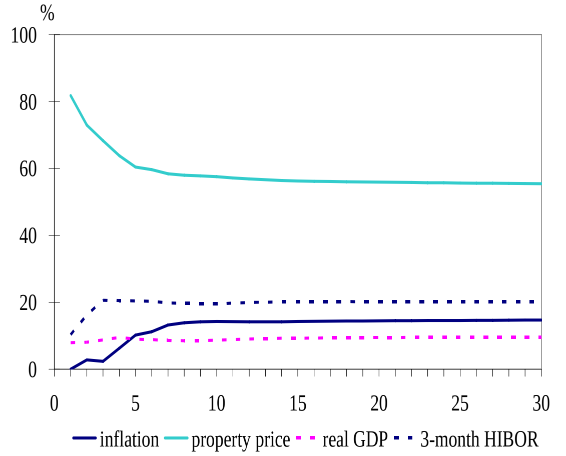
Chart A2

Variance decomposition

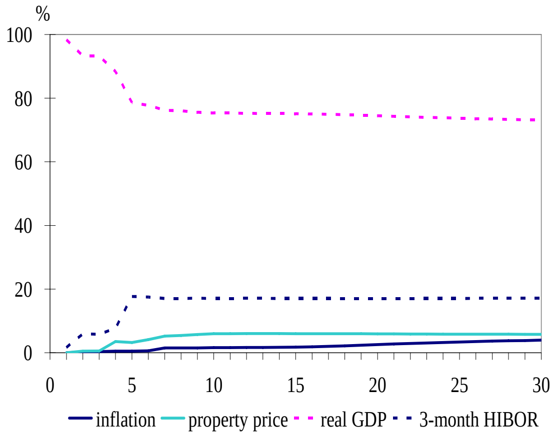
Variance decomposition of composite CPI inflation



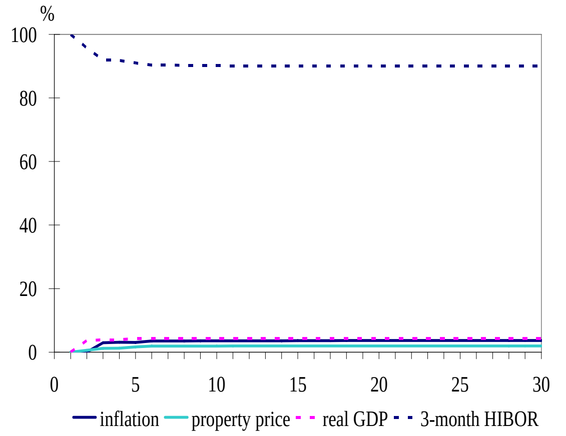
Variance decomposition of property price growth (qoq)



Variance decomposition of real GDP growth (qoq)



Variance decomposition of change in 3-month HIBOR



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The Hungarian monetary transmission mechanism: an assessment[1]

Balázs Vonnák[2]

1. Introduction

From the central bank's point of view, the transmission of monetary policy to the economy is of prominent interest among various macroeconomic topics. Without being aware of the monetary transmission mechanism (MTM), it is not possible to conduct good policy. In Hungary, our knowledge so far has been based mainly on intuitive understanding of the structural features of the economy instead of evidence from quantitative research.

At the beginning of 2004, a comprehensive research project was launched at the Magyar Nemzeti Bank (MNB). The objective of the project was to provide quantitative results about the Hungarian monetary transmission mechanism in order to form an overall picture. The focus of the project was on empirics. We first investigated those areas where the most up-to-date econometric methods could be applied.

The sample used for estimations typically covered the period between 1995 and 2004. In some cases when the higher frequency or the existence of panel data endowed us with enough observations, the sample was even shorter. The identification of the effect of monetary policy has been particularly challenging due to the fact that during this period the main driving force behind macroeconomic fluctuation came from the supply side, not from the demand side. Being aware of this difficulty, we tried to apply techniques capable of disentangling the monetary policy from other sources of shocks.

This paper attempts to create a synthetic view from particular results. During 2004 and 2006, nine papers were published within the project as either an MNB study or an MNB working paper. The synthesis basically relies on those studies, but other research results are also considered as long as they concern the transmission mechanism.

There are some aspects that make our synthesis challenging. The first difficulty to overcome is that the particular estimates were based on various sample periods. Despite this, we will treat the underlying studies as if they referred to the same sample, which is typically the decade between 1995 and 2004. The second problem is that the definition of monetary policy differs across estimations. Some papers consider the effect of an interest rate change, while other authors investigated only those changes that were not an endogenous reaction of monetary policy to some economic shocks. Taking into account their limited comparability, we try to create a qualitative synthesis which is consistent with all individual findings.

In the assessment of the overall picture, we focus on two particular issues that are of primary interest. The first is about the effectiveness of monetary policy. Having an open capital market with predominant presence of foreign investors, interest rates and the exchange rate are strongly influenced by the risk preferences and risk assessment of international players. It was sometimes not obvious whether there is an autonomous monetary policy in Hungary that conducts a policy according to its targets, or the interest and exchange rates are driven

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by international and other factors. Hence, we first posed the question whether it is possible to detect a significant effect of monetary policy on key variables.

The second question we try to answer is whether the exchange rate channel dominates the transmission mechanism. Hungarian monetary policy has paid special attention to exchange rate movements and expectations. The belief was that this is the most, if not the only, effective channel of transmission. It was observed that tradable goods prices closely followed exchange rate movements influencing incomes, wages and other prices. Should this picture change significantly, there might be consequences for the monetary policy strategy.

In order to be able to address the above-mentioned issues, we need a comprehensive view of the transmission mechanism. We try to synthesise particular results using a scheme that focuses on two stages of the transmission mechanism. At the first stage, monetary policy impulses are transmitted by special markets to agents who make decisions on purchasing and production. To describe the first stage, we rely on Mishkin's (1996) classification of different channels of the transmission mechanism. He distinguishes between the interest rate, exchange rate, other asset price and credit channels. Each mechanism is based on a particular theory of the effect of monetary policy. We add the expectation channel to the analysis, a mechanism that relates to the transparency and credibility of the monetary policy objective and strategy.

Several studies explicitly addressed this first step within the MTM project. Horváth et al (2004; HKN henceforth) investigated how commercial bank rates follow the policy rate. Rezessy (2005) presented estimates of the pass-through to government bond yields and equity prices. Kiss and Vadas (2005) provide information about the Hungarian housing market. HKN (2006) asked whether the credit supply of banks is affected by monetary policy.

The first stage includes the behaviour of the exchange rate as well. Unfortunately, the empirical literature has so far provided mainly puzzling results regarding the effect of monetary policy. Although these puzzles were interesting from a scientific point of view, they were of less practical importance regarding large, closed economic entities like the United States or the euro area. Hungary is a small open economy, and the exchange rate has played a distinct role in formulating and communicating monetary policy. Hence, we allocated more resources to this issue than is usual in the literature on the monetary transmission mechanism. Whereas Rezessy (2005) and Karádi (2005) investigated the short-term reaction of the exchange rate using high-frequency data from the very recent period, Vonnák (2005) obtained estimates for a longer horizon.

After accumulating all the information about the stance of monetary policy through commercial bank interest rates and asset prices economic agents on the goods market make their purchase decisions. At this second stage, we analyse the behaviour of aggregate demand with special regard to private consumption, investment decisions and foreign trade.

Finally, we give a brief overview of how relative price changes disappear in the long run and what role the labour market plays in this procedure. We can consider this as the third stage of the transmission process. Despite its obvious importance, we cannot have a deep insight as we have no specific research focusing on this area.

The structure of the paper is the following. In section 2, we present the overall picture and put it into an international context highlighting the special features of the Hungarian MTM. Section 3 classifies particular results using Mishkin's (1996) approach. In Section 4, we investigate aggregate demand. In Section 5, we review our knowledge about medium-run effects, including the labour market and the non-tradable sector. Section 6 concludes and, based on Orbán and Szalai (2005), attemps to assess future trends.

2. The overall picture

The most important aspect of the transmission mechanism is the way monetary policy can influence inflation and output. Central banks usually have the primary goal of maintaining price stability. The volatility of output is also of prominent concern. In this section, we present a bird's eye view of the effect of a Hungarian monetary policy shock. We compare our results for inflation and output to findings for other countries. In the subsequent sections, we go beyond the overall picture and try to describe the mechanism in more detail and to explain the special features of the Hungarian MTM.

We investigate the behaviour of output and prices after an unexpected monetary tightening. According to Vonnák (2005), a typical monetary policy shock can be characterised as a 30-40 basis point interest rate hike coupled with a 0.6–0.8% exchange rate appreciation. Both changes are transitory, with the variables returning to the baseline after three to four years.

The response of Hungarian consumer prices to the shock is shown in Figure 1 borrowed from Jakab et al (2006; JVV henceforth). There is substantial similarity between the three impulse response functions, each of them coming from a model estimated on Hungarian data. Consumer prices react to monetary tightening by a quick drop. The lower price level seems to persist for several years. In terms of the yearly inflation rate, which is the target variable in Hungary, it means that the effect of monetary policy is the largest within the first two years, with the peak being somewhere at the end of the first year.

This shape of the price response is somewhat different from those found in closed, developed economies like the United States or the euro area. Most SVAR estimates[3] show a slight increase during the first year and prices typically begin to fall only later, but then the decline lasts for several years. Accordingly, the yearly inflation rate is higher at the beginning, but later falls below the baseline persistently. This stands in clear contrast with Hungarian price dynamics.

The response of Hungarian output is not as clear-cut as in the case of prices. While two models in JVV show a slight decline in real activity after the contractionary shock, SVAR estimates using time series of GDP suggest rather a small although not significant increase. The reason for this is that within the same framework a significantly higher consumption of households is detected that offsets the decline in investments. It should be noted, however, that, using the same methodology but industrial production data instead of GDP, Vonnák (2005) estimated a significant drop in industrial output and the magnitude was even higher than those found by the other two models in JVV. We conclude therefore that Hungarian GDP drops somewhat after the contraction.

Estimates for the United States and the euro area show a more pronounced output response. Although there are some studies that could not find a significant effect of monetary policy,[4] most results indicate a clear slowdown of the economy after an unexpected monetary tightening. The consensus view fits the basic features of a new-Keynesian economy with sticky prices: after the monetary policy action, volumes react quicker to the changes of demand and output returns to its natural level only when price adjustment takes place, that is, the GDP response leads the price response.

In the case of Hungary, the same new-Keynesian explanation alone is not able to explain fully what happens after a monetary policy shock. The response of output is moderate. The reaction of prices is instantaneous and does not lag behind that of the output gap. For

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3 For examples, see Christiano et al (1998) and Angeloni et al (2003).

4 Uhlig (2005) is such an example.

Hungary, some alternative description of the transmission mechanism is needed. In the following sections, we try to identify the special features of the Hungarian MTM relying mainly on our fresh results.

3. The channels of monetary transmission

The mechanism through which monetary policy affects the economy can be divided into two steps. In the first step, monetary policy influences market interest rates, the exchange rate, asset prices, the credit supply of the banking sector and expectations through its policy rate and communication. Economic agents extract the signal transmitted by those markets and make decisions on their demand for goods and production. The second stage of the MTM consists of the reaction of demand as well as the adjustment process of the supply side and the labour market.

In this section, we classify the results that relate to the first stage of the MTM relying on Mishkin (1996), who distinguishes between interest rate, exchange rate, asset price and credit channels. This framework provides a convenient way to separate distinct mechanisms of monetary transmission. Another advantage is that Mishkin's categories are widely used when talking about the effect of monetary policy. However, the framework has some shortcomings as well. These channels cannot be regarded as a model-based, complete decomposition of the whole effect. For example, we augment Mishkin's classification scheme with the expectation channel. Another problem is that in some cases separating these channels is very difficult. Nonetheless, we found this framework to be a useful tool for arranging the results of our research on various aspects of the transmission mechanism.

3.1 Interest rate channel

The first stage of the interest rate channel is the mechanism through which the policy rate passes through to commercial bank rates, that is, to corporate and household deposit and loan rates. The second stage is when households and firms make their consumption and investment decisions in the face of new interest rate conditions. We summarise here our findings concerning the first stage, which is far simpler than the second.

Monetary policy has the power to determine the very short end of the yield curve by providing or absorbing liquidity with a maturity ranging typically from overnight to two weeks or one month. The rate set by the central bank is the (opportunity) cost of having excess liquidity for commercial banks, and therefore influences money market interest rates of the same maturity very quickly and effectively. In Hungary during the past 10 years, a short-term deposit rate has acted as policy instrument. Up until 1997, its maturity was one month, and since then the policy rate has been the two-week deposit rate.

According to the expectation hypothesis, longer maturities are linked to the policy rate through expectations of the future development of short-term rates. For example, if an interest rate hike by the central bank is expected to be temporary, longer-term interest rates will not be affected to the extent that short-term rates change. On the contrary, if the market expects that higher rates will remain for longer, long-term yields will increase more, whereby monetary policy may be more effective.

An important feature of most of our research is that typically three-month money market or T-bill rates are used as the policy rate instead of the central bank's deposit interest rate. The reason for this is twofold. On the one hand, for higher-frequency estimation (monthly or more frequent) the policy rate sometimes does not reflect the frequent change in the monetary policy stance. On the other hand, we can consider the three-month interest rate as embedding more information than the policy rate, since it contains expectations about its movement in the very near future. If, for example, the Monetary Council leaves the base rate unchanged according to market expectations, but at the same time releases a statement containing reference to tightening bias, three-month market rates will rise and this reflects a genuine monetary tightening correctly, even in the absence of an immediate interest rate move. Nonetheless, at a monthly or quarterly frequency the policy rate co-moves with three-month market rates closely, as is shown in Figure 2.

For government bond yields and T-bill rates, Rezessy (2005) estimated the immediate effect of an unexpected interest rate move on the yield curve. He found significant impact all along the curve. Even the 10-year benchmark yield increased by 10 basis points after a surprise 100 basis point policy rate hike on the same day. The one-year-ahead forward interest rate increased by half a percentage point, but beginning with the five-year horizon a significant decrease was detected. As long as forward rates reflect interest rate expectations, the reaction of forward rates can be interpreted as: half of the unexpected move is expected to be maintained one year later, and to die out completely by the fifth year.

Although the pass-through from short to longer maturities is found to be satisfactory, it is not necessary for an effective interest rate channel because in Hungary the maturity of loans and deposits is typically shorter than in developed countries. In some cases, like corporate loans, even if the maturity is longer, the interest rate is linked to the three-month interbank rate, rendering it essentially a short-term debt with frequent repricing.

HKN (2004) investigate the connection between the short-term money market rate and commercial bank rates. They detect relatively fast pass-through, with the adjustment of corporate loan rates being the fastest and most complete, but even the most slowly and least completely reacting consumption loan rates absorb 80% of short-term interest rate moves.

From our point of view, the relevant finding of these papers is that this first stage of the interest rate channel performs well, and that it depends on the household and corporate sector whether interest rate movements exert direct influence on aggregate demand. As we will see in Section 4, the interest rate channel may be effective mainly through investment decisions.

3.2 Exchange rate channel

The first, and perhaps empirically the most challenging, step of the exchange rate channel is the reaction of the exchange rate to interest rate movements. A very simple and in theoretical modelling widely used assumption is uncovered interest rate parity (UIP). Within the UIP framework, risk neutral agents demand excess yield on assets that compensate them for the expected loss caused by depreciation:

$$i_t = i_t * + E_t s_{t+1} - s_t \tag{1}$$

where i denotes one-period yield, s is the domestic currency (forint) value of the foreign currency (euro) and * stands for foreign variable.

As in Dornbusch's (1976) model, an unexpected interest rate increase with flat foreign rates causes the spot exchange rate to appreciate and/or the expected future rate to weaken. Unfortunately, statistical methods failed to detect this mechanism.[5] The estimated relationship between interest rate and exchange rate was just the opposite, that is, appreciation was more frequently coupled with a positive interest rate differential.

One possible explanation is the presence of time-varying risk preferences. When the right-hand side of (1) is augmented with a risk premium term, the relationship alters in a way that investors require compensation not only for an expected depreciation, but also for

[5] For a survey, see MacDonald and Taylor (1992).

holding domestic assets at all. The latter term can represent, for instance, an exchange rate risk premium if investors are risk-averse.

$$i_t = i_t * + E_t s_{t+1} - s_t + rp_t \qquad (1')$$

It is easy to see that an increase in risk premium (*rp*) can lead to a higher domestic interest rate or to a spot depreciation or can be offset by an appreciation in the future. If risk premium shocks dominate autonomous monetary policy, the observed co-movement between interest rate and exchange rate will be the opposite of the pure UIP case.

For Hungary, the model containing a time-varying risk premium is certainly the relevant one. During the past decade, since foreign portfolio investors appeared at forint markets, several episodes were recorded when it was obvious that changing risk assessments and preferences caused large swings in the exchange rate. Monetary policy tried to partially neutralise those shocks, otherwise they would have caused undesired movements in consumer prices.

The presence of shocks to the risk premium makes it difficult to measure the effect of monetary policy on the exchange rate. Relying purely on the correlation between interest rate and exchange rate would lead to a perverse effect: monetary tightening would seem to weaken the currency. Distinguishing between two types of "financial" shock, monetary policy and risk premium shocks, is therefore crucial. Unfortunately, due to its limited relevance for developed economies, this problem has not received much attention in the empirical literature.

Three of our research papers dealt explicitly with the reaction of the exchange rate to monetary policy. Rezessy (2005) estimated the immediate impact of monetary policy shocks on the exchange rate. He used daily data starting in the middle of 2001, when the intervention band of the forint was widened and the inflation targeting regime was introduced. His identification strategy exploited the fact that on the occasion of rate-setting meetings of the Monetary Council monetary policy shocks are typically larger than on other days. He detected a significant effect with the expected sign on the first day, and an even larger effect on the day after a rate-setting meeting.

For a longer period, beginning in 1995, Vonnák (2005) estimated the dynamic effect of monetary policy shocks on industrial production, consumer prices, the short-term interest rate and the nominal exchange rate. It is important to note that the response of the exchange rate was in one case part of the identifying assumptions, therefore it cannot be considered as being purely estimated. One identification strategy assumed that, out of all the possible shocks that have only a delayed effect on output, the monetary policy shock is the only one producing negative correlation between the interest rate and exchange rate (higher interest rates with appreciation). The other identification scheme, however, did not use any presumption about the exchange rate, being based instead on some historical evidence about Hungarian monetary policy. The response of the exchange rate was in each case almost identical and, despite the different data set, comparable to Rezessy's (2005) results. We are therefore quite certain that during the past five to 10 years monetary policy has been able to influence the exchange rate. An unexpected 25 basis point rate hike on average appreciates the exchange rate almost immediately by 0.5–1%.

Karádi (2005) introduced a more sophisticated model of monetary policy and the exchange rate. In his setup, there are two channels via which the central bank affects the exchange rate: one is the traditional interest rate policy, the second is by influencing exchange rate expectations. The relevance of his model is obvious from the characteristics of Hungarian monetary policy in the past. During the crawling peg regime, the preannounced rate of depreciation anchored expectations. Even later, in the first two years of inflation targeting, a range of exchange rates considered to be consistent with the inflation target was usually announced.

From equation (1) it is obvious that with full control over exchange rate expectations it is possible to manage the spot exchange rate without changing the policy rate. With constant foreign and domestic interest rates, a 1% change in the expected future exchange rate will move the spot rate by the same amount in the same direction. It is therefore possible to tighten monetary conditions simply by announcing a credible exchange rate target which is stronger than earlier expected. Something similar happened after the widening of the intervention band in May 2001. The measure itself was a clear message for the markets that the MNB would like to see a more appreciated exchange rate in order to bring down inflation. As a consequence, the forint appreciated by 10% within two months without any policy rate hike.

The second step in the exchange rate channel concerns the relationship between domestic prices and the exchange rate. This link is traditionally viewed as the most important one in Hungary. Monetary policy strategies have been based on the role of the exchange rate. Hungary being a small open economy, the consensus view has been that exchange rate movements are tracked closely by tradable goods prices and affect the tradables sector strongly. Hence, the level of the exchange rate, not that of interest rate, was considered as a proper representation of the monetary policy stance. Although this MTM link belongs rather to the second stage, here we briefly review the most important findings for Hungary.

There is a branch of papers in the literature investigating how exchange rate changes pass through to domestic nominal variables. From our point of view, most of the results are only partly informative, since we restrict our attention to exchange rate movements that are generated by monetary policy. Pass-through coefficient estimates are usually not conditioned to a specific shock, therefore they can be considered as an average across all possible sources of shocks with weights proportional to the importance, or frequency, of that particular shock, as is stressed in Bouakez and Rebei (2005).

In order to highlight this issue, let us consider the case of the changing risk premium again. In several cases, Hungarian monetary policy has been successful in preventing the real economy from being affected by risk premium shocks. It has achieved this by quickly reversing exchange rate movements induced by sudden shifts in the risk assessment of foreign investors. As a result, these shocks have had virtually no effect on output and prices. In contrast to this, autonomous monetary policy had a persistent effect on the exchange rate, and therefore consumer prices also reacted in the medium term. Intuitively, after an exchange rate change economic agents are more or less aware of the nature of the shock, and they reset their prices only if they do not expect the exchange rate to return to its previous level quickly.

To our knowledge, two papers so far have attempted to estimate the Hungarian exchange rate pass-through or describe its main features. Darvas (2001) applied an equilibrium real exchange rate framework. He modelled price and exchange rate dynamics in a two-equation system, and estimated time-varying parameters for Hungary, the Czech Republic, Poland and Slovenia. He found that the long-run exchange rate pass-through was high in Hungary during the years of the crawling peg regime, compared to the other three countries.

Jakab and Kovács (2003) investigate the role of expectations, the goods market and the labour market in the exchange rate pass-through. Simulating with the Hungarian block of the NIGEM[6] model, they conclude that during the first one to two years after an exchange rate movement the pass-through mainly depends on the pricing elasticity to cost changes and the role which expectations play in price and wage setting. From the third year onwards, the markup elasticity becomes dominant. Labour market characteristics, namely the elasticity of wages to unemployment and productivity, are important only in the longer run, roughly five years after the shock.

6 World model of National Institute of Economic and Social Research.

Our project has not included any research with the sole aim of obtaining fresh estimates for the pass-through. Nevertheless, for the understanding of consumption and investment decisions, JVV could not escape from dealing with the pass-through of monetary policy induced exchange rate movements. Using information from three empirical macromodels, they concluded that the pass-through to tradable goods prices is immediate and almost complete, but it is slow to prices of non-tradable goods. The pass-through to overall consumer prices seems to be gradual.

Finally, Kovács (2005) gives very informative insights into the effects of exchange rate depreciations on the real economy using the experiences of the austerity package of finance minister Bokros Lajos in 1995. One central element of that package was the surprise devaluation of the forint by 9%, which serves as an excellent example for investigating some aspects of the exchange rate channel. His main conclusions concerning the external equilibrium were the following: (1) the profitability of the corporate sector was not significantly affected by the devaluation; (2) the position of the household sector deteriorated because of the negative income effect of the surprise inflation; and (3) the success of the package hinged primarily on fiscal policy, especially on the fact that inflating the expenditure side of the budget was not followed by a correction, so there was a persistent improvement in real terms on the expenditure side.

It is in order here to mention the role of intermediate goods in transmitting exchange rate changes. McCallum and Nelson (2001) present an open-economy model in which imports are treated not as finished goods but rather as raw-material inputs to domestic production. Hence, exchange rate movements affect production costs directly through the price of intermediate goods. They show that their model produced a relationship between exchange rate and inflation that is closer to empirical evidence.

We have only little empirical evidence on how the exchange rate pass-through works through production costs. Although our project has not covered the supply side, we can invoke some other studies. As Tóth and Vincze (1998) report, citing the two most important reasons for changing their prices, Hungarian companies in a survey refer to changes in “fuel, raw material, accessories price” or in “the exchange rate”. On the other hand, demand and productivity are ranked among the least important determinants of pricing. This observation suggests that the cost channel may be relevant in Hungary.

Kovács (2005) demonstrates that firms’ profits did not significantly improve after the depreciation in 1995–96. The reason is that while surprise inflation decreased real wages, material-related expenses grew considerably at the same time, rendering the total effect nearly neutral. The neutralising role of material costs was particularly important for firms producing for export. After the nominal appreciation in 2001–02, a similar story but with opposite sign can be read from firm-level data. Kovács (2005) concludes that, in Hungary, corporate sector profitability is mainly determined by foreign trade partners’ business cycle; the role of the real exchange rate is negligible.

3.3 Asset price channel

According to monetarist as well as Keynesian theories, asset prices decline after a monetary contraction. Higher interest rates result in higher yields expected from bonds whose prices fall. Stock prices also fall. The loss of property value can also be important as households’ consumption spending might be affected through house equity withdrawal.

Mishkin (1996) explains the asset price channel focusing on stock prices. The first example he cites is Tobin’s q theory of investment (Tobin, 1969). When equities are cheap relative to the replacement cost of capital, firms do not want to issue new equities in order to buy investment goods, therefore investment declines. The second channel works through household consumption. Lower equity prices reduce household wealth and they consume less.

In Hungary, there are at least two reasons for considering the stock price channel as irrelevant. First, there is no empirical evidence that monetary policy affects stock prices. We have estimates only for the instantaneous impact of monetary policy decisions on the Hungarian stock market index (BUX). Rezessy (2005) found no effect, which is in contrast with Rigobon and Sack (2004), who detected significant decreases in major US stock market indices after an unexpected tightening. Taking into account the ability of stock markets to absorb news quickly, it is hard to imagine that monetary policy shocks have only a delayed effect on equity prices.

Second, shares play a minor role in Hungarian households' financial wealth. They amounted typically to approximately 10% of all financial assets during the past 10 years. The same is true for other securities, like government bonds. Their amount has never exceeded 10% of total assets. Even households' financial wealth itself is not as large as in more developed countries. At the end of 2004, total financial assets excluding items that are not supposed to play a role in the asset price channel (cash, deposits, insurance technical reserves) amounted to 40% of annual GDP (see Figure 3).

Housing wealth may play a more important role in the asset price channel, as its market value is more than three times larger than household financial assets. Kiss and Vadas (2005) estimated the effect of an interest rate increase on house prices. They then fed the results into the consumption function of the MNB's quarterly projection model.[7] It is important to emphasise that they obtained an estimate that combines the asset price channel with the credit channel, as the consumption function cannot distinguish between the two mechanisms. They detected a significant effect of the interest rate on private consumption and housing investments through house prices. However, if we compare it to other macro-level estimates like JVV or Vonnák (2005) and take into account the relative size of the interest rate shock,[8] we can conclude that even the housing market is unable to explain the effect of monetary policy.

3.4 Credit channel

The role of credit supply in magnifying the effect of monetary policy is discussed in detail among others in Bernanke et al (1995). The basic idea is that monetary tightening leads to a higher external finance premium stemming from imperfections in the credit market, such as principal-agent problems. They argue that the conventional cost-of-capital effect fails to explain the size, timing and composition of the observed response of spending on durable goods. The additional mechanism, called the credit channel, should not be seen as a stand-alone mechanism but rather as an amplifier of the conventional way the interest rate exerts its effect. It works in the same direction: a monetary contraction not only reduces demand for durables, it also decreases loan supply.

The authors distinguish between the bank lending channel and the balance sheet channel. The former concept rests on the assumption that a monetary contraction drains loanable funds from the banking sector. Commercial banks can raise new funds only at a higher price by issuing certificates of deposit or equity. The balance sheet channel is related to the financial accelerator phenomenon. Changes in the interest rate affect the net worth of a firm through its cash flow and the value of collateral. Higher interest rates thus lead to lower net worth and a higher external finance premium.

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[7] A non-technical summary of the model is available on the MNB's website (Jakab et al, 2004).

[8] Kiss and Vadas (2005) assumed a permanent 1 percentage point increase in the interest rate and they obtained 0.3% and 1% deviation of consumption and housing investments from the baseline. In JVV, a much smaller interest rate shock (0.4 percentage point increase in the first quarter, shrinking to 0.1 by the end of the year) resulted in a 0.1-0.2% response of GDP components.

Stylised facts about the Hungarian economy suggest that even if a credit channel exists, its contribution to the transmission mechanism may not be highly significant. Many commercial banks as well as a large part of the non-financial corporate sector are owned by large foreign companies. Loans from the parent company are available for many domestic firms at a normal price even if monetary policy is tight in Hungary, as either these loans are in fact internal financing at firm level or the cost of raising additional funds from external sources is not affected by Hungarian monetary policy. The same argument, but to a limited extent, also applies to Hungarian commercial banks owned mainly by foreign banks.

Regarding the estimation, Kashyap and Stein (1995) argue that the easiest way to test for the existence of a credit channel is to use cross-section estimates. In this way, one can identify a credit supply effect that is independent of the demand side. The idea is that certain banks and firms, typically the smaller ones, suffer more from a higher external premium. HKN (2006) tested whether the existence of cross-bank asymmetries in lending activity can be rejected in Hungary. They estimated several credit supply equations on a panel of 25 commercial banks during the period 1995–2004. They related banks' ability to raise new funds to their size, liquidity, capitalisation and foreign ownership. In the regression they also controlled for GDP growth, inflation, the exchange rate and the foreign interest rate. Using several specifications, they could not reject the null hypothesis that the effect of monetary policy is magnified by the bank lending channel.

As for the balance sheet channel, we have no research at hand dedicated exclusively to that phenomenon. However, there is some indirect evidence. Kátay and Wolf (2004) estimated an investment equation on a large panel of non-financial firms. In their specification, the investment depended on the user cost of capital, sales revenues and the cash flow. They found that the latter had a significant non-zero effect on investment spending. Although several channels may exist through which cash flow can influence investment, one plausible candidate is the external finance premium, that is, the balance sheet channel.

Taking into account the ownership structure of the Hungarian banking and corporate sector, as well as the results of HKN (2006) and Kátay and Wolf (2004), we arrive at the conclusion that although empirical evidence points to the existence of the credit channel, for structural reasons we do not consider it to be a crucial ingredient in the transmission mechanism.

3.5 Expectations

In a simple model with a Taylor-type monetary policy rule, long-term or steady state inflation is determined by the target of the central bank. Forward-looking and rational agents in this model world anchor their interest rate expectations to the known policy rule, their long-run inflation expectations to the known target. If a shock occurs, monetary policy responds to it according to its rule and no one doubts that all the variables, including inflation, will return to the steady state value. As a consequence of forward-looking behaviour, the effect of the shock is mitigated by the public's expectations as well. Similarly, if the central bank changes its target and announces it, expectations may help interest rate policy achieve the new goal, as long as perfect credibility is assumed. In the model world, the expectation channel has more to do with the policy rule than with policy shocks.

In the real world, it is usually the case that the target is either not explicit or not believed by the public (credibility problem). The central bank may want to signal that its target is below or above the current or forecast level of inflation. It can do this by communication or, in the absence of credibility, by demonstrative, unexpected changes of its instrument. Monetary policy shocks can thus be useful for sending messages about monetary policy preferences to signal commitment and to gain credibility. In reality, and particularly when policy preferences are changing, the expectation channel is related more to monetary policy surprises than systematic policy.

The role of monetary policy in coordinating expectations is most obvious in price and wage setting, the two mechanisms that play crucial roles in new-Keynesian theories of monetary transmission. The higher the credibility of monetary policy, the lower the real cost of disinflation, that is, the sacrifice ratio depends heavily on the expectation channel. With more flexible nominal wages, production can be adjusted to changes in real demand without major changes in employment; therefore the short-run supply curve is more vertical than in the rigid-wage case.

An important example of the way expectations determine price setting is the so-called Taylor hypothesis. Taylor (2000) investigates the observed low pass-through of cost shocks to consumer prices. He relates the phenomenon to the low-inflation and low nominal volatility environment, arguing that, when setting their prices, producers do not closely follow input prices as changes in the latter are expected to be short-lived due to the nominal stability established by monetary policy.

Expectations also play a role in some of the channels analysed earlier, especially in the response of asset prices, including the exchange rate. The way interest rate steps affect the entire yield curve is determined mainly by what market participants think of the future course and the effectiveness of monetary policy. The reaction of the exchange rate as well as of other asset prices is also crucially dominated by the assessment of monetary policy.

Unfortunately, we have limited knowledge about price and wage setting in Hungary and how it has changed over time. As for pricing behaviour, Tóth and Vincze (1998) and Tóth (2004) report the results of a survey in which Hungarian private companies were asked about their pricing practice in 1998 and 2001. In 1998, the typical frequency of price reviews was lower in Hungary than that found in the United Kingdom by a similar survey reported in Hall et al (1997). In an environment of higher inflation, one would expect more frequent re-optimising of prices. Nevertheless, whereas a typical Hungarian firm reviewed prices quarterly, in the United Kingdom respondents did so monthly. Another counterintuitive result was that in the 2001 Hungarian survey the pattern became more similar to the UK pricing practice despite the fact that Hungarian inflation had been decreasing between 1998 and 2001, even if not very dramatically (from 14–15% to 10%). The relatively rare practice in Hungary of reviewing prices can be justified by the costs of gathering information, as argued in Mankiw and Reis (2002). In any case, firms' responses regarding the reasons for price-changing suggest that costs are more important than expectations.

We know even less about the Hungarian labour market. Pula (2005) gives a comprehensive description of the flexibility of the Hungarian labour market. He claims that in Hungary the bargaining power of trade unions and employees is weak compared to other EU members. On the other hand, JVV found that nominal wages are rigid. After a monetary policy shock, it takes at least one year until nominal wages are modified according to the new path of prices. Putting these two observations together, a plausible reason for wage stickiness is the backward-looking nature of wage setting. An alternative explanation can be that the disinflationary monetary policy was not entirely credible, with economic agents expecting the past level of inflation to remain.

Some results related to other channels bear information about expectations. One possible explanation of the findings of Rezessy (2005), namely that long-term forward interest rates decrease after an unexpected rate hike, is that market participants believed in the success of monetary policy. Interest rate policy served to some extent as a channel for signalling long-term monetary policy preferences.

Karádi's (2005) exchange rate model incorporates public expectations about central bank exchange rate preferences. His results show that communication was effective in coordinating market participants' exchange rate expectations and it helped exert influence on spot rates too. These two examples highlight the importance of the expectations of agents in financial markets.

Although this channel is the most difficult one from the econometrician's point of view and we do not have specific results, we have the overall impression that while financial markets were supportive and expectations made policy more effective, expectations of price and wage setters have not been anchored by the goals of monetary policy. Nevertheless, the latter fact is quite natural taking into account that the monetary policy in our sample period can be best characterised as shifting gradually from a more external position oriented regime towards a price stability oriented one and that gaining credibility for the new objectives takes time.

4. Demand

In basic models of the MTM, production is affected by monetary policy mainly through the demand channel, as explained in Ireland (2005). According to the new-Keynesian view, changes in demand first influence output, with prices adjusting only with some delay. The mechanism is the following: tighter (looser) monetary policy reduces (expands) demand for real goods, to which firms first respond by temporarily decreasing (increasing) their output, as repricing is costly and thus can be done only later. Lower demand without price adjustment results in output level and marginal costs lower (higher) than natural. As time passes, firms cut (lift) their prices according to the altered environment. Lower (higher) prices stimulate (calm down) demand and production returns to its natural level. This mechanism can be labelled as the output gap or demand channel.

There is some empirical evidence for Hungary of such a new-Keynesian pattern in the demand channel. Tóth and Vincze (1998) digest the results of a survey taken among Hungarian private companies in 1998. Tóth (2004) evaluates how the picture has changed relying on a 2001 survey. One of the questions in both surveys was the ordering of possible responses to a change in demand. Firms typically ranked steps like adjusting hours worked and employment or changing capacity before repricing. Their finding is in accordance with the results of a similar survey in the United Kingdom in 1995 (Hall et al, 1997).

In this section, we review what we have learned about the behaviour of some key components of aggregate demand, namely consumption, investment and net exports. For this section, JVV is our starting point. Using three different macromodels, they show that a significant effect of monetary policy can be detected first of all in the case of investment. In the following, we survey the relevant literature and check how their findings fit existing evidence. At the end of the section, we connect the demand components to the individual channels of the transmission.

4.1 Consumption

Investigating the transmission mechanism within an SVAR framework, Angeloni et al (2003) find that while in the United States. household consumption dominates the response of output to monetary policy shocks, in the euro area the contribution of investment is more important. Nevertheless, the signs of impulse responses are intuitive in both economies, namely: after an unexpected tightening, both consumption and investment drop.

In contrast with the euro area and the United States, JVV demonstrated that in Hungary there is no empirical evidence of lower consumption after monetary contraction; one model even shows rising consumption. This finding may appear to be counterintuitive especially when one takes into account the results of Kiss and Vadas (2005), who detected a significant effect of monetary policy on consumption through the housing market.

Nevertheless, there are some empirical studies as well as theoretical ones which suggest that this type of consumption response is plausible. Theoretically, one important reason can be that the appreciation of the currency increases the wealth of households. Households then may spend their excess revenue stemming from the higher purchasing power of their wealth on either tradable or non-tradable goods depending on the income elasticities of both. Benczúr (2003) shows in a two-sector dynamic growth model how a nominal appreciation can stimulate consumption.

Van Els et al (2001) compare the main characteristics of the MTM in euro area members using country models. In four out of the 12 countries, consumption is above the baseline for a couple of years after a monetary tightening shock. In Belgium and Italy, the authors attribute rising consumption to the net creditor position of households. In the case of Finland, their explanation is in line with Benczúr (2003) claiming that the pure exchange rate channel dominates. In the German model, prices fall faster than nominal wages, raising real wages and thereby consumer spending.

JVV explain the reaction of consumption by the stickiness of nominal wages and relatively quick exchange rate pass-through. Their argument is that tradable prices respond to monetary policy quickly because they track exchange rate movements closely. Since the short-term reaction of non-tradable prices is virtually neutral, the overall price level declines already during the first year. Contrary to prices, nominal wages remain unchanged for at least one year, meaning that real wages rise. The income effect offsets other mechanisms such as asset price changes.

It is important to stress that the empirical evidence of this kind of consumption response is not strong enough. The identification of the effect of monetary policy is complicated by the fact that the appreciation of the forint after the widening of the intervention band coincided with several fiscal measures aimed at stimulating private consumption. Since the band widening in 2001 can be regarded as probably the biggest unexpected monetary tightening during the past 10 years,[9] statistical methods that do not control for fiscal policy may fail to separate the two effects. Nevertheless, the way JVV explained why consumption does not fall after monetary contraction is in line with Jakab and Vadas (2001), who found that wages are by far the most important explanatory variable for consumption and who could not detect a significant role for interest rates.

To sum up, and putting these findings into Mishkin’s framework, we can conclude that there are no signs that after a monetary tightening private consumption falls in Hungary. The reason is the relatively quick exchange rate pass-through and the slower nominal wage adjustment. Our interpretation is that the exchange rate channel offsets interest rate, asset price and other channels concerning the behaviour of Hungarian households.

4.2 Investments

JVV found that the reaction of investment spending is the most robust ingredient of the demand effect of unexpected monetary policy. Hence, to form an overall picture of the monetary transmission mechanism, it is crucial that we understand the mechanism through which firms’ investment decisions are affected.

Kátay and Wolf (2004, KW henceforth) give us a deeper insight into the investment behaviour of Hungarian firms. They estimate an investment function using a large number of observations of firm-level balance sheet data obtained from the APEH[10] database. The main advantage of their approach over aggregate time series techniques is the high degrees of freedom from the cross-section observations.

[9] Actually, one of the identification schemes of Vonnák (2005) was based on that assumption and proved to be equivalent to a completely different characterisation of monetary policy.

[10] Hungarian Tax Authority.

Most importantly, they found a significant and quick reaction of investment to changes in user cost, which reinforces the finding of JVV. Obviously, there are serious limitations in translating KW's result to the macro level. The first problem comes from the cross-section heterogeneity. The obtained impulse response is valid at the aggregate level only as long as there is no considerable heterogeneity between firms with regard to their investment function, particularly the user cost elasticity.

The second challenge is the missing link between the instrument of monetary policy (in Hungary, the two-week deposit rate) and the user cost. The specification they used relates investment to the user cost, which consists of expected return on equity and bank lending rates among others. Obviously, monetary policy has no direct control over these factors. In order to assess the impact of monetary policy on investments, we need to know the relationship between the policy rate and user cost, but, unfortunately, we have no empirical evidence.

The third difficulty to overcome is that they estimate only one dynamic equation in which investment spending is explained by the user cost, sales and cash flow. Even if we treat user cost as exogenous, which is a questionable assumption in itself, cash flow and sales apparently depend on past investments; therefore, for the calculation of the dynamic effect of user cost, additional relationships would be necessary.

Finally, monetary policy can affect firms' cash flow and sales through channels other than investment. The appropriate exercise would therefore be to simulate the effect of the policy instrument on user cost, cash flow and sales, and to calculate the response of investments to these variables, taking into account that lagged investment changes also influence cash flow and output. The simulated firm-level behaviour then needs a proper aggregation technique.

Using the same database as KW, Reiff (2006) estimates at the firm level an investment model for the Hungarian corporate sector in which firms face three types of adjustment costs: the standard convex cost, a fixed cost and an irreversibility cost. Using the estimated model, he is then able to analyse at both aggregate and firm level how investment responds to a so-called profitability shock. In line with KW and JVV, he finds that firms react immediately by reducing investment spending after profitability falls. His findings are informative also from the MTM point of view as there are substantial similarities between monetary policy and profitability shocks and he solves the aggregation problem as well.

Despite all the shortcomings mentioned above and the limited comparability of the three models, the high degree of similarity between impulse responses from micro- and macro-estimates makes us believe that those results reinforce each other and – similarly to the euro area – investment is a key ingredient of the demand effect of monetary policy. As we will show in the next subsection, the demand for investment goods may help keep foreign trade balanced despite the strong exchange rate response.

It is worth noting that although the cost-of-capital channel is usually counted as part of the classical interest rate channel, the role of the exchange rate in investment decisions may be important, as JVV emphasise. Since investment goods are typically tradables, their prices move closely together with the exchange rate. The cost of capital includes the (expected) inflation of investment goods, and declining prices of the latter involves higher cost of capital as postponing investment spending pays off. Their conclusion is that although the existing evidence is insufficient to separate the exchange rate effect from the direct interest rate effect, the response of investment is likely to reflect both channels.

4.3 Net exports

The third main component of output investigated by JVV is net exports. The results from the three models they used were less conclusive than for private consumption and investments, and the authors concluded that they could not detect any significant effect of monetary policy. Only one model predicted considerable deterioration of the trade balance after an unexpected monetary tightening, the other two suggesting rather a balanced path but with substantial uncertainty.

Looking at exports and imports separately, it becomes obvious that while the models indicate a similar response of exports, it is the reaction of imports that is responsible for diverging results. All three models predict a sizeable drop in exports after a monetary tightening. Export prices also decline quickly, suggesting that the export sector reacts flexibly to changes in demand. The lack of price stickiness can be understood taking into account strong competition in the international goods markets.

There is, however, much less agreement among models on how imports react to monetary policy. According to the quarterly projection model of the MNB, imports rise after a tightening. Contrary to that, the other two models used in the paper referred to predict declining imports, which can explain the fairly balanced net export response they obtained.

There are several plausible explanations for the insignificant net export response and the ambiguous import response. According to Kim (2001), after an appreciation expenditure-switching results in lower exports and more imports, due to the change in their relative price. The observed behaviour of Hungarian consumption itself would imply higher import demand, at least according to two models used in JVV. On the other hand, contractionary monetary policy may reduce imports by lowering domestic demand, that is, through income absorption. In Hungary, the significant drop in investment and exports may easily offset the additional import effect of higher consumption, because of their high import content.

To conclude, foreign trade is probably affected by monetary policy in several ways. First, exchange rate changes cause a quick response of exports in terms of both volumes and prices. Second, changes in investment and consumption as well as exports influence imports. It seems that the import demand from investments and exports dominates imports. Therefore the income absorption effect offsets expenditure-switching, implying that no significant net export reaction can be detected by econometric methods.

4.4 How do individual channels of transmission influence demand for real goods?

In this subsection, we combine the findings on particular channels of transmission with those regarding demand. Of course, not all channels can be associated with all components of demand; for example, we have no idea how credit supply asymmetries could affect net exports. In other cases, even if the relationship exists, the interpretation is not straightforward. This is especially true for the exchange rate channel with regard to consumption and investments. There are also cases that are not covered by our research project; sometimes it is not possible to identify through which channel a certain component of demand was affected. Nevertheless, using this scheme, we can rank the importance of particular mechanisms.

Taking into account the high sensitivity of private investment to monetary policy, the interest rate channel may play an important role in the transmission mechanism. Nonetheless, it is not possible to disentangle it from other channels. JVV explain how exchange rate appreciation can lead to the same reaction through the user cost of capital. Similarly, we cannot rule out that credit supply also contributes. On the other hand, the asset price channel seems not to influence the investment behaviour.

In the case of consumption, the exchange rate channel was identified as the main reason for the insignificant response. Through the income effect, it can offset the interest rate and credit channels. Asset prices are not found to explain consumption behaviour.

The role of the exchange rate is trivial in the case of net exports. Although we could not detect a significant effect of monetary policy on the trade balance, the quick reaction of export and import prices highlights the dominance of the exchange rate channel in short-run price development.

We can conclude that the exchange rate channel dominates the short-run output and price effect of monetary policy. Due to the openness of the Hungarian economy, consumer prices react more quickly than in the United States or the euro area, while the change in output is smaller due to the lack of households' consumption response. Nevertheless, the significant reaction of investment suggests that the interest rate channel may not be negligible in Hungary.

5. Nominal adjustment in the medium run

Changes in aggregate demand affect various sectors differently. In the medium run, relative prices adjust mainly because the labour market transmits monetary policy impulses between sectors. As for Hungary, we expect that tradable price changes spread over the entire economy, including non-tradable goods prices. In this section, we present what we know about the medium-run effects of monetary policy. Since we have not conducted specific research on this topic, we rely on some other studies outside the MTM project and present some fresh estimates.

The most important observation is that although exchange rate and tradable prices dominate the short-run effect of monetary policy, consumer prices remain at a lower level even when the exchange rate returns to its initial value. Since tradable prices follow exchange rate movements closely, this indicates some price adjustment of non-tradable goods.

Indeed, SVAR estimates[11] show (see Figure 4) that non-tradable prices, approximated by the price index of market services, respond slowly to monetary policy. The adjustment of goods prices not directly affected by the exchange rate seems to prolong the immediate reaction of tradable prices.

One possible explanation of relative price adjustment is based on the labour market. If wages equate between sectors, demand shocks to some sectors spill over to the rest of the economy. In our case, the fall in exports and investment after a monetary contraction may exert downward pressure on employment and wages in the entire economy. Lower wages allow producers in sectors not directly affected by lower demand to cut their prices. The relevance of the labour market in the medium run is demonstrated by Jakab and Kovács (2003), who found that, several years after an exchange rate shock, pass-through depends on labour market developments in Hungary.

In JVV, wage responses to a monetary policy shock are shown. Nominal wages tend to react only one year after the shock occurs, which is not an extremely sticky style of wage setting, but taking into account the relatively quick exchange rate pass-through to consumer prices results in significant changes in real wages.

Figure 5 presents impulse responses from an SVAR similar to the previous one used to estimate the tradable and non-tradable price response.[12] As in JVV, nominal wages decline slower than consumer prices after a monetary contraction. Real wages, therefore, increase significantly for two years. On the other hand, employment drops quickly and begins to return

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[11] The estimation was based on Vonnák (2005). Similarly to the SVAR estimation strategy introduced in JVV, I augmented the four-variable benchmark monthly VAR (industrial production, CPI, three-month T-bill rate, exchange rate, sample 1995:m1–2004:m12) with industrial goods and market services subindices. For identification of monetary policy shocks, I used sign restriction as in Vonnák (2005). The results are comparable to those of the paper referred to.

[12] In this case, a VAR model of quarterly GDP, the CPI, the short-term interest rate, the nominal exchange rate, employment and nominal wages in the private sector was estimated. The identification was the same as in the previous SVAR.

to the baseline as early as in the second year. Probably it is the higher unemployment rate that promotes the nominal wage adjustment. According to the SVAR estimates, firms respond to higher wage costs first by cutting jobs. Lower employment then pushes wages down, allowing firms to keep prices low even three to four years after the monetary shock.

6. Conclusion and forward-looking remarks

In this paper, we reviewed the fresh results of nine studies conducted under the umbrella of the Hungarian MTM project. Relying on other studies as well, we created a synthesis from particular findings.

Our overall picture about how monetary policy works in Hungary can be summarised as follows. Consumer prices are affected immediately in the first year after monetary policy tightens through an increase in the policy rate. The response is persistent; the price level remains lower for several years. On the other hand, output reacts only marginally. The reason for this on the demand side may be that while investment drops significantly after a monetary tightening, consumption seems to more or less offset the demand effect of decreasing investment spending.

The output and price dynamics differ significantly from that found for large, developed economies. Empirical estimates for the US and euro area monetary transmission mechanism suggest that in those economies output reacts first and significantly, and consumer prices are adjusted only with a substantial lag.

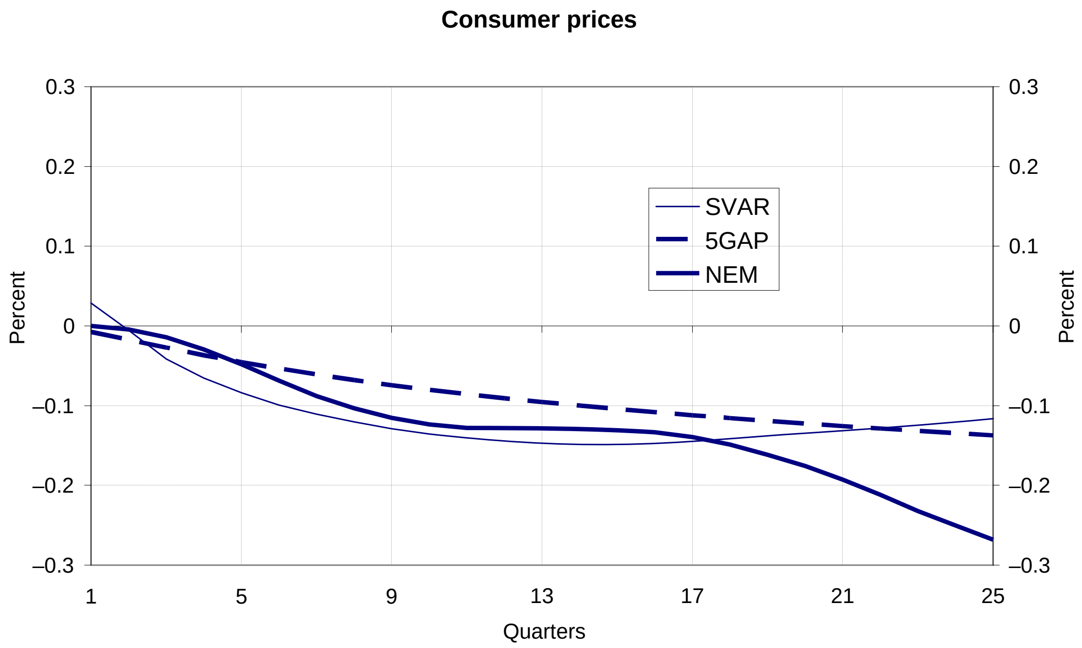
We attribute the difference first of all to the central role that the exchange rate plays in the Hungarian monetary transmission mechanism, mainly for two reasons. First, due to openness, exchange rate movements pass through to tradable goods prices quickly. Second, the output response is mitigated by the fact that, because of the short-run nominal wage rigidity and the quick exchange rate pass-through, the income effect offsets the interest rate effect on consumption, resulting in a fairly insensitive reaction.

Being an EU member country, Hungary is expected to adopt the common European currency as soon as it meets the Maastricht criteria. With the adoption of the euro, the most important channel of transmission will disappear. This raises the question of whether it is optimal for Hungary to join the euro area and run the risk that the economy will remain without an effective monetary policy that could smooth shocks.

Orbán and Szalai (2005) point out that, after euro adoption, the scope of the interest rate channel will broaden for at least two reasons. First, common monetary policy shocks in the euro area will influence the Hungarian economy through foreign demand, which is now an exogenous factor for monetary policy. Second, the ECB’s interest rate policy affects the interest rate burden on euro-denominated loans directly. The authors conclude that the differences between the Hungarian MTM and those of present euro area member countries will not be so important that an asymmetric response to common monetary policy and real divergence in the euro area could be expected.

Figure 1

CPI responses to an unexpected rate hike[1]



[1] NEM and 5GAP model simulations from JVV; SVAR estimates from Vonnák, 2005.

Figure 2

Three-month money market, T-bill rates and the policy rate

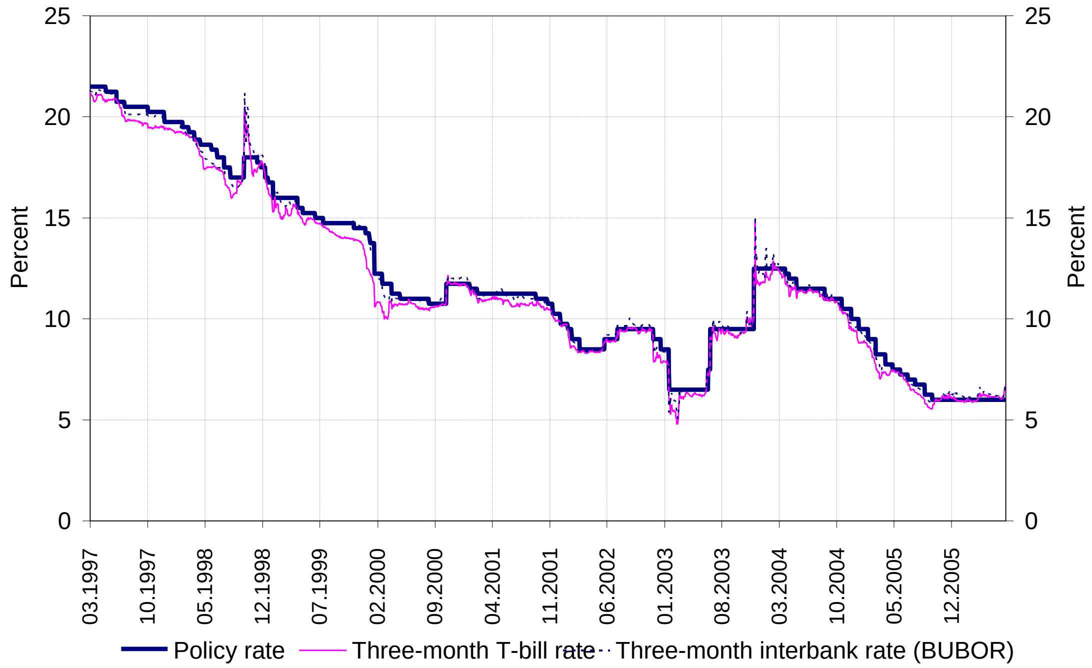


Figure 3

Households' wealth as a percentage of GDP

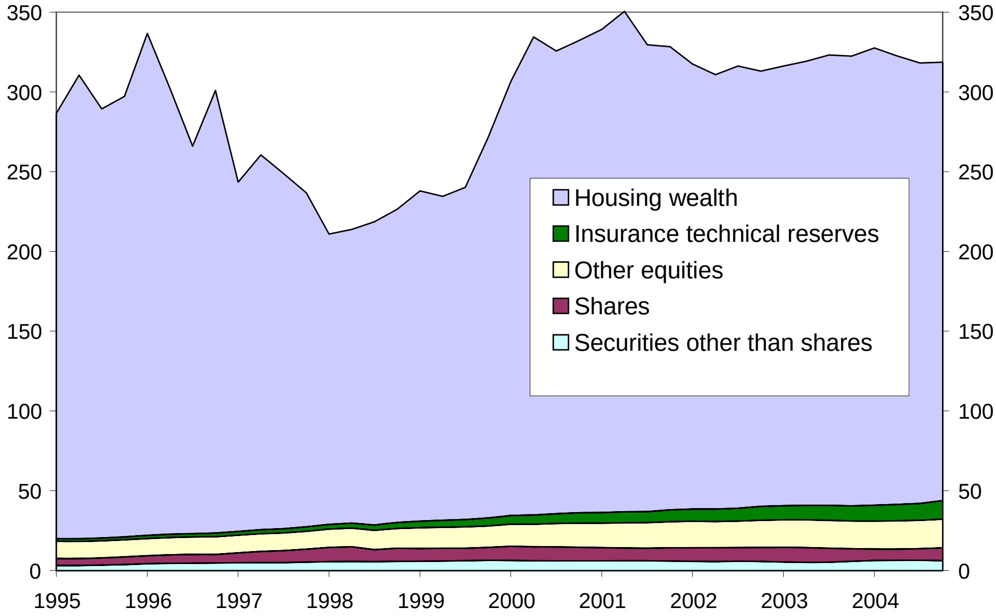
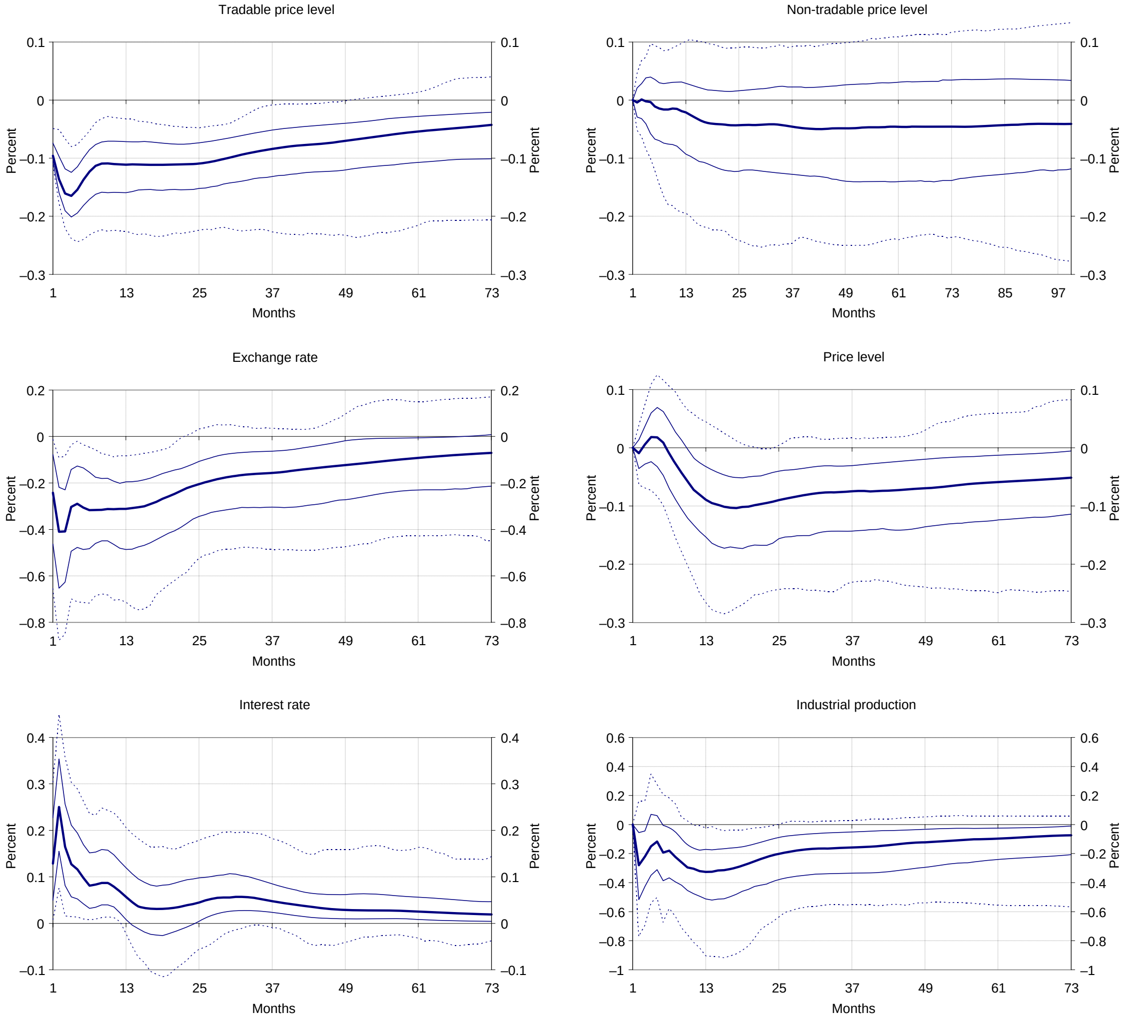


Figure 4

Response of tradable and non-tradable goods prices to an unexpected rate hike[1]

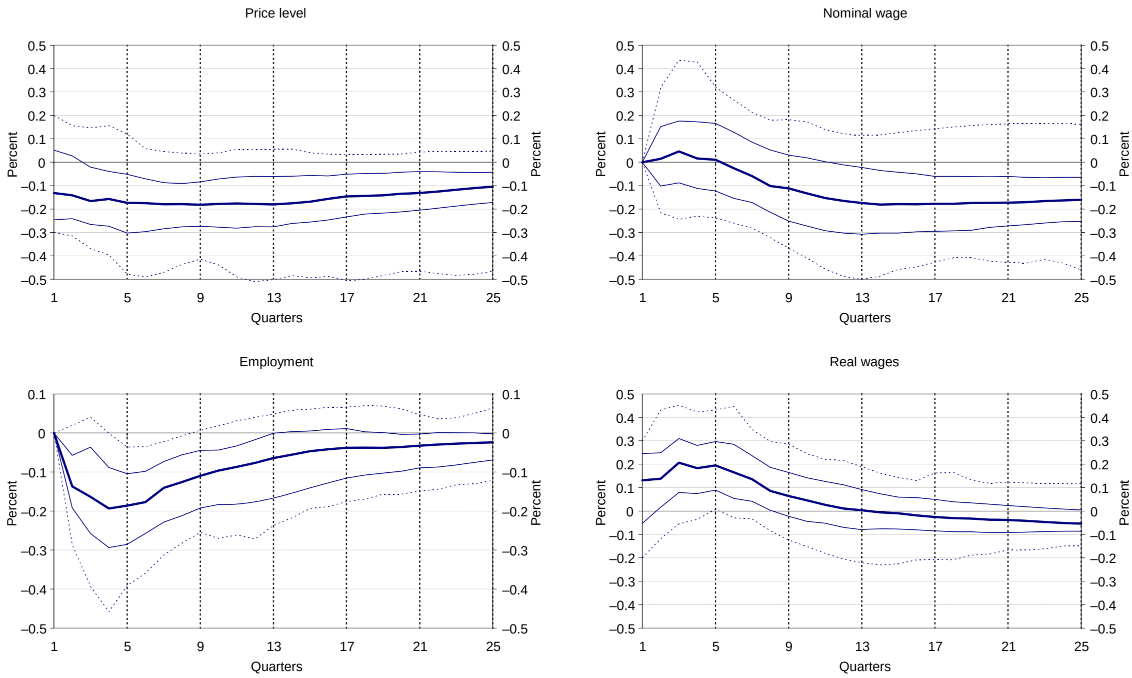


The median estimates and the middle 68% and 95% of the Bayesian posterior distributions.

[1] SVAR estimates.

Figure 5

Response of employment and private sector wages to an unexpected rate hike[1]



The median estimates and the middle 68% and 95% of the Bayesian posterior distributions.

[1] SVAR estimates.

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Monetary policy transmission in India

Rakesh Mohan[1]

Key to the efficient conduct of monetary policy is the condition that it must exert a systematic influence on the economy in a forward-looking sense. A priori economic theory backed by some empirical evidence has identified the main channels through which monetary policy impacts its final targets, viz, output, employment and inflation. Broadly, the vehicles of monetary transmission can be classified into financial market prices (eg, interest rates, exchange rates, yields, asset prices, equity prices) or financial market quantities (money supply, credit aggregates, supply of government bonds and foreign denominated assets). It is recognized that, whereas these channels are not mutually exclusive, the relative importance of each channel may differ from one economy to another depending on a number of factors, including the underlying structural characteristics, the state of development of financial markets, the instruments available to monetary policy, the fiscal stance and the degree of openness.

Traditionally, four key channels of monetary policy transmission are identified, viz, interest rate, credit aggregates, asset prices and exchange rate channels. The interest rate channel emerges as the dominant transmission mechanism of monetary policy. An expansionary monetary policy, for instance, is expected to lead to a lowering of the cost of loanable funds, which, in turn, raises investment and consumption demand and should eventually be reflected in aggregate output and prices. Monetary policy also operates on aggregate demand through changes in the availability of loanable funds, ie, the credit channel. It is, however, relevant to note that the "credit channel" is not a distinct, free-standing alternative to the traditional transmission mechanism but should rather be seen as a channel that can amplify and propagate conventional interest rate effects (Bernanke and Gertler, 1995). Nevertheless, it is fair to regard the credit channel as running alongside the interest rate channel to produce monetary effects on real activity (RBI, 2002). Changes in interest rates by the monetary authorities also induce movements in asset prices to generate wealth effects in terms of market valuations of financial assets and liabilities. Higher interest rates can induce an appreciation of the domestic currency, which in turn leads to a reduction in net exports and, hence, in aggregate demand and output.

In the recent period, a fifth channel – expectations – has assumed prominence in the conduct of forward-looking monetary policy in view of its influence on the traditional four channels. For example, the link between short- and long-term real rates is widely believed to follow from the expectational hypothesis of the term structure of interest rates. In a generalized context, the expectations channel of monetary policy postulates that the beliefs of economic agents about future shocks to the economy as well as the central bank's reactions can affect the variables that are determined in a forward-looking manner. Thus, "open-mouth operation" by the central bank, ie, an announcement of future central bank policy, influences expectations in financial markets and leads to changes in output and inflation. Clearly, the credibility of the monetary authority drives the expectations channel.

The rest of the paper focuses on the Indian experience with monetary policy transmission. Section I delineates the objectives of monetary policy in India. Section II presents the framework and instruments of monetary policy alongside the evolution of institutional

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developments which were to have a fundamental bearing on the monetary policy transmission. Section III discusses the monetary policy transmission channels: operating procedures, channel of bank lending and rates, debt market channel, exchange rate channel, and communication and expectations channel. Section IV makes an assessment of monetary transmission in terms of the ultimate objectives of monetary policy: price stability and growth. Section V discusses what is needed to improve monetary transmission. In conclusion, Section VI sums up the challenges and dilemmas of monetary policy.

I. Objectives of monetary policy

The short title to the Reserve Bank of India Act, 1934 sets out the objectives of the Bank: “to regulate the issue of Bank notes and the keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage”. Although there has not been any explicit legislation for price stability, the twin objectives of monetary policy in India are widely regarded as (i) price stability and (ii) provision of adequate credit to productive sectors of the economy so as to support aggregate demand and ensure high and sustained growth. With the increasing openness of the Indian economy, greater emphasis has been laid in recent years on strengthening the institutional capacity in the country to support growth consistent with stability in the medium term. Given the overarching consideration for sustained growth in the context of high levels of poverty and inequality, price stability has evolved as the dominant objective of monetary policy. The underlying philosophy is that it is only in a low and stable inflation environment that economic growth can be sustained.

In recent years, financial stability has assumed priority in the conduct of monetary policy in view of the increasing openness of the Indian economy, financial integration and possibility of cross border contagion. Strong synergies and complementarities are observed between price stability and financial stability in India. Accordingly, regulation, supervision and development of the financial system remain in India within the legitimate ambit of monetary policy, broadly interpreted.

II. Framework and instruments

Prior to the mid-1980s, there was no formal enunciation of monetary policy objectives, instruments and transmission channels in India other than that of administering the supply/allocation of and demand for credit in alignment with the needs of a planned economy. Over the period from 1985 to 1997, India followed a monetary policy framework that could broadly be characterised as one of loose and flexible monetary targeting with feedback (Annex I). Under this approach, growth in broad money supply (M3) was projected in a manner consistent with expected GDP growth and a tolerable level of inflation. The M3 growth thus worked out was considered a nominal anchor for policy. Reserve money (RM) was used as the operating target and bank reserves as the operating instrument. As deregulation increased the role of market forces in the determination of interest rates and the exchange rate, monetary targeting, even in its flexible mode, came under stress. Capital flows increased liquidity exogenously, putting upward pressure on the money supply, prices and the exchange rates, the latter having gained importance vis à vis quantity variables. While most studies in India showed that money demand functions had been fairly stable, it was increasingly felt that financial innovations and technology had systematically eroded the predictive potential of money demand estimations relative to the past. Interest rates gained relative influence on the decision to hold money. Accordingly, the monetary policy framework was reviewed towards the late 1990s, and the Reserve Bank switched over to a more broad-based multiple indicator approach from 1998–99. In this approach, policy perspectives are obtained by juxtaposing interest rates and other rates of return in different markets (money, capital and government securities markets), which are available at high frequency with medium and low frequency variables such as currency, credit extended by banks and financial institutions, the fiscal position, trade and capital flows, inflation rate, exchange rate, refinancing and transactions in foreign exchange and output. For simplicity and to facilitate greater understanding, the quarterly policy statements of the Reserve Bank continue to be set in a framework in terms of money, output and prices.

Since the late 1980s, there has been an enhanced emphasis by many central banks on securing operational freedom for monetary policy and investing it with a single goal, best embodied in the growing independence of central banks and inflation targeting as an operational framework for monetary policy, which has important implications for transmission channels. In this context, the specific features of the Indian economy have led to the emergence of a somewhat contrarian view: "In India, we have not favoured the adoption of inflation targeting, while keeping the attainment of low inflation as a central objective of monetary policy, along with that of high and sustained growth that is so important for a developing economy. Apart from the legitimate concern regarding growth as a key objective, there are other factors that suggest that inflation targeting may not be appropriate for India. First, unlike many other developing countries we have had a record of moderate inflation, with double digit inflation being the exception, and largely socially unacceptable. Second, adoption of inflation targeting requires the existence of an efficient monetary transmission mechanism through the operation of efficient financial markets and absence of interest rate distortions. In India, although the money market, government debt and forex markets have indeed developed in recent years, they still have some way to go, whereas the corporate debt market is still to develop. Though interest rate deregulation has largely been accomplished, some administered interest rates still persist. Third, inflationary pressures still often emanate from significant supply shocks related to the effect of the monsoon on agriculture, where monetary policy action may have little role. Finally, in an economy as large as that of India, with various regional differences, and continued existence of market imperfections in factor and product markets between regions, the choice of a universally acceptable measure of inflation is also difficult" (Mohan, 2006b).

The success of a framework that relies on indirect instruments of monetary management such as interest rates is contingent upon the extent and speed with which changes in the central bank's policy rate are transmitted to the spectrum of market interest rates and exchange rate in the economy and onward to the real sector. Clearly, monetary transmission cannot take place without efficient price discovery, particularly with respect to interest rates and exchange rates. Therefore, in the efficient functioning of financial markets, the corresponding development of the full financial market spectrum becomes necessary. In addition, the growing integration of the Indian economy with the rest of the world has to be recognized and provided for. Accordingly, reforms have been undertaken which focus on improving the operational effectiveness of monetary policy, while simultaneously strengthening the regulatory role of the Reserve Bank, tightening the prudential and supervisory norms, improving the credit delivery system and developing the technological and institutional framework of the financial sector.

Market development

Given the pivotal role of the money market in transmission, efforts initiated in the late 1980s were intensified over the full spectrum. Following the withdrawal of the ceiling on inter-bank money market rates in 1989, several financial innovations in terms of money market instruments such as certificate of deposits, commercial paper and money market mutual funds were introduced in phases. Barriers to entry were gradually eased by increasing the number of players and relaxing the issuance and subscription norms in respect of money market instruments, thus fostering better price discovery. Participation in the call money market was widened to cover primary and satellite dealers and corporates (through primary dealers), besides other participants. In order to improve monetary transmission, and also for prudential considerations, steps were initiated in 1999 to turn the call money market into a pure inter-bank market and, simultaneously, to develop a repo market outside the official window for providing a stable collateralised funding alternative, particularly to non-banks who were phased out of the call segment, and banks. The Collateralised Borrowing and Lending Obligation (CBLO), a repo instrument developed by the Clearing Corporation of India Limited (CCIL) for its members, with the CCIL acting as a central counterparty for borrowers and lenders, was permitted as a money market instrument in 2002. With the development of market repo and CBLO segments, the call money market has been transformed into a pure inter-bank market, including primary dealers, since August 2005. A recent noteworthy development is the substantial migration of money market activity from the uncollateralised call money segment to the collateralised market repo and CBLO markets (Annex II). Thus, uncollateralized overnight transactions are now limited to banks and primary dealers in the interests of financial stability (Table 1).

Table 1

Activity in money market segments

Rupees billion

Year/ month	**Average daily turnover (one leg)**				**Commercial paper (outstanding)**	**Certificates of deposit (out-standing)**
	Call money market	**Market repo**	**CBLO**	**Term money market**		
1	**2**	**3**	**4**	**5**	**6**	**7**
2003–04[1]	86	26	3	3	78	32
2004–05[1]	71	43	34	3	117	61
2005–06[1]	90	53	100	4	173	273
2006–07						
April	85	55	163	5	165	441
May	90	90	172	5	169	502
June	87	106	138	6	197	564
July	91	97	157	4	211	592
August	107	78	156	5	229	656
September	118	92	148	6	244	653
October	132	97	170	5	232	658
November	128	94	161	4	242	689
December	121	72	155	5	233	686

CBLO: Collateralised borrowing and lending obligation.

[1] The average daily turnover (one leg) for a year is arrived at by adding daily turnovers (one leg) and then dividing the sum by the number of days in the year.

Source: *Macroeconomic and Monetary Developments*, various issues, RBI.

The Government securities market is important for the entire debt market as it serves as a benchmark for pricing other debt market instruments, thereby aiding the monetary transmission across the yield curve. The key policy development that has enabled a more independent monetary policy environment as well as the development of the Government securities market was the discontinuation of automatic monetization of the government's fiscal deficit since April 1997 through an agreement between the Government and the Reserve Bank of India in September 1994 (Annex III). Subsequently, enactment of the Fiscal Responsibility and Budget Management Act, 2003 has strengthened the institutional mechanism further: from April 2006 onwards, the Reserve Bank is no longer permitted to subscribe to government securities in the primary market. This step completes the transition to a fully market-based system for Government securities. Looking ahead, consequent to the recommendations of the Twelfth Finance Commission, the Central Government would cease to raise resources on behalf of State Governments, which, henceforth, will have to access the market directly. Thus, State Governments' ability to raise resources will be market-determined and based on their own financial health. To ensure a smooth transition, institutional processes are being revamped towards greater integration in monetary operations.

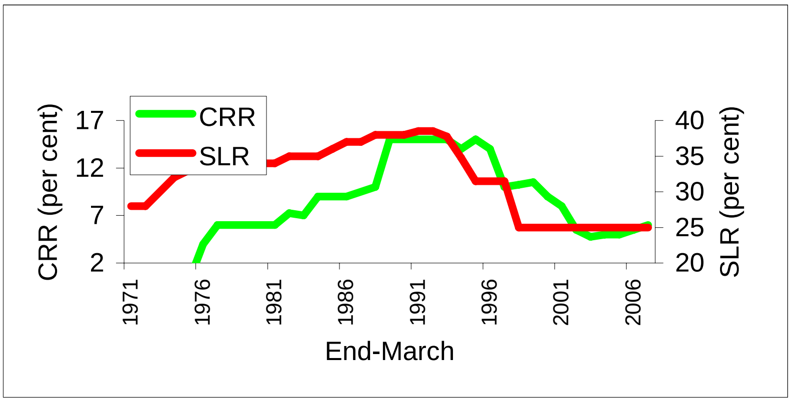
As regards the foreign exchange market, reforms have been focused on market development, incorporating prudential safeguards so that the market would not be destabilised in the process. The move towards a market-based exchange rate regime in 1993, the subsequent adoption of current account convertibility and de-facto capital account convertibility for select categories of non-residents were the key enabling factors in reforming the Indian foreign exchange market prior to now. India's approach to financial integration has so far been gradual and cautious, guided by signposts/concomitants in terms of improvement in fiscal, inflation and financial sector indicators, inter alia. Efforts are currently underway to move towards fuller capital account convertibility even for residents. In the period 2000–06, a number of measures were initiated to integrate the Indian forex market with the global financial system, with increasing freedom given to banks to borrow abroad and fix their own position and gap limits (Annex IV).

The development of the monetary policy framework has also involved a great deal of institutional initiatives in the area of trading, payments and settlement systems along with the provision of technological infrastructure. The interaction of technology with deregulation has also contributed to the emergence of a more open, competitive and globalised financial market. While the policy measures in the pre-1990s period were essentially devoted to financial deepening, the focus of reforms in the last decade and a half has been on engendering greater efficiency and productivity in the banking system (Annex V). Legislative amendments have also been carried out to strengthen the RBI's regulatory jurisdiction over financial markets, providing greater instrument independence and, hence, ensuring monetary transmission.

The relative weights assigned to various channels of transmission of monetary policy also reflect a conscious effort to move from direct instruments of monetary control to indirect instruments. Illustratively, the CRR, which had been brought down from a peak of 15 per cent in 1994–95 to 4.5 per cent by June 2003, before the onset of withdrawal of monetary accommodation, since October 2004 is now 6.0 per cent (Chart 1). The recent amendment to the RBI Act in 2006 will further strengthen monetary maneuverability since it allows for the removal of the floor of 3 per cent and ceiling of 15 per cent on the CRR. Monetary control is also exercised through the prescription of a statutory liquidity ratio (SLR), which is a variant of the secondary reserve requirement in several countries. It is maintained in the form of specified assets such as cash, gold and "approved" and unencumbered securities – the latter being explicitly prescribed – as a proportion of banks' net demand and time liabilities (NDTL). Accordingly, the SLR is also important for prudential purposes, ie, to assure the soundness of the banking system. The pre-emption under the SLR, which had increased to about 38.5 per cent of NDTL in the beginning of the 1990s, was brought to its statutory minimum of 25 per cent by October 1997. Banks, however, continue to hold more government securities than the statutory minimum SLR, reflecting risk perception and portfolio choice. The statutory minimum SLR of 25 per cent has been removed now (January 2007) to provide for greater flexibility in the RBI's monetary policy operations. The reform of the monetary and financial sectors has thus enabled the Reserve Bank to expand the array of instruments at its command and enhanced its ability to respond to evolving circumstances.

Chart 1

Reserve requirements



III. Operating procedure for monetary policy

Short-term interest rates have emerged as the key indicators of the monetary policy stance all over the world. It is also recognised that stability in financial markets is critical for efficient price discovery and meaningful signaling. Since the interest rate and exchange rate are key prices reflecting the cost of money, it is particularly important for efficient functioning of the economy that they be market-determined and easily observed.

Central banks follow a variety of operating frameworks and procedures for signaling and implementing the monetary policy stance on a day-to-day basis, with a view to achieving the ultimate objectives – price stability and growth. The choice of policy framework in any economy is always a difficult one and depends on the stage of macro-economic and financial sector development, and is somewhat of an evolutionary process (Mohan, 2006a). In a market-oriented financial system, central banks typically use instruments that are directly under their control: required reserve ratios, interest charged on borrowed reserves (discount window) provided directly or through rediscounting of financial assets held by depository institutions, open market operations (OMOs) and selective credit controls. These instruments are usually directed at attaining a prescribed value of the operating target, typically bank reserves and/or a very short-term interest rate (usually the overnight interbank rate). The optimal choice between price and quantity targets would depend on the sources of disturbances in the goods and money markets (Poole, 1970). If money demand is viewed as highly unstable, greater output stability can be attained by stabilizing interest rates. If, however, the main source of short-run instability arises from aggregate spending or unsterilized capital inflows, a policy that stabilizes monetary aggregates could be desirable. In reality, it often becomes difficult to trace out the sources of instability. Instead, monetary policy is implemented by fixing, at least over the short time horizon, the value of an operating target or policy instrument. As additional information about the economy is obtained, the appropriate level at which to fix the policy instrument/target changes.

The operating procedures of monetary policy of most central banks have largely converged to one of the following three variants: (i) a number of central banks, including the US Federal Reserve, estimate the demand for bank reserves and then carry out open market operations to target short-term interest rates; (ii) another set of central banks, of which the Bank of

Japan used to be a part until recently, estimate market liquidity and carry out open market operations to target bank reserves, while allowing interest rates to adjust; and (iii) a growing number of central banks, including the European Central Bank and the Bank of England, modulate monetary conditions in terms of both quantum and price of liquidity, through a mix of OMOs, standing facilities and minimum reserve requirements, and changes in the policy rate. The operating procedure followed in India, however, presents a fourth variant.

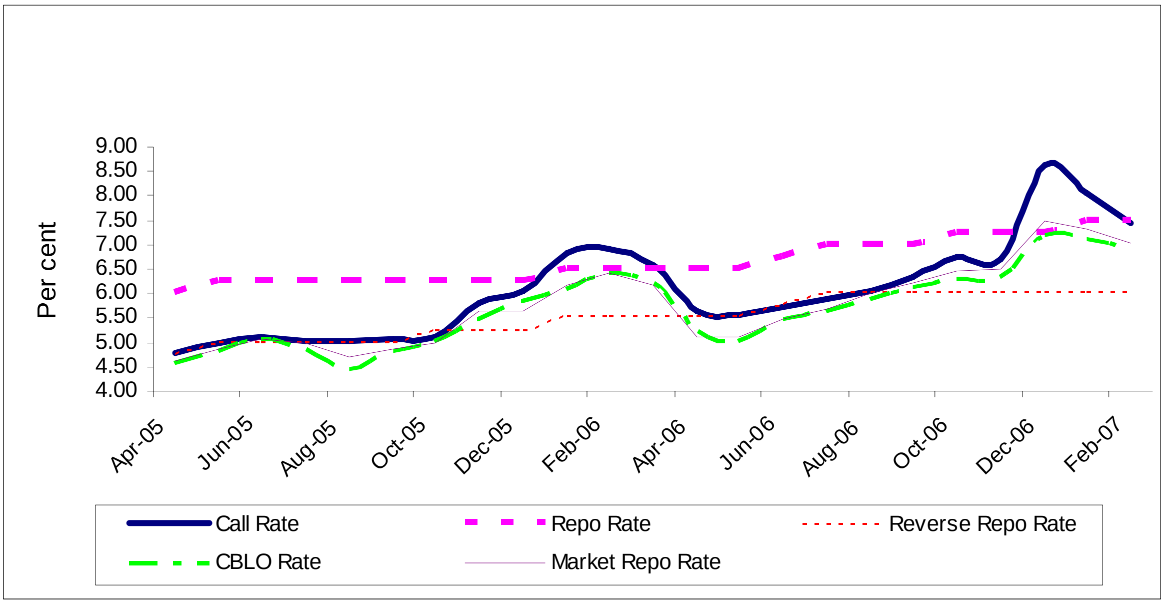
III.1 Money markets and the liquidity adjustment facility

In the Indian context, reforms in the monetary policy operating framework, which were initiated in the late 1980s, crystallised into the Liquidity Adjustment Facility (LAF) in 2000 (Annex VI). Under the LAF, the Reserve Bank sets its policy rates, ie, repo and reverse repo rates, and carries out repo/reverse repo operations, thereby providing a corridor for overnight money market rates (Chart 2). The LAF avoids targeting a particular level of overnight money market rate in view of exogenous influences impacting liquidity at the shorter end, viz, volatile government cash balances and unpredictable foreign exchange flows.

Although repo auctions can be conducted at variable or fixed rates for overnight or longer-term, given market preference and the need to transmit interest rate signals quickly, the LAF has settled into a fixed rate overnight auction mode since April 2004. With the introduction of Second LAF (SLAF) from November 28, 2005, market participants now have a second window during the day to fine-tune their liquidity management (Chart 3). LAF operations continue to be supplemented by access to the Reserve Bank's standing facilities linked to repo rate: export credit refinance to banks and standing liquidity facility to the primary dealers.

Chart 2

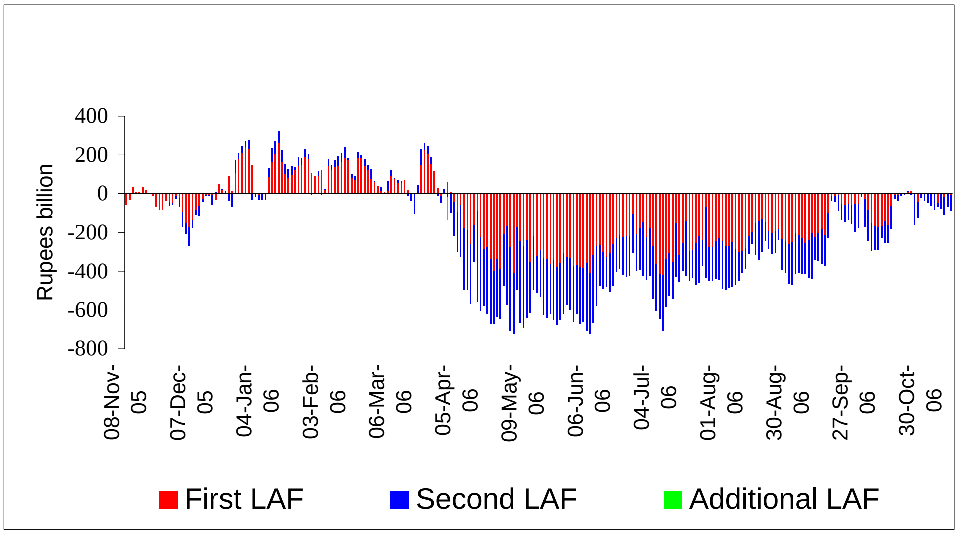
Liquidity adjustment facility and money market instruments for liquidity management



The introduction of LAF has had several advantages. First and foremost, it made possible the transition from direct instruments of monetary control to indirect instruments. Since LAF operations enabled reduction in CRR without loss of monetary control, certain dead weight loss for the system was saved. Second, LAF has provided monetary authorities with greater flexibility in determining both the quantum of adjustment and the rates by responding to the needs of the system on a daily basis. Third and most importantly, although there is no formal targeting of a point overnight interest rate, LAF helped to stabilise overnight call rates within a specified corridor, the difference between the fixed repo and reverse repo rates currently being 150 basis points. It has thus enabled the central bank to affect demand for funds through policy rate changes. In this sense, LAF rates perform the role of nominal anchor effectively. Although call money rates edged above the repo rate in January–February 2006, the rates in the collateralised segment of the money market – market repos and Collateralised Borrowing and Lending Obligations (CBLO), which account for nearly 80 per cent of the market turnover – remained below the repo rate.

Chart 3

Repo (+)/ reverse repo (-) under LAF

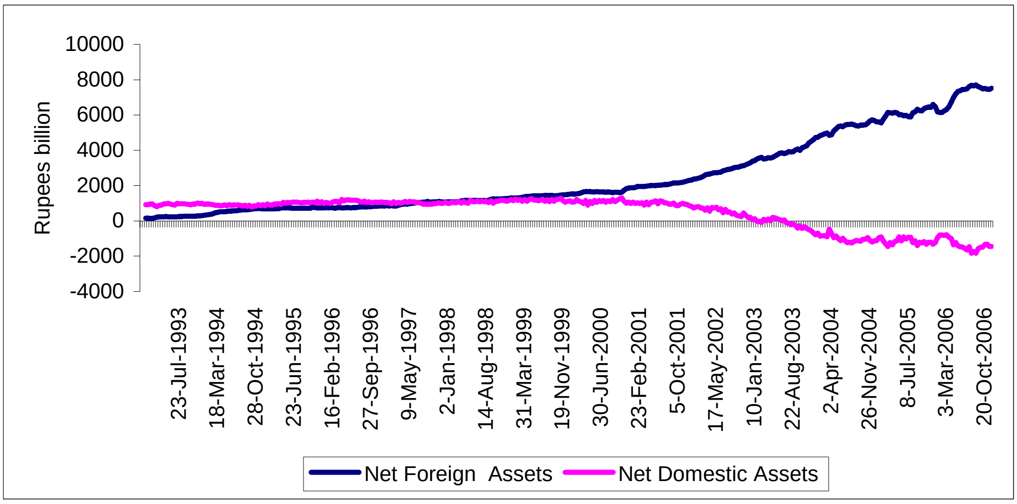


III.2 Market stabilisation scheme

In the context of increasing openness of the economy, a market-determined exchange rate and large capital inflows, monetary management may warrant sterilizing foreign exchange market intervention, partly or wholly, so as to retain the intent of monetary policy. Initially, the Reserve Bank sterilized capital inflows by way of OMOs. Such sterilization, however, involves cost in terms of lower returns on international assets vis-à-vis domestic assets (Chart 4). The finite stock of government securities with the Reserve Bank also limited its ability to sterilize. The LAF operations, which are essentially designed to take care of frictional daily liquidity, began to bear the burden of stabilization disproportionately.

Chart 4

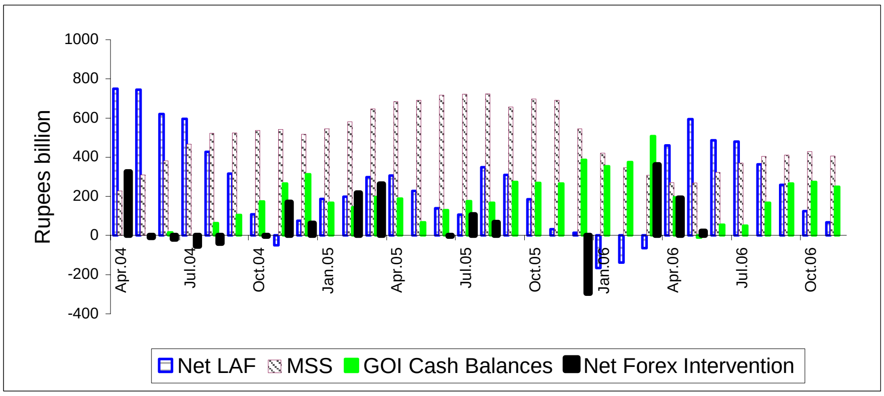
Changes in net domestic assets and net foreign assets



The Reserve Bank, therefore, signed in March 2004 a Memorandum of Understanding (MoU) with the Government of India for issuance of Treasury Bills and dated Government Securities under the Market Stabilisation Scheme (MSS), in addition to normal Government borrowings (Annex VII). The new instrument empowered the Reserve Bank to absorb liquidity on a more enduring but still temporary basis while leaving LAF for daily liquidity management and using conventional OMO on a more enduring basis (Chart 5). The MSS has provided the Reserve Bank with the flexibility not only to absorb but also to inject liquidity in times of need by way of unwinding. Therefore, short-term instruments are generally preferred for MSS operations.

Chart 5

Liquidity management



The various tools of liquidity management have thus enabled the Reserve Bank to maintain liquidity conditions and orderly movement in both exchange rates and interest rates, and conduct monetary policy in accordance with its stated objectives (Annex VIII and Table 2).

Table 2

Phases of Reserve Bank's liquidity management operations

Rupees billion

	Item	Variation during 2003–04	2004–05	2005–06	2006–07 Q1	2006–07 Q2
	1	2	3	4	5	6
A.	**Drivers of liquidity (1 + 2 + 3 + 4)**	**721**	**581**	**–317**	**355**	**–158**
1.	RBI's foreign currency assets (adjusted for revaluation)	1414	1150	688	285	105
2.	Currency with the Public	–434	–409	–573	–215	–1
3.	Surplus cash balances of the centre with the Reserve Bank	–177	5	–227	402	–262
4.	Others (residual)	–83	–165	–205	–118	–1
B.	**Management of liquidity (5 + 6 + 7 + 8)**	**–464**	**–567**	**580**	**–390**	**320**
5.	Liquidity impact of LAF Repos	–322	153	121	–353	407
6.	Liquidity impact of OMO (Net)[1]	–176	12	107	5	1
7.	Liquidity impact of MSS	0	–642	351	–42	–88
8.	First round liquidity impact due to CRR change	35	–90	0	0	0
C.	**Bank Reserves (A + B)**[2]	**257**	**14**	**263**	**–35**	**162**

Note: Data pertain to March 31 and last Friday for all other months.

(+) Indicates injection of liquidity into the banking system. (–) Indicates absorption of liquidity from the banking system.

[1] Adjusted for Consolidated Sinking Funds (CSF) and Other Investments and including private placement.
[2] Includes vault cash with banks and adjusted for first round liquidity impact due to CRR change.

Source: *Annual Report* and *Macroeconomic and Monetary Developments*, various issues, RBI.

Government cash balances with the Reserve Bank often display sizeable volatility. First, due to operational requirements which are difficult to predict (except for salary payments, coupon/interest payments, redemption of loans and the like), the Government needs to maintain a substantial cash position with the Reserve Bank. Second, there is the need for maintaining or building up cash balances gradually over many weeks ahead of large, known disbursements such as lumpy redemption of bonds contracted for financing high fiscal deficit and, particularly, benchmark bonds, if markets are not to be disrupted. Third, while a major part of outflows from government cash balances is regular, inflows by way of direct tax revenues and other sources are lumpy and irregular in nature.

Accumulating Government cash balances with the central bank act, in effect, as withdrawal of liquidity from the system and have the same effect as that of monetary tightening, albeit without any intention to do so by the monetary authority. Similarly, there would be injection of liquidity into the system if Government cash balances maintained with the central bank decline, despite a situation in which, for instance, monetary policy is biased towards tightening liquidity. Thus, volatile Government cash balances could cause unanticipated expansion or contraction of the monetary base, and consequently, money supply and liquidity, which may not necessarily be consistent with the prevailing stance of monetary policy. In the presence of fluctuating Government cash balances, the task of monetary management becomes complicated, often warranting offsetting measures, partly or wholly, so as to retain the intent of monetary policy.

III.3 Bank credit and lending rate channels

There is some evidence of the bank lending channel working in addition to the conventional interest rate channel. In view of the asymmetry in the resource base, access to non-deposit sources, asset allocation and liquidity, big and small banks are found to respond in significantly different ways. In particular, small banks are more acutely affected by contractionary monetary policy shocks as compared to big banks, ie, smaller banks curtail their lending more sharply vis-à-vis large banks (Pandit et al, 2006). Available empirical evidence also indicates that prudential norms, as proxied by banks' capital adequacy ratios, exert a significant influence on bank lending (Annex IX, Nag and Das, 2002; Pandit et al, 2006).

Table 3

Sectoral shares in non-food bank credit

Per cent

Sector/industry	Outstanding on October 27, 2006	March 2006	March 2005	March 2004
Non-food gross bank credit	**100**	**100**	**100**	**100**
1. Agriculture and allied activities	12	12	13	12
2. Industry (small, medium and large)	39	39	43	43
2.1 Small scale industries	6	6	8	9
3. Services	2	3	3	…
3.1 Transport operators	1	1	1	…
3.2 Professional and others	1	1	1	…
4. Personal loans	26	25	25	…
4.1 Housing	14	13	13	…
4.2 Advances against fixed deposits	2	3	3	4
4.3 Credit cards	1	1	1	…
4.4 Education	1	1	1	…
4.5 Consumer durables	1	1	1	1
5. Trade	6	6	6	3
6. Others	9	14	11	41
6.1 Real estate loans	2	2	1	1
6.2 Non-banking financial companies	2	2	2	2
Memo item				
Bank credit-GDP ratio	*40.3*[1]	*42.2*	*35.2*	*30.4*

Note: Sectoral shares may not add up to 100 due to rounding off.

[1] Approximately.

Source: *Annual Report 2005–06*, RBI.

The monetary policy stance of the Bank is often articulated as a commitment to ensure that all genuine requirements for bank credit are adequately met in order to support investment and export demand consistent with price stability (Annex X). Liquidity operations are conducted with a view to ensuring that the demand for reserves is satisfied and credit projections consistent with macro-economic objectives are achieved. Simultaneously, improvements in the delivery of bank credit are pursued in recognition of the possibility of market failure in efficiently auctioning credit. An integral element of the conduct of monetary policy has, therefore, been the direction of bank credit to certain sectors of priority such as agriculture, exports, small scale industry, infrastructure, housing, micro-credit institutions and self-help groups. An ongoing policy endeavour is enhancing and simplifying the access to credit with a view to securing the widest inclusion of society in the credit market (Table 3).

Available empirical evidence covering the period September 1998–March 2004 suggests that the interest rate pass-through from changes in the policy rate was 0.61 and 0.42 for lending and deposit rates, respectively, ie, a reduction/increase of 100 basis points (bps) in the Bank Rate led to a reduction/increase of almost 40 bps in the banks' deposit rates and 60 bps in their prime lending rate (Tables 4 & 5). Rolling regressions suggest some improvement in pass-through to lending rates and deposits. Thus, although pass-through is less than complete, there are signs of an increase in pass-through over time (RBI, 2004b).

Table 4

Outstanding term deposits of scheduled commercial banks by interest rate

At the end of March

Per cent to total deposits

Interest Rate Slab	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
< 8%	10.8	11.2	11.5	13.3	16.8	16.9	25.0	53.7	74.0	86.4
8–9%	2.4	5.2	4.8	6.1	6.5	10.5	22.6	16.4	9.9	5.8
9–10%	4.5	7.1	6.4	9.0	14.3	16.1	19.8	12.0	7.3	3.1
10–11%	15.2	14.1	13.7	17.7	20.9	23.9	17.3	10.5	5.1	2.5
11–12%	13.9	14.3	16.3	20.2	19.2	17.9	9.1	4.5	2.3	1.1
12–13%	23.4	20.9	22.3	19.2	13.9	9.1	4.3	2.3	1.1	0.5
>13%	29.8	27.2	25.0	14.5	8.4	5.6	1.9	0.8	0.5	0.7

Source: Basic Statistical Returns of Scheduled Commercial Banks in India, various issues, Reserve Bank of India.

Table 5

Outstanding loans of scheduled commercial banks by interest rate

At the end of March

Per cent to total loans

Interest Rate Slab	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	2	3	4	5	6	7	8	9	10	11	12
<6%	2.7	2.3	1.1	1.0	0.3	0.2	0.2	0.1	0.1	0.4	0.4
6–10%	6.8	2.1	0.5	0.4	3.7	1.0	0.6	3.2	5.3	13.6	19.5
10–12%	4.8	2.3	1.4	2.3	3.3	7.9	17.0	24.5	22.9	16.1	17.5
12–14%	21.4	10.6	10.7	13.2	20.3	26.8	28.6	22.5	25.1	25.7	22.4
14–15%	4.4	6.7	10.9	14.9	9.7	11.5	12.6	14.1	19.4	16.2	16.6
> 15%	59.8	76.0	75.4	68.2	62.7	52.6	41.0	35.6	27.1	28.0	23.6

Source: As in Table 4.

The improvement in the pass-through can be attributed to policy efforts to impart greater flexibility to the interest rate structure in the economy through various measures such as advising banks to: introduce a flexible interest rate option for new deposits; review their maximum spreads over the prime lending rate (PLR) and reduce them wherever they are unreasonably high; announce the maximum spread over PLR to the public along with the announcement of the PLR; and switch over to an "all cost" concept for borrowers by explicitly declaring the various charges such as processing and service charges (Table 6).[2] Besides, interest rates have emerged as a more potent instrument than before with the move towards floating, as against fixed rate products, under which the transmission is limited at the margin.

[2] From October 18, 1994, banks have been free to fix the lending rates for loans above Rupees 200,000. Banks were required to obtain the approval of their respective Boards for the PLR which would be the minimum rate charged for loans above Rupees 2,00,000. In the interest of small borrowers, as well as to remove the disincentive for credit flow to such borrowers, the PLR was converted into a ceiling rate for loans up to Rupees 2,00,000 in 1998–99. Sub-PLR lending was allowed in 2001–02 in keeping with international practice. For customers' protection and meaningful competition, bank-wise quarterly data on the PLR, along with maximum and minimum lending rates, have been placed on the Reserve Bank's website, starting from June 2002. To encourage greater transparency in loan pricing in the context of sticky behaviour of lending rates, the system of BPLR (ie, benchmark PLR) was introduced in 2003–04. Banks were advised to specify their BPLR taking into account (a) the actual cost of funds, (b) operating expenses and (c) a minimum margin to cover regulatory requirements of provisioning and capital charges, and profit margin. Whereas conceptually the BPLR should turn out to be a median lending rate, in practice the specification of the BPLR by banks has turned out to be sticky. Movements in the actual interest rate charged take place less transparently through changes in the proportion of loans above or below the announced BPLR. The share of sub-BPLR lending has, in recent times, increased to over 75 per cent, reflecting the overall decline in interest rates until recently. This has undermined the role of the BPLR as a reference rate, complicating the judgment on monetary transmission with regard to lending rates.

Table 6

Lending rates of scheduled commercial banks in India

Per cent

	Public sector banks		Foreign banks		Private sector banks	
	Demand loans	Term loans	Demand loans	Term loans	Demand loans	Term loans
1	2	3	4	5	6	7
Jun-02	12.75–14.00	12.75–14.00	13.00–14.75	13.00–15.50	13.75–16.00	14.00–16.00
Sep-02	12.00–14.00	12.25–14.00	13.00–14.75	12.75–14.50	14.00–16.00	13.50–15.00
Dec-02	11.85–14.00	12.25–14.00	12.00–14.75	11.70–13.63	13.50–15.75	13.50–15.00
Mar-03	11.50–14.00	12.00–14.00	10.50–12.75	10.25–13.50	13.50–15.50	13.00–15.00
Jun-03	11.50–14.00	11.50–14.00	10.00–14.00	9.73–13.00	13.00–15.00	12.50–14.75
Sep-03	11.50–13.50	11.00–13.50	9.50–12.75	9.25–13.50	13.00–14.50	12.00–14.50
Dec-03	11.50–13.00	11.00–13.25	7.75–13.65	9.00–13.00	12.50–14.50	11.50–14.50
Mar-04	11.00–12.75	11.00–12.75	7.50–11.00	8.00–11.60	12.00–14.00	11.25–14.00
Jun-04	10.50–12.50	10.75–12.75	6.50–11.50	7.25–10.95	11.50–13.75	11.00–14.00
Sep-04	10.50–12.50	9.50–12.25	6.75–9.00	7.25–11.00	11.25–13.25	9.50–13.00
Dec-04	9.00–12.50	8.38–12.13	7.25–9.00	7.38–10.95	10.00–13.00	9.25–13.00
Mar-05	9.00–12.50	8.38–12.00	7.13–9.00	7.63–9.50	10.00–12.50	9.00–13.00
Jun-05	8.00–12.13	8.00–11.88	7.75–9.00	7.50–9.50	10.00–12.75	9.00–13.00
Sep-05	8.00–11.63	8.00–11.88	7.00–10.25	7.35–9.50	10.00–12.50	9.00–13.00
Dec-05	8.00–11.63	8.00–11.63	7.00–9.50	7.20–9.50	10.00–13.00	9.25–13.00
Mar-06	8.00–11.63	8.00–11.63	8.00–9.75	7.53–9.75	9.50–13.00	9.00–13.18
Jun-06	8.00–11.25	8.00–12.00	7.63–9.75	7.53–9.75	9.75–13.50	9.23–13.75
Sep-06	8.25–11.50	8.50–12.13	8.08–9.57	7.85–9.75	10.00–13.50	9.45–13.50
Dec-06	8.00–11.88	8.50–12.00	8.05–10.00	8.00–9.50	10.00–13.13	9.23–12.63

Note: Median lending rates in this table are the range within which at least 60 per cent of business is contracted.

Source: Reserve Bank of India, available at http://rbidocs.rbi.org.in/lendingrate/home.html.

In recent times, there has been some tendency to widen the net of administered interest rates to cover bank loans for agriculture. While such a tendency may not be an unlikely outcome given the predominance of publicly-owned financial intermediaries, it needs to be recognized that the current pricing system for bank loans appears less than satisfactory, particularly in respect of agriculture and small scale industries (SSI). Competition has moved the pricing of a significant proportion of loans far out of alignment with the BPLR and in a non-transparent manner. Thus, there is a public perception that banks' risk assessment processes are less than appropriate and that there is underpricing of credit for corporates, while there could be overpricing of lending to agriculture and SSI. Therefore, the current practices on pricing of credit need to be revamped by banks through well structured, segment-wise analysis of costs at various stages of intermediation in the whole credit cycle.

The Indian financial system appears to have responded favourably to reforms initiated in the early 1990s with relatively higher efficiency, competitiveness and resilience. This has enabled banks to increase their lending to the commercial sector. Non-food credit extended by scheduled commercial banks recorded an average annual growth of 26.4 per cent between 2002–03 and 2005–06, notably higher than that of 14.5 per cent recorded during the preceding four-year period (1998–99 to 2001–02) as well as the long-run average of 17.8 per cent (1970–2006). Reflecting the growth in bank credit, the ratio of bank credit to GDP has also witnessed a sharp rise. The credit-GDP ratio, after moving in a narrow range of around 30 per cent between mid-1980s and late 1990s, started increasing from 2000–01 onwards to 35 per cent during 2004–05 and further to 40 per cent during 2006–07. The stagnation in credit flow observed during the late 1990s was, in retrospect, partly caused by a reduction in demand on account of an increase in real interest rates, the cyclical down turn and the significant business restructuring that occurred during that period. The sharp expansion in bank credit in the past 4–5 years also reflects, in part, policy initiatives to improve the flow of credit to sectors like agriculture. While demand for agricultural and industrial credit has remained strong in the current cycle, increasingly, retail credit has emerged as the driver of growth. The strengthening of the banking system has thus worked towards financial widening and deepening. In the process, greater monetization and financial inclusion are extending the net of the formal financial system and, hence, enhancing the scope of monetary transmission.

The increasing reach of formal finance has gradually expanded to cover larger segments of the population. The “demographic dividend” of a larger and younger labour force has meant that banks have been able to expand their loan portfolio rapidly, enabling consumers to satisfy their lifestyle aspirations at a relatively young age with an optimal combination of equity and debt to finance consumption and asset creation. In the process, interest has become a much more potent tool of monetary policy, affecting consumption and investment decisions of the population much more rapidly than was the case earlier. This is evident in the share of retail credit in total bank credit, increasing from around 6 per cent in March 1990 to over 22 per cent in March 2005. A large part of this increase has taken place in the past 5–6 years. In view of this growing share of household credit, it is likely that household consumption decisions, in the coming years, may be more strongly influenced by monetary policy decisions, with implications for the monetary transmission mechanism. Consequently, the monetary authority may need to contend increasingly with public opinion on monetary management, much more than hitherto, given the rising share of personal/household loans. In the context of large scale public ownership of banks, such pressures of public opinion would also manifest themselves into political pressures.

In brief, there is increasing evidence that the bank credit and lending rate channels of monetary transmission are gaining in strength with the widening and deepening of the financial system and the progress towards greater price discovery. A number of constraints continue, however, to interfere with monetary transmission. First, the stipulation of priority sector lending of 40 per cent of net bank credit affects flexibility in sectoral credit allocation, even though there is no interest rate stipulation for the priority sector. Second, allocational flexibility is further constrained under the extant prescription of an SLR of 25 per cent of net demand and time liabilities (NDTL), although the relevant Act has now been amended to give the Reserve Bank flexibility to reduce this statutory liquidity ratio. Third, the system of BPLR for credit pricing has proved to be relatively sticky downward, and more so for specific sectors like agriculture and small scale industries (SSI). As the BPLR has ceased to be a reference rate, assessment of the efficacy of monetary transmission has become difficult. Fourth, the Government of India continues to own around 70 per cent of banks’ assets. While the Government, as a legitimate owner, is entitled to issue direction to public sector banks, such exercise by the Government introduces elements of uncertainty and market imperfections, impacting monetary transmission.

III.4 Debt market channel

While government debt management was one of the motivating factors for the setting up of central banks in many countries, currently the function, with its focus on lowering the cost of public debt, is often looked upon as constraining monetary management, particularly when compulsions of monetary policy amidst inflation expectations may necessitate a tighter monetary policy stance. Therefore, it is now widely believed that the two functions – monetary policy and public debt management – need to be conducted in a manner that ensures transparency and independence in monetary operations. The fuller development of financial markets, reasonable control over the fiscal deficit and necessary legislative changes are regarded as pre-conditions for separation of debt management from monetary management. The Reserve Bank currently performs the twin function of public debt and monetary management.

> "The logical question that follows is whether the experience of fiscal dominance over monetary policy would have been different if there had been separation of debt management from monetary management in India? Or, were we served better with both the functions residing in the Reserve Bank? What has really happened is that there was a significant change in thinking regarding overall economic policy during the early 1990s, arguing for a reduced direct role of the Government in the economy. A conscious view emerged in favour of fiscal stabilisation and reduction of fiscal deficits aimed at eliminating the dominance of fiscal policy over monetary policy through the prior practice of fiscal deficits being financed by automatic monetization. It is this overall economic policy transformation that has provided greater autonomy to monetary policy making in the 1990s.
>
> "The Indian economy has made considerable progress in developing its financial markets, especially the government securities market since 1991. Furthermore, fiscal dominance in monetary policy formulation has significantly reduced in recent years. With the onset of a fiscal consolidation process, withdrawal of the RBI from the primary market of Government securities and expected legislative changes permitting a reduction in the statutory minimum Statutory Liquidity Ratio, fiscal dominance would be further diluted. All of these changes took place despite the continuation of debt management by the Reserve Bank. Thus, one can argue that effective separation of monetary policy from debt management is more a consequence of overall economic policy thinking rather than adherence to a particular view on institutional arrangements" (Mohan, 2006b).

The Fiscal Responsibility and Budget Management (FRBM) Act, 2003 has set the stage for a front-loaded fiscal correction path for the Central Government. Similar enactments have also taken place in a number of States. As already mentioned, the FRBM Act, 2003 has prohibited the Reserve Bank from participating in primary issuance of government securities with effect from April 1, 2006, except under exceptional circumstances. In preparation, the institutional structures within the Reserve Bank have been modified to strengthen monetary operations with a view to moving towards functional separation between debt management and monetary operations. Accordingly, a new Financial Markets Department (FMD) has been constituted to undertake (i) monetary operations, (ii) regulation and development of money market instruments and (iii) monitoring of money, government securities and foreign exchange markets. The enactment of the FRBM Act has arguably strengthened monetary transmission through the debt market. It has also mitigated the possibility of conflict in monetary policy in order to contain the cost of Government borrowing.

The auction-based issue of government debt according to a pre-announced calendar has enabled price discovery and liquidity in the market. A Negotiated Dealing System was introduced in February 2002 to facilitate electronic bidding, secondary market trading and settlement and to disseminate information on trades on a real-time basis. In the context of the Reserve Bank's absence from primary auctions, a "when, as and if issued" market in Government securities has been allowed recently.

Vibrant secondary market trading has helped to develop a yield curve and the term structure of interest rates. This has facilitated pricing of debt instruments in various market segments and, thereby, monetary transmission across maturity and financial instruments. While market yields, at times, turn out to be puzzling, particularly in the wake of global policy signaling as as well as in times of re-pricing of risks, the reverse repo rate set out by the Reserve Bank remains the overnight floor for the market. The falling interest rate scenario witnessed up to 2003–04 and the comfortable liquidity position in the system had helped to bring down yields and the yield curve turned relatively flat. Long-term yields, however, continue to be impervious across the globe to subsequent reversal of the interest rate cycle, giving rise to a "conundrum" a la Greenspan (2005). In the Indian context, the transmission from shorter to longer end of the yield curve has been vacillating, linked, inter alia, to changes in monetary policy rates, inflation rates, international interest rates and, on other occasions, the SLR stipulation. With the increasing openness of the domestic economy, it appears that international economic developments are set to exert a greater influence on the domestic yield curve than before. Thus, even in the absence of fuller capital account convertibility, monetary transmission may need to contend with impulses that arise from international developments. Furthermore, the process of fiscal consolidation currently underway could potentially lead to a situation of excess demand for government securities in relation to their supply, which would, in turn, impact the shape of the yield curve and, thereby, impede monetary transmission. The stipulation for SLR could also undergo a change guided by prudential considerations, affecting, in the process, the demand for government securities and, thereby, the yield curve as banks remain invested with government securities for the purpose of SLR. Such developments, however, may not be in consonance with the monetary policy stance and hence, could get in the way of intended monetary transmission.

While the government securities market is fairly well developed now, the corporate debt market remains to be developed for facilitating monetary signaling across various market segments. In the absence of a well developed corporate debt market, the demand for debt instruments has largely concentrated on government securities, with the attendant implications for the yield curve and, in turn, for monetary transmission. The secondary market for corporate debt has suffered from a lack of market making, resulting in poor liquidity. Corporates continue to prefer private placements to public issues for raising resources in view of ease of procedures and lower costs. There is a need for development of mortgage-backed securities, credit default swaps, bond insurance institutions for credit enhancement, abridgment of disclosure requirements for listed companies, rating requirements for unlisted companies, real time reporting of primary and secondary trading, retail access to bond market by non-profit institutions and small corporates and access to RTGS. A concerted effort is now being made to set up the institutional and technological structure that would enable the corporate debt market to operate. Furthermore, the on-going reforms in the area of social security coupled with the emergence of pension and provident funds are expected to increase the demand for long-term debt instruments. In the process, the investor base for government securities would be broadened, extending the monetary transmission across new players and participants.

III.5 Exchange rate channel

The foreign exchange market in India has acquired increasing depth with the transition to a market-determined exchange rate system in March 1993 and the subsequent gradual but significant relaxation of restrictions on various external transactions. Payment restrictions on all current account transactions were removed with the acceptance of the obligations of Article VIII of the IMF's Articles of Agreement in August 1994. While the rupee remains virtually convertible on the capital account for foreign nationals and non-resident Indians (NRIs), similar moves are on course for the domestic residents. Significant relaxations have been allowed for capital outflows in the form of direct and portfolio investment, non-resident deposits, repatriation of assets and funds held abroad. Indian residents can now open foreign currency accounts with banks in India.

The major initiatives taken to widen and deepen the Indian forex market and to link it with the global financial system have been: (i) freedom for banks to fix net overnight position limits and gap limits, initiate trading positions in the overseas markets, and use derivative products for asset-liability management; (ii) permission for authorised dealers (ADs) in foreign exchange to borrow abroad up to limits related to their capital base as a prudential measure; and (iii) freedom for corporates to hedge anticipated exposures, cancel and rebook forward contracts. The CCIL has commenced settlement of forex operations for inter-bank US Dollar/Indian rupee spot and forward trades from November 2002 and inter-bank US dollar/Indian rupee cash and tom trades from February 2004.

The annual turnover in the foreign exchange market has increased more than threefold from US $ 1434 billion in 2000–01 to US $ 4413 billion in 2005–06 (Table 7). Inter-bank transactions continue to account for the bulk of the transactions in the forex market, albeit with a declining share over the years. The forward market segment (swaps plus forward) is also growing at a faster pace. Reflecting the build-up of forex reserves, the strong capital flows and the confidence in the Indian economy, forward premia have come down sharply from the peak reached in 1995–96. Under the market-determined exchange rate regime, the Indian rupee has exhibited two-way movements and the foreign exchange market has displayed stable conditions, as reflected in the annual coefficient of variation of 0.9–2.3 per cent during 2000–01 to 2005–06. The exchange rate policy of the Reserve Bank in recent years has been guided by the broad principles of careful monitoring and management of exchange rates with flexibility, without a fixed target or a pre-announced target or a band, coupled with the ability to intervene, if and when necessary.

Table 7

Foreign exchange market: Activity indicators

Year	Foreign exchange market-annual turnover (US $ billion)	Gross volume of BoP transactions (US $ billion)	RBI's foreign currency assets[1] (US $ billion)	CV of exchange rate of rupee (per cent)	Col 2 over Col 3	Col 2 over Col 4
1	2	3	4	5	6	7
2000–01	1434	258	40	2.3	5.6	36
2001–02	1487	237	51	1.4	6.3	29
2002–03	1585	267	72	0.9	5.9	22
2003–04	2141	362	107	1.6	5.9	20
2004–05	2892	481	136	2.3	6.0	21
2005–06	4413	657	145	1.5	6.7	30

[1] At end-March; CV: Coefficient of variation; BoP: Balance of payments.

Source: Reserve Bank of India.

Exchange rate flexibility, coupled with the gradual removal of capital controls, has widened the scope for monetary maneuverability, enabling transmission through exchange rates. In the event of interest rate arbitrage triggered by monetary policy action, foreign exchange inflows can tend to pick up until the interest rate parity is restored by exchange rate adjustments. An appreciating exchange rate, in turn, would have a dampening effect on aggregate demand, containing inflationary pressures. However, if large segments of economic agents lack adequate resilience to withstand volatility in currency and money markets, the option of exchange rate adjustments may not be available, partially or fully. Therefore, the central bank may need to carry out foreign exchange operations for stabilizing the market. In the process, the injection of liquidity into the system by the central bank would go against its policy stance and weaken monetary transmission. Thus, monetary management becomes complicated, and the monetary authority may need to undertake offsetting sterilization transactions in defence of monetary stability and intended transmission. In the Indian context, faced with similar circumstances, sterilization operations have been carried out from 2004 through issuance of government securities under the Market Stabilisation Scheme (MSS).

Available evidence suggests that exchange rate depreciation has the expected effect of raising domestic prices and the coefficient of exchange rate pass-through to domestic inflation ranges between 8–17 basis points (depending upon the measure of inflation), ie, a 10 per cent depreciation of the Indian rupee (vis-a-vis the US dollar) would, other things remaining unchanged, increase consumer inflation by less than 1 percentage point and the GDP deflator by 1.7 percentage points. Rolling regressions suggest some decline in the exchange rate pass-through coefficient in recent years (RBI, 2004b). The coefficient on the exchange rate exhibits a declining trend, although the estimates turn out to be somewhat imprecise. This suggests a possible decline in exchange rate pass-through to domestic inflation. The decline in pass-through during the 1990s is consistent with the cross-country evidence. In India, inflation rates have declined significantly since the second half of the 1990s and this could be one explanation for the lower pass-through. Another key factor that could have lowered the pass-through is the phased decline in tariffs as well as non-tariff barriers such as quotas. Average import duties are now less than one-third of what they were a decade ago. This steep reduction in tariffs could have easily allowed domestic producers to absorb some part of the exchange rate depreciation without any effect on their profitability.

Another factor that could reduce the pass-through is related to globalization and "Walmartization". The increased intensity of globalization and the commodification of many goods have perhaps reduced the pricing power of producers, particularly of low technology goods in developing countries, whereas the pricing power of large retailers like Walmart has risen. The decline in pass-through across a number of countries, as suggested by various studies, has implications for the efficacy of the exchange rate as an adjustment tool. The lower pass-through suggests that, in the new globalised economy, exchange rate adjustments as a means of correction of imbalances may have become less potent; if so, then the swing in exchange rates to correct emerging imbalances will have to be much larger than before, eventually bringing greater instability in their wake (Mohan, 2004).

III.6 Communication and expectations channel

In a market-oriented economy, well-informed market participants are expected to enable an improved functioning of the markets, and it is held that a central bank is in the best position to provide such useful information to the market participants. Whether providing information would result in shaping and managing expectations, and if so, whether it is desirable, remain unsettled issues. There are several dilemmas faced by central banks while designing an appropriate communications policy. First, what should be communicated and to what degree of disaggregation? The second set relates to: at what stage of evolution of internal thinking and debate should there be dissemination? The third set relates to the timing of communication with reference to its market impact. The fourth relates to the quality of information and the possible ways in which it could be perceived. Thus, alleged incoherence or an element of ambiguity at times on the part of central bankers in explaining policies is as much a reflection of the complexity of the issues as it is of the differing perceptions of a variety of audiences to which the communication is addressed. It is essential to appreciate that communication policy is not merely about explaining or getting feedback on policy, but may include elements of influencing the policy direction itself. A central bank does this through several channels, including research publications and speeches (Reddy, 2001; 2006). It is recognised that credible communication and creative engagement with the market and economic agents have emerged as the critical channel of monetary transmission as against the traditional channels. For example, the US Federal Reserve, since 1994, appears to have been providing forward guidance, while the European Central Bank appears to be in the mould of keeping the markets informed rather than guiding it.

With the widening and deepening of inter-linkages between various segments of financial markets, the Reserve Bank has adopted a consultative process for policy making in order to ensure timely and effective implementation of the measures. The Bank has taken a middle path of sharing its analysis in addition to providing information, but in no way guiding the market participants. However, in doing so, the RBI has the benefit of the process of two-way communication, of information as well as perceptions, between the market participants and the RBI. In the process, the Bank's signaling/announcements are increasingly seen to have an influence on expectations formation in the market.

The more complex the mandate for the central bank, the greater the need for communication (Mohan, 2005). The Reserve Bank of India clearly has complex objectives. Apart from pursuing monetary policy, financial stability is one of the overriding concerns of the RBI. Within the objective of monetary policy, both control of inflation and providing adequate credit to the productive sectors of the economy so as to foster growth are equally important. This apart, the Reserve Bank acts as a banking regulator, public debt manager, government debt market regulator and currency issuer. Faced with such multiple tasks and complex mandate, there is an utmost necessity of clearer communication on the part of the Reserve Bank.

In general, for a central bank, there is a need for three kinds of communication: (a) policy measures, (b) reasons behind such policy measures and (c) analysis of the economy. The Reserve Bank is engaged with all three kinds of communication. In fact, by international standards the Reserve Bank has a fairly extensive and transparent communication system. Policy statements (quarterly since April 2005 onwards and bi-annual prior to this period) have traditionally communicated the Reserve Bank's stance on monetary policy in the immediate future of six months to one year. The practice of attaching a review of macroeconomic developments to the quarterly reviews gives an expansive view of how the central bank sees the economy. In the bi-annual policy meetings with leading bankers, the Governor explains the rationale behind the measures at length. These policy meetings are not one-way traffic. Each banker present in the meeting interacts with the Governor to express his or her reaction to the policy announcement. After the policy announcement is over, the Governor addresses a press conference in the afternoon. The Deputy Governor in charge of monetary policy normally gives live interviews to all the major television channels on the same day. The Governor also gives interviews to print and electronic media over the next few days after the monetary policy announcement.

Communication of policy also takes place through speeches of the Governor and Deputy Governors, and various periodic reports. A significant step towards transparency of monetary policy implementation is formation of various Technical Advisory Committees (TACs) in the Reserve Bank with representatives from market participants, other regulators and experts. In line with the international best practices and with a view to further strengthening the consultative process in monetary policy, the Reserve Bank, in July 2005, set up a Technical Advisory Committee on Monetary Policy (TACMP) with external experts in the areas of monetary economics, central banking, financial markets and public finance. The Committee meets at least once a quarter, reviews macroeconomic and monetary developments and advises the Reserve Bank on the stance of monetary policy. The Committee has contributed to enriching the inputs and processes of monetary policy setting in India. Recognizing the importance of expectations in the conduct and formulation of monetary policy, the Reserve Bank has recently initiated surveys of business and inflation expectations.

Finally, in the context of growing openness of the Indian economy and increasing integration with the rest of the world, global economic and financial developments – such as monetary policy decisions of the US Fed and other major economies and trends in international crude oil prices – are also shaping expectations. The Reserve Bank also takes such factors and expectations into account.[3]

The process of monetary policy formulation in India is now relatively transparent, consultative and participative with external orientation, and this has contributed to stabilizing expectations of market participants. Illustratively, an important element in coping with liquidity management has been the smoothing behaviour of the Reserve Bank and its communication strategy. In August 2004, the headline inflation rate shot up to 8.7 per cent, partly on account of rising global oil prices and partly due to a resurgence in manufacturing inflation. The turning of the interest rate cycle looked imminent. The issue was addressed through burden sharing by appropriate monetary and fiscal coordination and by preparing markets for a possible interest rate reversal. In measured and calibrated steps the monetary policy stance was changed and measures such as those on CRR and reverse repos were taken in a phased manner. Also, banks were allowed to transfer HFT (Held for Trading) and AFS (Available for Sale) securities to the HTM (Held to Maturity) category, thereby affording them some cushion against the possible interest rate shock. Markets were prepared with a careful communication on the stance of the monetary policy stating that the central bank would strive for provision of appropriate liquidity while placing equal emphasis on price stability. Monetary management thus succeeded in building credibility and keeping inflation expectations low.

In brief, there has been a noteworthy improvement in the operational efficiency of monetary policy from the early 1990s. Financial sector reforms and the contemporaneous development of the money market, Government securities market and the foreign exchange market have strengthened monetary transmission by enabling more efficient price discovery, and improving allocative efficiency even as the RBI has undertaken developmental efforts to ensure the stability and smooth functioning of financial markets. The approach has been one of simultaneous movement on several fronts, graduated and calibrated, with an emphasis on institutional and infrastructural development and improvements in market microstructure. The pace of the reform was contingent upon putting in place appropriate systems and procedures, technologies and market practices. There has been close co-ordination between the Government and the RBI, as well as between different regulators, which helped in the orderly and smooth development of the financial markets in India. Markets have now grown in size, depth and activity, paving the way for flexible use of indirect instruments. The Reserve Bank has also engaged in refining the operating procedures and instruments as well as risk management systems, income recognition and provisioning norms, disclosure norms, accounting standards and insolvency in line with international best practices with a view to fostering the seamless integration of Indian financial markets with global markets.

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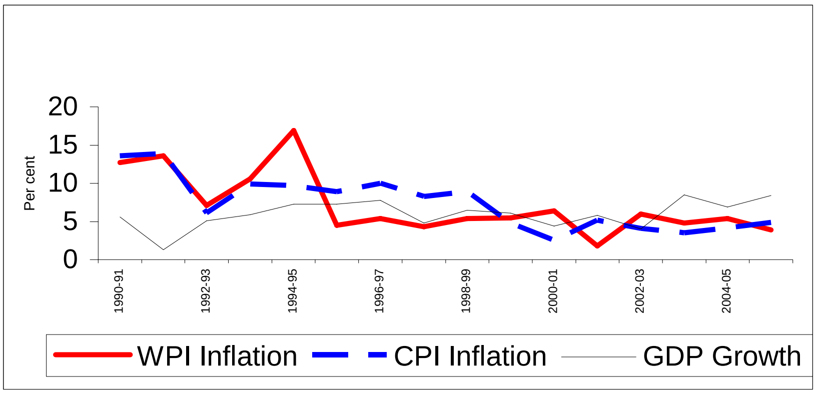
[3] Illustratively, the Reserve Bank in its Annual Policy Statement for 2006–07 (April 2006) stressed that: “Domestic macroeconomic and financial conditions support prospects of sustained growth momentum with stability in India. It is important to recognise, however, that there are risks to both growth and stability from domestic as well as global factors. At the current juncture, the balance of risks is tilted towards the global factors. The adverse consequences of further escalation of international crude prices and/or of disruptive unwinding of global imbalances are likely to be pervasive across economies, including India. Moreover, in a situation of generalised tightening of monetary policy, India cannot afford to stay out of step. It is necessary, therefore, to keep in view the dominance of domestic factors as in the past but to assign more weight to global factors than before while formulating the policy stance” (RBI, 2006).

IV. How well do monetary transmission channels work?

Turning to an assessment of monetary policy transmission, it would be reasonable to assert that monetary policy has been largely successful in meeting its key objectives in the post-reforms period. There has been a fall in inflation worldwide since the early 1990s, and in India since the late 1990s. Inflation has averaged close to 5 per cent per annum in the decade gone by, notably lower than the 8 per cent of the previous four decades (Chart 6). Structural reforms since the early 1990s coupled with improved monetary-fiscal interface and reforms in the Government securities market enabled better monetary management from the second half of the 1990s onwards. More importantly, the regime of low and stable inflation has, in turn, stabilised inflation expectations, and inflation tolerance in the economy has come down. It is encouraging to note that despite record high international crude oil prices, inflation remains low and inflation expectations also remain stable (Table 8). Since inflation expectations are a key determinant of the actual inflation outcome, and given the lags in monetary transmission, the Reserve Bank has been taking pre-emptive measures to keep inflation expectations stable. As discussed earlier, a number of instruments, both existing as well as new, were employed to modulate liquidity conditions to achieve the desired objectives. A number of other factors such as increased competition, productivity gains and strong corporate balance sheets have also contributed to this low and stable inflation environment, but it appears that calibrated monetary measures had a substantial role to play as well.

Chart 6

GDP growth and WPI and CPI inflation



In the context of the recent firming up of core as against headline inflation particularly in industrial countries, primarily on account of higher non-oil commodity prices, issues of proper measurement of inflation and inflationary pressures have attracted renewed debate. In particular, the debate involves the relevance of core inflation as a guide for the conduct of monetary policy vis-à-vis the use of headline inflation. In India, core inflation is not considered as relevant for several reasons, but mainly because the two major sources of supply shock, food and fuel, account for a large share of the index. Further, in the absence of a harmonized consumer price index for India, the use of core inflation based on wholesale prices may not be very meaningful. While the permanent component is judgmental, broad magnitudes could be perceived and articulated. Such an explanatory approach to headline and underlying inflation pressure in monetary policy has added credibility to the policy and influenced and guided the inflation expectations in India.

Table 8

Wholesale price inflation (WPI) and consumer price inflation (CPI)

Year-on-year

Per cent

Inflation Measure	March 2000	March 2001	March 2002	March 2003	March 2004	March 2005	March 2006	February 2007
1	2	3	4	5	6	7	8	9
WPI Inflation (end-Month)	6.5	5.5	1.6	6.5	4.6	5.1	4.1	6.6[1]
CPI-IW	4.8	2.5	5.2	4.1	3.5	4.2	4.9	6.9[2]
CPI-UNME	5.0	5.6	4.8	3.8	3.4	4.0	5.0	6.9[2]
CPI-AL	3.4	–2.0	3.0	4.9	2.5	2.4	5.3	9.5[3]
CPI-RL	…	–1.6	3.0	4.8	2.5	2.4	5.3	8.9[3]

…: Not available; IW: Industrial workers; UNME: Urban non-manual employees; AL: Agricultural labourers; RL: Rural labourers.

[1] As on February 10, 2007; [2] As in December 2006; [3] As in January 2007.

Source: *Annual Report and Handbook of Statistics of Indian Economy*, various issues, Reserve Bank of India.

Table 9

Monetary policy and corporate performance: interest rate-related indicators

Year	Growth rate in interest expenses (%)	Debt service to total uses of funds ratio[1]	Interest coverage ratio[2]
1990–91	16.2	22.4	1.9
1991–92	28.7	28.3	1.9
1992–93	21.6	24.4	1.6
1993–94	3.1	20.9	2.0
1994–95	8.1	27.2	2.4
1995–96	25.0	21.5	2.7
1996–97	25.7	18.7	2.1
1997–98	12.5	8.1	1.9
1998–99	11.1	17.6	1.6
1999–00	6.7	17.6	1.7
2000–01	7.1	14.0	1.7
2001–02	–2.7	19.4	1.7
2002–03	–11.2	8.9	2.3
2003–04	–11.9	12.7	3.3
2004–05	–5.8	21.8	4.6

[1] Represents the ratio of loans and advances plus interest accrued on loan to total uses of funds.
[2] Represents the ratio of gross profit (ie, earning before interest and taxes) to interest expenses.

Source: The data is based on selected non-government, non-financial, public limited companies, collected by RBI.

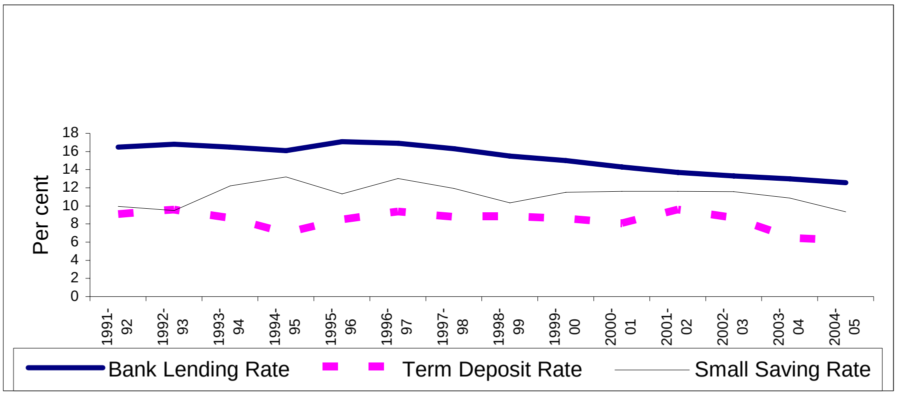
How did monetary policy support the growth momentum in the economy? As inflation, along with inflation expectations, fell during the earlier period of this decade, policy interest rates were also brought down. Consequently, both nominal and real interest rates fell. The growth rate in interest expenses of the corporates declined consistently since 1995–96, from 25.0 per cent to a negative of 5.8 per cent in 2004–05 (Table 9). Such decline in interest costs has significant implications for the improvement in bottom lines of the corporates. Various indicators pertaining to interest costs, which can throw light on the impact of interest costs on corporate sector profits, have turned positive in recent years.

V. What is needed to improve monetary transmission?

While the changes in policy rates are quickly mirrored in the money market rates as well as in Government bond yields, lending and deposit rates of banks exhibit a degree of downward inflexibility. In this context, administered interest rates fixed by the Government on a number of small saving schemes and provident funds are of special relevance as they generally offer a rate higher than corresponding instruments available in the market as well as tax incentives (RBI, 2001; RBI, 2004a). As banks have to compete for funds with small saving schemes, the rates offered on long-term deposits mobilized by banks set the floor for lending rates at a level higher than would have obtained under competitive market conditions (Chart 7). In fact, this was observed to be a factor contributing to downward stickiness of lending rates, with implications for the effectiveness of monetary policy (Table 10).

Chart 7

Bank lending rate, deposit rate and small saving rate



These small savings schemes administered by the Government through the wide reach of post offices, and some through commercial banks, give small savers access to tax savings instruments that are seen as safe and stable. Benchmarking these administered interest rates to market-determined rates has been proposed from time to time. Whereas some rationalization in such schemes has taken place, further progress in this direction will depend on the provision of better social security and pension systems, and perhaps easier access to marketable sovereign instruments (Mohan, 2006c).

Table 10

Small savings and bank deposits

Amount in Rupees billion

	Average interest rate on small savings (%)	**Small savings outstanding**	**Average interest rate on banks' term deposits (%)**	**Bank term deposits outstanding**	**Small savings as % of Bank deposits**
1	**2**	**3**	**4**	**5**	**6**
1991–92	9.95	586	9.1	2,308	25.4
1992–93	9.48	609	9.6	2,686	22.7
1993–94	12.21	677	8.7	3,151	21.5
1994–95	13.20	833	7.0	3,869	21.5
1995–96	11.33	937	8.5	4,338	21.6
1996–97	13.03	1,061	9.4	5,056	21.0
1997–98	11.92	1,268	8.8	5,985	21.2
1998–99	10.34	1,553	8.9	7,140	21.7
1999–00	11.50	1,875	8.6	8,133	23.1
2000–01	11.60	2,251	8.1	8,201	27.4
2001–02	11.61	2,629	9.6	9,503	27.7
2002–03	11.56	3,138	8.7	10,809	29.0
2003–04	10.88	3,758	6.5	12,794	29.4
2004–05	9.37	4,577	6.2	14,487	31.6
2005–06	8.91	5,246		17,444	30.1

Source: *Annual Report* and *Handbook of Statistics on the Indian Economy*, various issues, Reserve Bank of India.

In consonance with the objective of enhancing the efficiency and productivity of banks through greater competition – from new private sector banks and the entry and expansion of several foreign banks – there has been a consistent decline in the share of public sector banks in total assets of commercial banks. Notwithstanding such transformation, public sector banks still account for over 70 per cent of assets and income of commercial banks. While the public sector banks have responded well to the new challenges of competition, this very public sector character does influence their operational flexibility and decision making and, hence, interferes, on occasions, with the transmission of monetary policy impulses. Similar influence on monetary transmission is exerted by the priority sector directives in terms of allocation of 40 per cent of credit for specified sectors. The impact is, however, very limited now with the deregulation of lending rates and the rationalization of the sectors for priority credit allocation.

VI. Summing up

The brief survey of monetary policy transmission in India suggests that monetary policy impulses impact on output and prices through interest rates and exchange rate movements in addition to the traditional monetary and credit aggregates. It is necessary, however, to take note of a few caveats. First, the transmission lags are surrounded by a great deal of uncertainty. In view of the ongoing structural changes in the real sector as well as financial innovations, the precise lags may differ in each business cycle. Second, the period was also marked by heightened volatility in the international economy, including developments such as the series of financial crises beginning with the Asian crisis. Third, the period under study has been marked by sharp reductions in customs duties and increasing trade openness, which could have impacted the transmission process. The 1990s were also witness to global disinflation. Overall, the period has been one of substantial ongoing changes in various spheres of the Indian economy as well as in its external environment. Fourth, the period of study has been characterized by significant shifts in the monetary policy operating framework from a monetary-targeting framework to a multiple indicator approach. Fifth, the size of interest rate pass-through has increased in recent years, with implications for transmission. Finally, empirical investigation is constrained by the use of industrial production as a measure of output in the absence of a reasonably long time series on quarterly GDP of the economy. In view of the significant structural shifts towards the services sector and the inter-linkages between agriculture, industry and services, the results of these empirical exercises should be considered tentative and need to be ratified with a comprehensive measure of output, as well as by considering alternative techniques.

On the whole, the Indian experience highlights the need for emerging market economies to allow greater flexibility in exchange rates but the authorities can also benefit from the capacity to intervene in foreign exchange markets in view of the volatility observed in international capital flows. Therefore, there is a need to maintain an adequate level of foreign exchange reserves and this in turn both enables and constrains the conduct of monetary policy. A key lesson is that flexibility and pragmatism are required in the management of the exchange rate and monetary policy in developing countries rather than adherence to strict theoretical rules.

Annex I:
Reforms in the monetary policy framework

Objectives

- Twin objectives of "maintaining price stability" and "ensuring availability of adequate credit to productive sectors of the economy to support growth" continue to govern the stance of monetary policy, although the relative emphasis on these objectives has varied depending on the importance of maintaining an appropriate balance.
- Reflecting the increasing development of the financial market and greater liberalization, the use of broad money as an intermediate target has been de-emphasised and a multiple indicator approach has been adopted.
- Emphasis has been put on development of multiple instruments to transmit liquidity and interest rate signals in the short-term in a flexible and bi-directional manner.
- Increase of the interlinkage between various segments of the financial market including money, government security and forex markets.

Instruments

- Move from direct instruments (such as administered interest rates, reserve requirements, selective credit control) to indirect instruments (such as open market operations, purchase and repurchase of government securities) for the conduct of monetary policy.
- Introduction of Liquidity Adjustment Facility (LAF), which operates through repo and reverse repo auctions, effectively providing a corridor for short-term interest rates. LAF has emerged both as the tool for liquidity management and as a signalling devise for interest rates in the overnight market.
- Use of open market operations to deal with overall market liquidity situation, especially those emanating from capital flows.
- Introduction of Market Stabilisation Scheme (MSS) as an additional instrument to deal with enduring capital inflows without affecting the short-term liquidity management role of LAF.

Developmental measures

- Discontinuation of automatic monetization through an agreement between the Government and the Reserve Bank. Rationalization of Treasury Bill market. Introduction of delivery versus payment system and deepening of inter-bank repo market.
- Introduction of Primary Dealers in the government securities market to play the role of market maker.
- Amendment of Securities Contracts Regulation Act (SCRA), to create the regulatory framework.

- Deepening of the government securities market by making the interest rates on such securities market-related. Introduction of auctions of government securities. Development of a risk-free credible yield curve in the government securities market as a benchmark for related markets.
- Development of a pure inter-bank call money market. Non-bank participants to participate in other money market instruments.
- Introduction of automated screen-based trading in government securities through Negotiated Dealing System (NDS). Setting up of risk-free payments and system in government securities through Clearing Corporation of India Limited (CCIL). Phased introduction of a Real Time Gross Settlement (RTGS) System.
- Deepening of the forex market and increased autonomy of Authorised Dealers.

Institutional measures

- Setting up of Technical Advisory Committee on Monetary Policy with outside experts to review macroeconomic and monetary developments and advise the Reserve Bank on the stance of monetary policy.
- Creation of a separate Financial Market Department within the RBI.

Annex II:
Money market instruments for liquidity management

The Reserve Bank has been making efforts to develop a repo market outside the LAF for bank and non-bank participants, so as to provide a stable collateralised funding alternative with a view to promoting smooth transformation of the call/notice money market into a pure inter-bank market and for deepening the underlying Government securities market. Thus, the following new instruments have been introduced.

Collateralised borrowing and lending obligation (CBLO)

- Developed by the Clearing Corporation of India Limited (CCIL) and introduced on January 20, 2003, it is a discounted instrument available in electronic book entry form for the maturity period ranging from one day to ninety days (can be made available up to one year as per RBI guidelines).
- In order to enable the market participants to borrow and lend funds, CCIL provides the Dealing System through the Indian Financial Network (INFINET), a closed user group for the Members of the Negotiated Dealing System (NDS) who maintain a current account with the RBI, and through the Internet for other entities who do not maintain a current account with the RBI.
- Membership (including Associate Membership) of the CBLO segment is extended to banks, financial institutions, insurance companies, mutual funds, primary dealers, NBFCs, non-Government provident funds, corporates, etc.
- Eligible securities are Central Government securities including Treasury Bills.
- Borrowing limits for members are fixed by the CCIL at the beginning of the day taking into account the securities deposited by borrowers in their CSGL account with CCIL. The securities are subjected to the necessary hair-cut after marking them to market.
- The auction market is available only to NDS Members for overnight borrowing and settlement on a T + 0 basis. At the end of the auction market session, CCIL initiates auction matching based on the uniform yield principle.
- CCIL assumes the role of the central counterparty through the process of novation and guarantees settlement of transactions in CBLO.
- Automated value-free transfer of securities between market participants and the CCIL was introduced during 2004–05.
- Members can reckon unencumbered securities for SLR calculation purposes.
- The operations in CBLO are exempted from cash reserve requirements (CRR).

Market repo

- To broaden the repo market, the Reserve Bank enabled non-banking financial companies, mutual funds, housing finance companies and insurance companies not holding SGL accounts to undertake repo transactions with effect from March 3, 2003.

These entities were permitted to access the repo market through their “gilt accounts” maintained with the custodians.

- Subsequently, non-scheduled urban co-operative banks and listed companies with gilt accounts with scheduled commercial banks were allowed to participate.
- Necessary precautions were built into the system to ensure delivery versus payment (DvP) and transparency, while restricting the repos to Government securities only.
- Rollover of repo transactions in Government securities was facilitated with the enabling of the DvP III mode of settlement in Government securities, which involves settlement of securities and funds on a net basis, effective April 2, 2004. This provided significant flexibility to market participants in managing their collateral.

Some assessments

- CBLO and market repo helped in aligning short-term money market rates to the LAF corridor.
- Mutual funds and insurance companies are generally the main supplier of funds while banks, primary dealers and corporates are the major borrowers in the repo market outside the LAF.BoxText

Annex III: Reforms in government securities market institutional measures

- Administered interest rates on government securities were replaced by an auction system for price discovery.
- Automatic monetization of the fiscal deficit through the issue of ad hoc Treasury Bills was phased out.
- Primary dealers (PD) were introduced as market makers in the government securities market.
- To ensure transparency in the trading of government securities, delivery versus payment (DvP) settlement was introduced.
- Repurchase agreements (repos) were introduced as a tool for short-term liquidity adjustment. Subsequently, the Liquidity Adjustment Facility (LAF) was introduced.
- LAF operates through repo and reverse repo auctions and provides a corridor for short-term interest rates. LAF has emerged both as the tool for liquidity management and as a signalling device for interest rates in the overnight market. The Second LAF (SLAF) was introduced in November 2005.
- A Market Stabilisation Scheme (MSS) has been introduced, which has expanded the instruments available to the Reserve Bank for managing the enduring surplus liquidity in the system.
- Effective April 1, 2006, RBI has withdrawn from participating in primary market auctions of Government paper.
- Banks have been permitted to undertake primary dealer business, while primary dealers are being allowed to diversify their business.
- Short sales in Government securities are being permitted in a calibrated manner, while guidelines for the "when issued" market have been issued recently.

Increase in instruments in the government securities market

- A 91-day Treasury Bill was introduced for managing liquidity and benchmarking. Zero Coupon Bonds, Floating Rate Bonds, and Capital Indexed Bonds were issued and exchange traded interest rate futures were introduced. OTC interest rate derivatives like IRS/FRAs were introduced.
- Outright sales of Central Government dated securities that are not owned have been permitted, subject to them being covered by outright purchases from the secondary market within the same trading day subject to certain conditions.
- Repo status has been granted to State Government securities in order to improve secondary market liquidity.

Enabling measures

- Foreign Institutional Investors (FIIs) were allowed to invest in government securities subject to certain limits.
- Introduction of automated screen-based trading in government securities through Negotiated Dealing System (NDS).
- Setting up of a risk-free payment and settlement system in government securities through the Clearing Corporation of India Limited (CCIL).
- Phased introduction of Real Time Gross Settlement System (RTGS).
- Introduction of trading in Government securities on stock exchanges for promoting retailing in such securities, permitting non-banks to participate in the repo market.
- Recent measures include the introduction of NDS-OM and T + 1 settlement norms.

Annex IV:
Reforms in the foreign exchange market

Exchange rate regime

- Evolution of the exchange rate regime from a single-currency fixed exchange rate system to fixing the value of rupee against a basket of currencies and further to a market-determined floating exchange rate regime.
- Adoption of convertibility of the rupee for current account transactions with acceptance of Article VIII of the Articles of Agreement of the IMF. De facto full capital account convertibility for non-residents and calibrated liberalization of transactions undertaken for capital account purposes in the case of residents.

Institutional framework

- Replacement of the earlier Foreign Exchange Regulation Act (FERA), 1973 by the market friendly Foreign Exchange Management Act, 1999. Delegation of considerable powers by the RBI to authorised dealers to release foreign exchange for a variety of purposes.

Increase in instruments in the foreign exchange market

- Development of rupee-foreign currency swap market.
- Introduction of additional hedging instruments, such as foreign currency-rupee options. Authorised dealers permitted to use innovative products like cross-currency options, interest rate swaps (IRS) and currency swaps, caps/collars and forward rate agreements (FRAs) in the international forex market.

Liberalization measures

- Authorised dealers permitted to initiate trading positions, borrow and invest in the overseas market subject to certain specifications and ratification by the respective banks' boards. Banks are also permitted to fix interest rates on non-resident deposits, subject to certain specifications, use derivative products for asset-liability management and fix overnight open position limits and gap limits in the foreign exchange market, subject to ratification by the RBI.
- Permission for various participants in the foreign exchange market, including exporters, Indians investing abroad, FIIs, to avail themselves forward cover and enter into swap transactions without any limit subject to genuine underlying exposure.
- FIIs and NRIs permitted to trade in exchange-traded derivative contracts subject to certain conditions.

- Foreign exchange earners permitted to retain up to 100 per cent of their foreign exchange earnings in their Exchange Earners' Foreign Currency accounts. Residents are permitted to remit up to US$50,000 per financial year.
- Authorised dealer banks may borrow funds from their overseas branches and correspondent banks (including borrowing for export credit, external commercial borrowings (ECBs) and overdrafts from their Head Office/Nostro account) up to a limit of 50 per cent of their unimpaired Tier I capital or US$10 million, whichever is higher.
- Borrowers eligible for accessing ECBs can obtain an additional US$250 million with average maturity of more than 10 years under the approval route. Prepayment of ECB up to US$300 million without prior approval of the Reserve Bank.
- The existing limit of US$2 billion on investments in Government securities by foreign institutional investors (FIIs) to be enhanced in phases to US$32 billion by March 31, 2007.
- The extant ceiling of overseas investment by mutual funds of US$ 2billion is enhanced to US$3 billion.
- Importers to be permitted to book forward contracts for the customs duty component of imports.
- FIIs to be allowed to rebook a part of the cancelled forward contracts.
- Forward contracts booked by exporters and importers in excess of 50 per cent of the eligible limit to be on deliverable basis and cannot be cancelled.
- Authorised dealer banks to be permitted to issue guarantees/letters of credit for import of services up to US$100,000 for securing a direct contractual liability arising out of a contract between a resident and a non-resident.
- Lock-in period for sale proceeds of the immovable property credited to the NRO account to be eliminated, provided the amount being remitted in any financial year does not exceed US$1 million.

Annex V:
Reforms in the banking sector

Competition enhancing measures

- Granting of operational autonomy to public sector banks, reduction of public ownership in public sector banks by allowing them to raise capital from the equity market up to 49 per cent of paid-up capital.
- Transparent norms for entry of Indian private sector, foreign and joint-venture banks and insurance companies, permission for foreign investment in the financial sector in the form of foreign direct investment (FDI) as well as portfolio investment, permission for banks to diversify product portfolio and business activities.
- Roadmap for presence of foreign banks and guidelines for mergers and amalgamation of private sector banks and banks and NBFCs.
- Guidelines on ownership and governance in private sector banks.

Measures enhancing role of market forces

- Sharp reduction in pre-emption through reserve requirements, market-determined pricing for government securities, removal of administered interest rates with a few exceptions, and enhanced transparency and disclosure norms to facilitate market discipline.
- Introduction of a pure inter-bank call money market, auction-based repos-reverse repos for short-term liquidity management, facilitation of an improved payment and settlement mechanism.
- Significant advance in dematerialization; markets for securitised assets are being developed.

Prudential measures

- Introduction and phased implementation of international best practices and norms on risk-weighted capital adequacy requirements, accounting, income recognition, provisioning and exposure.
- Measures to strengthen risk management through recognition of different components of risk, assignment of risk weights to various asset classes, norms on connected lending, risk concentration, application of marked-to-market principle for investment portfolio and limits on deployment of funds in sensitive activities.
- "Know Your Customer" and "Anti-Money Laundering" guidelines, roadmap for Basel II, introduction of capital charge for market risk, higher graded provisioning for NPAs, guidelines for ownership and governance, securitization and debt restructuring mechanisms norms, etc.

Institutional and legal measures

- Setting up of Lok Adalats (people's courts), debt recovery tribunals, asset reconstruction companies, settlement advisory committees, corporate debt restructuring mechanisms, etc. for quicker recovery/restructuring.
- Promulgation of Securitisation and Reconstruction of Financial Assets and Enforcement of Securities Interest (SARFAESI) Act, 2002 and its subsequent amendment to ensure creditor rights.
- Setting up of Credit Information Bureau of India Limited (CIBIL) for information sharing on defaulters as well as other borrowers.
- Setting up of Clearing Corporation of India Limited (CCIL) to act as central counterparty for facilitating transactions through the payment and settlement system relating to fixed income securities and money market instruments.

Supervisory measures

- Establishment of the Board for Financial Supervision as the supreme supervisory authority for commercial banks, financial institutions and non-banking financial companies.
- Introduction of the CAMELS supervisory rating system, move towards risk-based supervision, consolidated supervision of financial conglomerates, strengthening of off-site surveillance through control returns.
- Recasting of the role of statutory auditors, increased internal control through strengthening of internal audit.
- Strengthening corporate governance, enhanced due diligence on important shareholders, fit and proper tests for directors.

Technology-related measures

- Setting up of INFINET as the communication backbone for the financial sector; introduction of Negotiated Dealing System (NDS) for screen-based trading in Government securities and Real Time Gross Settlement (RTGS) System.

Annex VI:
Liquidity adjustment facility

- As part of the financial sector reforms launched in mid-1991, India began to move away from direct instruments of monetary control to indirect ones. A transition of this kind involves considerable efforts to develop markets, institutions and practices. In order to facilitate such transition, India developed a Liquidity Adjustment Facility (LAF) in phases considering country-specific features of the Indian financial system. LAF is based on repo/reverse repo operations by the central bank.

- In 1998 the Committee on Banking Sector Reforms (Narasimham Committee II) recommended the introduction of a Liquidity Adjustment Facility (LAF) under which the Reserve Bank would conduct auctions periodically, if not necessarily daily. The Reserve Bank could reset its repo and reverse repo rates, which would in a sense provide a reasonable corridor for the call money market. In pursuance of these recommendations, a major change in the operating procedure became possible in April 1999 through the introduction of an Interim Liquidity Adjustment Facility (ILAF), under which repos and reverse repos were formalised. With the introduction of ILAF, the general refinance facility was withdrawn and replaced by a collateralised lending facility (CLF) up to 0.25 per cent of the fortnightly average outstanding of aggregate deposits in 1997–98 for two weeks at the bank rate. An additional collateralised lending facility (ACLF) for an equivalent amount of CLF was made available at the Bank Rate plus 2 per cent. CLF and ACLF taken out for periods beyond two weeks were subjected to a penalty rate of 2 per cent for an additional two-week period. Export credit refinance for scheduled commercial banks was retained and continued to be provided at the bank rate. Liquidity support to PDs against collateral of Government securities at the bank rate was also provided for. ILAF was expected to promote money market stability and ensure that the interest rates moved within a reasonable range.

- The transition from ILAF to a full-fledged LAF began in June 2000 and was undertaken in three stages. In the first stage, beginning June 5, 2000, LAF was formally introduced and the Additional CLF and level II support to PDs was replaced by variable rate repo auctions with same day settlement. In the second stage, beginning May 2001, CLF and level I liquidity support for banks and PDs was also replaced by variable rate repo auctions. Some minimum liquidity support to PDs was continued but at an interest rate linked to the variable rate in the daily repo auctions as determined by the RBI from time to time. In April 2003, the multiplicity of rates at which liquidity was being absorbed/injected under the back-stop facility was rationalised and the back-stop interest rate was fixed at the reverse repo cut-off rate at the regular LAF auctions on that day. If there was no reverse repo in the LAF auctions, the back-stop rate was fixed at 2.0 percentage points above the repo cut-off rate. It was also announced that on days when no repo/reverse repo bids were received/accepted, the back-stop rate would be decided by the Reserve Bank on an ad-hoc basis. A revised LAF scheme was operationalised effective March 29, 2004, under which the reverse repo rate was reduced to 6.0 per cent and aligned with the bank rate. The normal facility and the backstop facility were merged into a single facility and made available at a single rate. The third stage of full-fledged LAF had begun with the full computerization of the Public Debt Office (PDO), and the introduction of RTGS marked a big step forward in this phase. Repo operations today are mainly through electronic transfers. Fixed rate auctions have been reintroduced since April 2004. The possibility of operating LAF at different times on the same day is now close to being materialised. In that sense we have very nearly completed the transition to a full-fledged LAF.

- With the introduction of the Second LAF (SLAF) from November 28, 2005 market participants now have a second window to fine-tune the management of liquidity. In the past, LAF operations were conducted between 9.30 a.m. and 10.30 a.m. SLAF is conducted by receiving bids between 3.00 p.m. and 3.45 p.m. The salient features of SLAF are the same as those of LAF and the settlement for both is conducted separately and on a gross basis. The introduction of LAF has been a gradual process and the Indian experience shows that a phased rather than big bang approach is required for reforms in the financial sector and in monetary management.

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Annex VII:
Market stabilisation scheme (MSS)

- The money markets have operated in liquidity surplus mode since 2002 due to large capital inflows and current account surplus. The initial burden of sterilization was borne by the outright transaction of dated securities and T-bills. However, due to the depletion in stock of government securities, the burden of liquidity adjustment shifted to LAF, which is essentially a tool for marginal liquidity adjustment. Keeping in view the objective of absorbing the liquidity of enduring nature using instruments other than LAF, the Reserve Bank appointed a Working Group on Instruments of Sterilisation (Chairperson: Smt Usha Thorat). The Group recommended the issuance of T-bills and dated securities under the Market Stabilisation Scheme (MSS), with the proceeds of MSS being held by the Government in a separate identifiable cash account maintained and operated by the RBI. The amounts credited into the MSS Account would be appropriated only for the purpose of redemption and/or buy back of the Treasury Bills and/or dated securities issued under the MSS. In pursuance of the recommendation, the Government of India and RBI signed a Memorandum of Understanding (MoU) on March 25, 2004. As part of the MoU, the scheme was made operational in April 2004. It was agreed that the Government would issue Treasury Bills and/or dated securities under the MSS in addition to the normal borrowing requirements, for absorbing liquidity from the system. These securities would be issued by way of auctions by the Reserve Bank and the instruments would have all the attributes of existing T-bills and dated securities. They were to be serviced like any other marketable government securities. MSS securities are treated as eligible securities for the Statutory Liquidity Ratio (SLR), repos and the Liquidity Adjustment Facility (LAF).
- The proceeds of the MSS are held by the Government in a separate identifiable cash account maintained and operated by the Reserve Bank. The amount held in this account is appropriated only for the purpose of redemption and/or buyback of the Treasury Bills and/or dated securities issued under the MSS. The payments for interest and discount on MSS securities are not made from the MSS account. The receipts due to premium and/or accrued interest are also not credited to the MSS account. Such receipts and payments towards interest, premium and discount are shown in the budget and other related documents as distinct components under separate sub-headings. Thus, they only have a marginal impact on the revenue and fiscal balances of the Government to the extent of interest payment on the outstanding under the MSS.
- For mopping up enduring surplus liquidity, a policy choice exists between the central bank issuing its own securities or the Government issuing additional securities. A large number of countries, such as Chile, China, Colombia, Indonesia, Korea, Malaysia, Peru, the Philippines, Russia, Sri Lanka, Tawian and Thailand, have issued central bank securities. However, central banks of many of these countries faced deterioration in their balance sheets. As such, there are merits in issuing sterilization bonds on the government account. This is more so in the case of an already well established government debt market, where the issuance of new central bank bills of overlapping maturity could cause considerable confusion and possible market segmentation which could obfuscate the yield curve, reduce liquidity of the instruments and make operations that much more difficult.
- MSS has considerably strengthened the Reserve Bank's ability to conduct exchange rate and monetary management operations. It has allowed absorption of surplus liquidity by instruments of short-term (91-day, 182-day and 364-day T-bills) and

medium-term (dated Government securities) maturity. Generally, the preference has been for the short-term instruments. This has given the monetary authorities a greater degree of freedom in liquidity management during transitions in the liquidity situation.

Reference:

Reserve Bank of India (2003), Report of the Working Group on Instruments of Sterlisation, Mumbai, December.

Annex VIII:
Liquidity management during IMD redemption

- The India Millennium Deposits (IMDs) were foreign currency denominated deposits issued by the State Bank of India in 2000, on the advice of the Government of India. It mobilised a sum of USD 5.5 billion for a tenor of five years. IMD carried coupons of 8.50 per cent, 7.85 per cent and 6.85 per cent on US dollar, Pound Sterling and Euro denominated deposits respectively. IMD subscription was limited to non-resident Indians, persons of Indian origin and overseas corporate bodies. The interest income earned on IMD was exempted from tax and there was provision for premature encashment after six months only in non-repatriable Indian rupees. These IMDs matured on December 28–29, 2005 and the large sums involved presented a challenge for liquidity management.
- Liquidity management in the face of IMD redemptions was carried out to contain disequilibrium while retaining a monetary policy stance with a medium-term objective. Outflows on account of the redemptions were met by smoothing arrangements worked out for that purpose. During December 27–29, 2005, the RBI sold foreign exchange out of its foreign exchange reserves to the State Bank of India (SBI) totaling nearly US$ 7.1 billion, which in rupee equivalent terms was about Rs.32,000 crore. SBI, for its part, had built up the necessary rupee resources to meet the obligations. Temporary tightness in liquidity was met by releasing liquidity through the repo window (including the second LAF), averaging about Rs.23,000 crore per day in the last week of December, coinciding with the IMD redemptions, outflows due to advance tax payments and the continued surge in credit offtake. The second LAF window made available since November 28, 2005 provided an additional opportunity for market participants to fine tune their liquidity management. The smooth redemption of the IMD liability of this size, bunched at a point of time, reflects the growing maturity of the financial markets and the strength of the liquidity management system that has been put in place. Short-term money market rates eased remarkably in the first week of January 2006, reflecting smooth redemptions of IMDs, but firmed up in the second week, reflecting pressures emanating from scheduled auctions of Government securities.

Source: Mohan (2006a)

Annex IX: Prudential guidelines impacting monetary transmission in India

The Reserve Bank has issued several prudential capital requirement and supervisory guidelines which could have an impact on the transmission of monetary policy in India. These include:

- For ensuring a smooth transition to Basel II norms, banks were required to maintain a capital charge for market risk on their trading book exposures (including derivatives) by March 31, 2005 and on the securities included under the Available for Sale category by March 31, 2006.
- Banks in India have been advised to adopt the Standardised Approach for credit risk and Basic Indicator Approach for operational risk under the New Capital Adequacy Framework with effect from March 31, 2008.
- Effective March 31, 2002, banks were permitted to have single or group borrower credit exposure up to 15 per cent and 40 per cent of their capital funds (Tier I and Tier II capital) respectively, with an additional allowance of 5 per cent and 10 per cent of their capital funds for the infrastructure sector. In May 2004 banks were permitted to consider enhancement of their exposure to the borrower up to a further 5 per cent of capital funds, subject to the banks disclosing this in their annual reports.
- Banks' aggregate exposure to the capital market was restricted to 40 per cent of their net worth on a solo and consolidated basis. The consolidated direct capital market exposure was restricted to 20 per cent of banks' consolidated net worth.
- The RBI issued a "Guidance Note on Management of Operational Risk" in October 2005 to enable the banks to have a smooth transition to the New Capital Adequacy Framework. Banks using the Basic Indicator Approach were encouraged to comply with "Sound Practices for the Management and Supervision of Operational Risk" issued by the Basel Committee on Banking Supervision in February 2003.
- In order to encourage banks' early compliance with the guidelines for maintenance of a capital charge for market risks, banks were advised in April 2005 that banks which have maintained capital of at least 9 per cent of the risk-weighted assets for both credit risk and market risks for both the Held For Trading (HFT) and the Available For Sale (AFS) categories may treat the balance in excess of 5 per cent of securities included under HFT and AFS categories, in the Investment Fluctuation Reserves (IFR), as Tier I capital.
- In view of strong growth of housing and consumer credit, risk containment measures were put in place and the risk weights were increased in October 2004 from 50 per cent to 75 per cent in the case of housing loans and from 100 per cent to 125 per cent in the case of consumer credit including personal loans and credit cards. The risk weight on banks' exposure to commercial real estate was increased from 100 per cent to 125 per cent in July 2005 and further to 150 per cent in April 2006.
- It was decided in April 2006 that bank's total exposure to venture capital funds will form a part of their capital market exposure and banks should, henceforth, assign a higher risk weight of 150 per cent to these exposures.
- Taking into account the trends in credit growth, the general provisioning requirement for "standard advances" was increased in October 2005 from 0.25 per cent to 0.40 per cent. Banks' direct advances to the agricultural and SME sectors were

exempted from the additional provisioning requirement. In April 2006, the RBI further increased the general provisioning requirement on standard advances in specific sectors, ie, personal loans, loans and advances qualifying as capital market exposures, residential housing loans beyond Rs.20 lakh and commercial real estate loans, from the existing level of 0.40 per cent to 1.0 per cent. These provisions are eligible for inclusion in Tier II capital for capital adequacy purposes up to the permitted ceiling.

- With regard to trends in the credit markets, a supervisory review process was initiated with select banks having significant exposure to some sectors, namely, real estate, highly leveraged NBFCs, venture capital funds and capital markets, in order to ensure that effective risk mitigants and sound internal controls are in place for managing such exposures.
- In October 2005, the RBI restricted banks' aggregate exposure to the capital market to 40 per cent of their net worth on a solo and consolidated basis. The consolidated direct capital market exposure has been restricted to 20 per cent of banks' consolidated net worth.
- In January 2007, the provisioning requirement was increased to 2 per cent for standard assets in the real estate sector, outstanding credit card receivables, loans and advances qualifying as capital market exposure and personal loans (excluding residential housing loans); the provisioning requirement was also increased to 2 per cent for banks' exposures in the standard assets category to the non-deposit-taking systemically important non-banking financial companies (NBFCs); the risk weight was increased to 125 per cent for banks' exposure to non-deposit-taking systemically important NBFCs.

Annex X:
The evolving stance of monetary policy in India

Highlights

- The statement on the stance of monetary policy was introduced from the policy statement of April 1996.
- The emphasis on price stability and provision of credit to support growth has since run through the statements on stance.
- Exchange rate stability was underlined in the stance of April 1996.
- The pursuit of financial reforms, accelerated investment, improvement in credit delivery mechanisms particularly for agriculture and small and medium sectors, soft interest rate regime, interest rate signaling and liquidity management were included for the first time in the stance of April 1998.
- The role of active debt management was emphasized in the stance of April 1999.
- Ensuring financial stability came to be recognized from the stance of October 1999.
- Macroeconomic stability was emphasized in the stance of April 2004.
- The need for support to export demand, stabilization of inflation expectations and calibrated actions was underlined in the stance of October 2004.
- A prompt and effective response to the evolving situation was underlined in the stance of July 2005.
- The aspect of credit quality was emphasized in the stance of January 2006.
- A swift response to evolving global developments was promised in the stance of April 2006.
- Financial inclusion was emphasized, for the first time, in the stance of January 2007.

Details		
Year	**Annual policy**	**Mid term review**
1996–97	Credit support to sustain growth and a reasonable degree of price and exchange rate stability.	Price stability and adequate supply of bank credit to the productive sectors of the economy.
1997–98	Maintaining reasonable price stability and ensuring availability of adequate bank credit to support the growth of the real sector.	Promoting price stability and ensuring availability of adequate bank credit to meet the requirements of productive sectors of the economy.
1998–99	Need to accelerate industrial investment and output in the economy; maintenance of low rates of inflation; continued pursuit of financial reform; reduction in interest rates; and improvement in credit delivery mechanisms, particularly for agriculture and medium and small sectors.	Flexible use of interest rate instruments to signal RBI's stance regarding monetary conditions and management of the flow of liquidity in the system.
1999–00	Provision of reasonable liquidity; stable interest rates with policy preference for softening to the extent circumstances permit; active debt-management; orderly development of financial markets; and further steps in financial sector reforms.	Provision of reasonable liquidity; stable interest rates with preference for softening to the extent possible within the existing operational and structural constraints; orderly development of financial markets and ensuring financial stability.
2000–01	Continue the current stance of monetary policy and ensure that all legitimate requirements for bank credit are met while guarding against any emergence of inflationary pressures due to excess demand.	
2001–02	Provision of adequate liquidity to meet credit growth and support revival of investment demand while continuing a vigil on movements in the price level. Within the overall framework of imparting greater flexibility to the interest rate regime in the medium-term, to continue the present stable interest rate environment with a preference for softening to the extent the evolving situation warrants.	
2002–03	Provision of adequate liquidity to meet credit growth and support revival of investment demand while continuing a vigil on movements in the price level. Within the overall framework of imparting greater flexibility to the interest rate regime in the medium-term, to continue the present stable interest rate environment with a preference for softening to the extent the evolving situation warrants.	Same as outlined in Annual Policy of April 2002.

Details (cont)		
Year	**Annual policy**	**Mid term review**
2003–04	Provision of adequate liquidity to meet credit growth and support investment demand in the economy while continuing a vigil on movements in the price level. In line with the above, to continue the present stance on interest rates including preference for soft interest rates. To impart greater flexibility to the interest rate structure in the medium-term.	Same as outlined in Annual Policy of April 2003.
2004–05	Provision of adequate liquidity to meet credit growth and support investment demand in the economy while continuing a vigil on movements in the price level. In line with the above, to continue with the present stance of preference for a soft and flexible interest rate environment within the framework of macroeconomic stability.	Provision of appropriate liquidity to meet credit growth and support investment and export demand in the economy while placing equal emphasis on price stability. Consistent with the above, to pursue an interest rate environment that is conducive to macroeconomic and price stability, and maintaining the momentum of growth. To consider measures in a calibrated manner, in response to evolving circumstances with a view to stabilising inflationary expectations.

Year	Annual policy	First quarter review	Mid term review	Third quarter review
2005–06	Provision of appropriate liquidity to meet credit growth and support investment and export demand in the economy while placing equal emphasis on price stability. Consistent with the above, to pursue an interest rate environment that is conducive to macroeconomic and price stability, and maintaining the momentum of growth. To consider measures in a calibrated manner, in response to evolving circumstances with a view to stabilising inflationary expectations.	Same stance for the remaining part of the year as set out in the annual policy Statement of April 2005, but the Reserve Bank would respond, promptly and effectively, to the evolving situation depending on the unfolding of the risks.	Consistent with emphasis on price stability, provision of appropriate liquidity to meet genuine credit needs and support export and investment demand in the economy. Ensuring an interest rate environment that is conducive to macroeconomic and price stability, and maintaining the growth momentum. To consider measures in a calibrated and prompt manner, in response to evolving circumstances with a view to stabilising inflationary expectations.	To maintain the emphasis on price stability with a view to anchoring inflationary expectations. To continue to support export and investment demand in the economy for maintaining the growth momentum by ensuring a conducive interest rate environment for macroeconomic, price and financial stability. To provide appropriate liquidity to meet genuine credit needs of the economy with due emphasis on quality. To consider responses as appropriate to evolving circumstances.
2006–07	To ensure a monetary and interest rate environment that enables continuation of the growth momentum consistent with price stability while being in readiness to act in a timely and prompt manner on any signs of evolving circumstances impinging on inflation expectations. To focus on credit quality and financial market conditions to support export and investment demand in the economy for	To ensure a monetary and interest rate environment that enables continuation of the growth momentum while emphasizing price stability with a view to anchoring inflation expectations. To reinforce the focus on credit quality and financial market conditions to support export and investment demand in the economy for	To ensure a monetary and interest rate environment that supports export and investment demand in the economy so as to enable continuation of the growth momentum while reinforcing price stability with a view to anchoring inflation expectations. To maintain the emphasis on macroeconomic and, in particular, financial stability.	To reinforce the emphasis on price stability and well anchored inflation expectations while ensuring a monetary and interest rate environment that supports export and investment demand in the economy so as to enable continuation of the growth momentum. To re-emphasise credit quality and orderly conditions in financial

Year	Annual policy	First quarter review	Mid term review	Third quarter review
2006–07 (cont)	maintaining macroeconomic, in particular, financial stability. To respond swiftly to evolving global developments.	maintaining macroeconomic and, in particular, financial stability. To consider measures as appropriate to the evolving global and domestic circumstances impinging on inflation expectations and the growth momentum.	To consider promptly all possible measures as appropriate to the evolving global and domestic situation.	markets for securing macroeconomic and, in particular, financial stability while simultaneously pursuing greater credit penetration and financial inclusion. To respond swiftly with all possible measures as appropriate to the evolving global and domestic situation impinging on inflation expectations and the growth momentum.

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The transmission mechanisms of monetary policy in Indonesia

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1. The objective of monetary policy

A major change in the conduct of monetary policy in Indonesia in the aftermath of the 1997–2000 crisis was Act no 23/1999 and its revision in Act no 3/2004 that gives Bank Indonesia full autonomy in formulating and implementing policies. First, the objective of the central bank focuses on achieving and maintaining the stability of the rupiah (currency) value, meaning inflation and exchange rate.[2] Second, the central bank has been given independence in conducting its monetary policy (ie determining the monetary instrument used in monetary management), while the government in coordination with the central bank will set the inflation target. Third, the decision on monetary policy rests with the Bank Indonesia's Board of Governors, without any intervention from the government or other parties. And fourth, a clear mechanism for accountability and transparency of monetary policy is outlined in the Act, inter alia by requiring Bank Indonesia to announce its inflation target and plan of monetary policy at the beginning of the year and to provide a quarterly report to the Parliament for its conduct of monetary policy. Against the background, we argue that the most suitable framework of future monetary policy for Indonesia is inflation targeting. Two fundamental prerequisites for inflation targeting – ie, the ability to conduct monetary policy with independence and the absence of conflict with other nominal targets or policy objectives – are fulfilled.

With the mandate of the new Act, Bank Indonesia started to announce its annual inflation target and plan of monetary policy at the beginning of 2000. A monthly Board of Governors meeting has also been conducted to review and set the monetary policy stance and direction.[3] To support the decision-making, the research staff has been charged with providing better analysis and forecasts of inflation, economic, and financial trends as well as policy scenarios for monetary policy. The results of the meetings have been widely communicated to the public through various media, including press releases, press conferences, seminars with academicians and other stakeholders, as well as on the Bank's website. In order to fulfill its accountability to the Parliament, quarterly reports have been provided to include not only reviews of monetary policy, but also other tasks of Bank Indonesia on banking and payment systems.

It should be emphasized here, however, that the current framework is not a formal framework of inflation targeting as adopted by some countries such as the UK and New Zealand. Rather, it is simply a monetary policy with an inflation target. But adoption of the full-fledged inflation targeting framework started in July 2005.

Indonesia has undergone a number of far-reaching structural adjustments in all economic sectors since the early 1970s. As in many other countries, the adjustments were strengthened by faster globalization and have major implications for monetary management

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[2] However, the single objective has been focused on inflation since, under the flexible exchange rate system adopted in Indonesia, the exchange rate is determined in the market.

[3] The coverage of the meetings would be the annual review for January's meeting, quarterly reviews for April, July, and October's meeting, and monthly reviews for the other months.

and the transmission mechanism of monetary policy. This paper will discuss the Indonesian experience with regard to the macroeconomic environment and policy objective, how the monetary policy transmission mechanism works in Indonesia, and the impact of financial globalization on the financial market and exchange rate.

2. Macroeconomic environment and policy objectives

It is understood that the macroeconomic environment and structural changes have implications for the policy objectives of monetary policy. The monetary policy objectives or framework adopted in a country are closely related to the degree of financial development, structural adjustment, and the macroeconomic setting in which the monetary policy is implemented. In Indonesia, the relationship among the macroeconomic environment, structural changes, and the objectives of monetary policy in a broad sense can be divided into three periods, namely, before, during, and after the 1997–2000 financial crisis, especially as of mid-July 2005, when Bank Indonesia decided to implement an inflation targeting framework.

First is the *period before the financial crisis (1969–1996)*. During this period, the Indonesian economic environment was characterized by economic growth that was maintained at the reasonable level of around 6% annually, except during the periods 1969–1978 and 1989–1993 when Indonesia experienced booming economic growth of 7–8% per year. The main drivers of the economic growth were agriculture, manufacturing, and mining. The prolonged stable economic growth in this period was supported by high commitment of the New Order government to an economic management philosophy and objectives laid out in a series of five year development plans, which started in 1969/1970.

The New Order government has been committed to the trilogy of development: growth, equity, and stability. For the past 30 years, the government has sought to improve equity while promoting growth. This has led to a substantial reduction in poverty and a general movement toward an increased degree of income equality. Moreover, in order to attain growth and equity, the government has placed a strong emphasis on developing human, as well as physical, capital.

With regard to price development, before the financial crisis inflation could be maintained in the single digits (below 10% annually), with the exception of the period of 1974–1978 when inflation was quite high, around 15%. Inflation in Indonesia was characterized by high inflation on administered prices, especially on food prices, transportation, and other prices regulated by the government. On the external side, the balance of payments, especially the current account, generally showed a deficit of around 2–3% of GDP. The deficit was the result of high import taxes not only on raw materials, but also on machines and other mechanical equipment for production. Henceforth, the capital account showed a surplus figure for both the government and private sectors.

The exchange rate was relatively stable due to the adoption of a managed floating exchange rate system with a certain band. During the pre-crisis period, there was quite a large devaluation of the rupiah in response to relatively significant pressure on the exchange rate. The devaluation happened in 1978, 1983 (38% devalued), and 1986. On the fiscal side, the government implemented the balanced budget principle. By implementing this principle there was always balance between government revenues and expenditure. If a deficit occurred, due to government expenditure being bigger than its income the discrepancies would be covered by borrowing from abroad (government debt) or by issuing domestic government bonds.

During the stabilization period there were several reforms and structural changes. The essential reform in monetary policy started when the credit ceiling was implemented and an interest rate regime was administered. The credit ceiling policy limited the loans of each credit institution, to control domestic demand, curb domestic inflation, and to attack the deficit in the balance of payments. Then, in 1970, the government declared the rupiah to be fully a convertible currency (free foreign exchange regime), with no restrictions on the flow of foreign exchange into or out of Indonesia. This move was radical at the time and would still be considered radical today by some economists. This sequencing reform was primarily aimed at attracting foreign capital, especially foreign direct investment, and resulted in the appreciation of the rupiah.

Credit reform began in 1983, when the artificial restrictions on the allocation of bank credit and the state bank interest rate were eliminated. Bank Indonesia also reduced its significant role in refinancing bank loans and introduced Bank Indonesia Certificates (SBI) and money market securities issued and endorsed by banks (SBPU). After that, Bank Indonesia adopted indirect monetary policy to reduce the supply of reserve money. Under the indirect monetary policy, monetary policy transmission is viewed to run from monetary base (operating target) through monetary aggregate (intermediate target) to output and inflation (ultimate target).

An immediate outcome of these reforms was to increase substantially interest rates paid on deposits and charges for loans, with an improvement in resource allocation, even though the state-owned banks continued to dominate the system.

Financial sector reform was taken one step further in October 1988 with what was referred to as Pakto 88. Under Pakto 88, restrictions on the operations of foreign banks were eased, the procedures for establishing branch banks were simplified, and the requirements for becoming a foreign exchange bank were relaxed. Pakto 88 also reduced the special privileges and responsibilities of the state-owned financial institutions and narrowed the differential tax treatment affecting various financial instruments. The bank reserve requirement was lowered from 15% to 2% of all deposits, successfully reducing the spread between borrowing and lending rates. The re-utilization of the reserve requirement as an indirect instrument of monetary policy is intended to control bank credit in the light of the surge in capital inflows. In addition, the new provision will strengthen the power of monetary policy to influence the banks’ balance sheets.

The period of financial crisis (1997–2000). The economic and financial crisis in Indonesia, which started in mid-1997, has been more severe, prolonged, and difficult to resolve than in any other affected country in the region. The crisis, which was triggered by an excessive depreciation of the rupiah, resulted in the worst recession the economy has experienced. The economy shrank 13.68% during 1998 and the annual rate of inflation reached a very high figure, 77.6% in 1998 (year on year basis). This was also followed by several large scale bank and business failures and a huge increase in the unemployment rate.

Meanwhile, the balance of payments was in good condition, with a current account surplus as a result of high depreciation of the rupiah, and a capital account surplus, mainly due to high repayment of private debts. Unfavorable market sentiment caused excessive exchange rate volatility and made it difficult for monetary policy to maintain the stability of the rupiah, which had a negative impact on the overall macroeconomic situation. The weakening rupiah harmed macroeconomic stability through the pass-through impact on inflation, which led to higher interest rates than optimal to support economic and financial stability. Depreciation also affected the fiscal deficit, by raising the cost of external debt service as the rupiah value of the debt stock exploded.

To cope with the battered rupiah, the government widened the trading band on the rupiah, and also intervened both in forward and spot markets. However, realizing that defending the currency was futile under such strong pressure on the rupiah, the government finally let the exchange rate float in mid-August 1997. Soon after floating the currency, the government adopted an extremely tight money policy by raising interest rates sharply, in addition to suspending several monetary instruments which had expansionary effects such as the auction of SBPUs, discount facilities, and the purchase of SBIs using repos.

The high level of interest rates and the large depreciation severely affected the fragile banking and real sectors by worsening the banks' asset quality and contributing to corporate failures. To prevent bank runs and a collapse of the entire banking system, Bank Indonesia extended huge liquidity support to commercial banks. As a result, broad money and base money both grew around 30% from December 1997 to March 1998. As people's confidence in the rupiah eroded, a cycle of weakening currency, soaring prices, and expanding money supply threatened to break out in hyperinflation. *Bank Indonesia's main objective was therefore to restore confidence in the national currency.* Hyperinflation had to be prevented and inflation brought down. Bank Indonesia furthermore believed that if prices were stabilized, this would in turn strengthen the value of rupiah against other currency.

To achieve these aims, monetary expansion needed first to be halted and Bank Indonesia needed to regain control over its own balance sheet. All sources of central bank money creation needed to be under control and Bank Indonesia needed to reabsorb excess liquidity in the banking system. Bank Indonesia, with the support of the IMF, pursued a tight money policy stance with base money as a target. Quantitative targets were set up at the level of the central bank's balance sheet. Bank Indonesia did not allow domestic assets to expand – broadly speaking, net domestic assets would also be flat. To protect the foreign asset position, a floor was established for net international reserves (NIR).

To prevent further expansions of liquidity support, in April 1998 Bank Indonesia imposed a high penalty on the discount window facility and commercial banks' negative balance at Bank Indonesia. Furthermore, in May 1998 Bank Indonesia placed a ceiling on deposit rates and the interbank rate guaranteed by the government. The policy aimed at preventing banks from adopting imprudent measures that could lead to self-reinforcing expansion of liquidity support.

Due to a number of constraints in money market instruments such as the thin market of SBIs, open market operations were not able to fully absorb all the excess liquidity in the economy. To achieve the quantitative target, attempts were made to improve the open market operation. On 29 July 1998, Bank Indonesia changed the auction system of SBIs, shifting from an interest rate target to a quantitative target. Furthermore, auction participants, formerly restricted to primary dealers, were expanded to include bankers, money brokers, the capital market, and the general public. These changes were intended to allow greater competition among auction participants, hence the SBI rate was expected to better reflect the interaction between demand and supply.

Another innovation in enhancing monetary policy operations was "rupiah intervention". It is set to support monetary restraint and smooth interest rate volatility in the interbank money market. Accordingly, rupiah intervention not only served as a contractionary instrument but also as an expansionary one. Attempts to control monetary expansion of liquidity support originating from government expenditure were also supported by sterilization in the foreign exchange market, which simultaneously increased the supply of foreign exchange, thereby helping to stabilize the domestic currency.

Although the framework of monetary policy using base money as the policy target seemed to have been effective in the 1980s and early 1990s, the same approach was heavily challenged in periods thereafter. There have been concerns that it is difficult for policymakers to control M0 growth.[4] Three important factors were allegedly responsible for this problem. First, the money markets for SBIs and SBPUs were relatively thin and fragmented. As a result, the central bank found it difficult to control the liquidity of the economy using the instruments indirectly. Second, in certain periods, M0 was endogenous with respect to

[4] Budiono (1994): "Melihat kembali target moneter kita: M0, M1, atau M2?", (Revisiting our monetary targets: M0, M1, or M2?), unpublished.

output. For example, during periods of "upswing" in the economy, the growth of M0 was largely caused by aggregate demand which was reflected by the growth in foreign borrowing and liquidation of SBIs. Although this did not necessarily mean that the growth of M0 could not be completely controlled, it was a difficult job that sometimes needed an extremely high increase in interest rates in order to slow aggregate demand down. Third, the relationship between nominal income and money became increasingly unstable. Global financial innovation and deregulation had also caused this problem. This in turn made the monetary policy with quantity targets less reliable.

Facing this challenge, Bank Indonesia initially followed a rather pragmatic (eclectic) approach. Without leaving the quantity approach, more attention was given to the development of interest rates. Moreover, the intervention bands under the managed exchange rate regime were widened several times so as to allow some flexibility and ease some of the burden on monetary policy. This pragmatic approach was, however, thought to be transitory before monetary policy turned to a new approach, ie price (interest rate) targeting. However, before the second approach was fully in place, the recent financial crisis forced the monetary authority of Indonesia to postpone its implementation and review the quantity approach for reasons described below.

The period of implementing the new monetary policy framework. A major change in the conduct of monetary policy in the aftermath of the crisis was the new Bank Indonesia Act that gives the Bank full autonomy in formulating and implementing policies. First, the objective of the central bank focuses on achieving and maintaining the stability of the rupiah (currency) value, meaning inflation and exchange rate.[5] Second, the central bank has been given independence in both setting the inflation target (goal independence) and conducting its monetary policy (instrument independence).[6] Third, decisions on monetary policy rest on Bank Indonesia's Board of Governors, without any intervention from the government and other parties. And fourth, a clear mechanism for accountability and transparency of monetary policy is outlined in the Act, requiring, inter alia, Bank Indonesia to announce its inflation target and plan of monetary policy at the beginning of the year and to provide a quarterly report to the Parliament on its conduct of monetary policy. Against this background, the most suitable framework for future monetary policy in Indonesia is inflation targeting. Two fundamental prerequisites for inflation targeting – ie, the ability to conduct monetary policy with independence and the absence of conflict with other nominal targets or policy objectives – are fulfilled.

With the mandate of the new Act, Bank Indonesia started to announce its annual inflation target and plan of monetary policy at the beginning of 2000. A monthly Board of Governors meeting has also been conducted to review and set the monetary policy stance and direction.[7] To support the decision-making, the research staff have been charged with providing better analysis and forecasts of inflation, economic, and financial trends as well as policy scenarios for the monetary policy. The results of the meetings have been widely communicated to the public through various media, including press releases, press conferences, seminars with academicians and other stakeholders, as well as on the Bank's website. To meet Bank Indonesia's accountability to the Parliament, quarterly reports have been provided to include not only a review of monetary policy, but also other tasks of Bank Indonesia on banking and payment systems.

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5 However, the single objective has been focused on inflation since, under the flexible exchange rate system adopted in Indonesia, the exchange rate is determined in the market.

6 A process of amending the Act is now underway in which, among others, the inflation target will be set by the government upon taking into account recommendations from Bank Indonesia.

7 The coverage of the meetings would be the annual review for January's meeting, quarterly reviews for April, July, and October's meeting, and monthly reviews for the other months.

It should be emphasized here, however, that during the stabilization period under the IMF program Bank Indonesia adopted base money as the operational target as well as an anchor to achieve the ultimate target. The Bank also monitors various aggregates as well as interest rates. Over the long run, however, we noticed a number of shortcomings in the use of base money as the operating target, such as the difficulties in achieving the target and the poor signal it transmits to the market. Such a poor signal of monetary policy direction and targets obviously fails to meet the need to maintain market expectations on future exchange rate movements. In view of these factors, Bank Indonesia adopted a fully-fledged inflation targeting framework (ITF) in July 2005.

The framework has three primary characteristics, First, monetary policy is directed towards achieving an inflation target explicitly announced to the public for a specified time horizon. In this regard, under the new Central Bank Law – as mentioned above – the inflation target is set by the government after coordinating with Bank Indonesia. Second, monetary policy must be implemented on a forward-looking basis, responding to future developments in inflation. At the operational level, Bank Indonesia uses the BI rate as the policy rate to respond to the future trend in inflation. The BI rate is implemented through open market operations for one-month SBIs, mainly because they have been used as a benchmark by banks and market players in Indonesia, they reinforce the signaling of monetary policy response, and they play an important role in the monetary transmission mechanism.

In formulating monetary policy, the Taylor-type rule is used as a benchmark. Thus, in essence, interest rates used as monetary policy instruments are adjusted so as to respond to deviations in the inflation gap and output gap. Obviously, rules like these are not to be applied mechanically. A balance between rules and discretion, or constrained discretion, is especially necessary when monetary policy must be pursued within an increasingly globalized and complex financial environment.

The third characteristic of the ITF is that monetary policy is implemented on a transparent basis with measured accountability. Inflation targeting is more than a mere framework for monetary policy. Inflation targeting promotes the good governance of a central bank. By announcing the inflation target to the public, the central bank commits itself to its achievement. Uncertainty over future inflation will ease because public expectations have a point of reference, thus economic cost arising from uncertainty will also be reduced. Communication to the public on the future monetary policy direction is vital so that the public can anticipate the central bank monetary policy and to avoid surprises that could trigger volatility in the money market. Communications to the market players are also necessary, especially when financial markets are experiencing turbulence. In financial markets fraught with asymmetric information, the wealth of information held by the central bank is frequently of great benefit in mitigating this issue and thus preventing panic and herding by investors. In this regard, the credibility of the central bank is crucial.

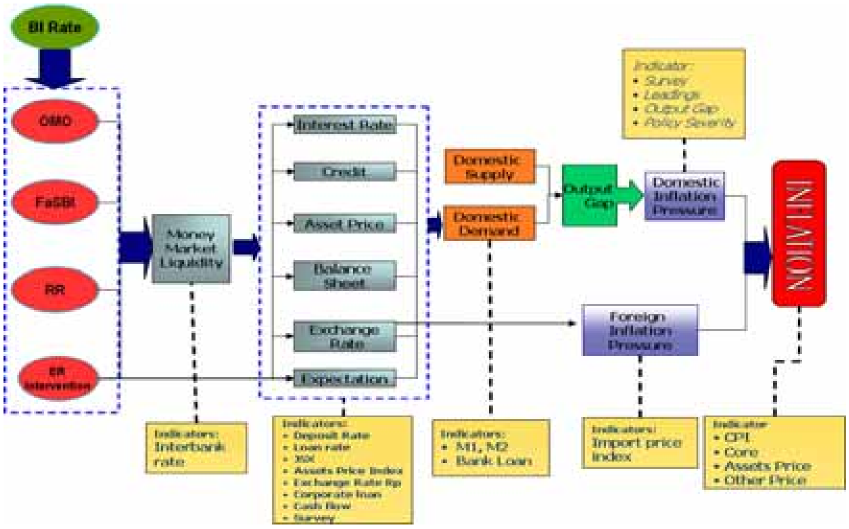
3. Monetary policy transmission mechanism

3.1 General framework of transmission channel

In view of the Bank Indonesia mandate to achieve stability in the rupiah, or in this case to control inflation, it is vital for Bank Indonesia to have a grasp on how monetary policy influences inflation. The monetary policy process that influences the wider economy and inflation in particular is known as the monetary policy transmission mechanism. The individual channels through which monetary policy operates are known as transmission channels. In theory, there are six transmission channels, which are respectively the exchange rate, the asset price, the interest rate, the corporate balance sheet, the credit, and the expectations channels. Each of these channels is described briefly below.

Scheme 1

Summary of transmission mechanism of monetary policy



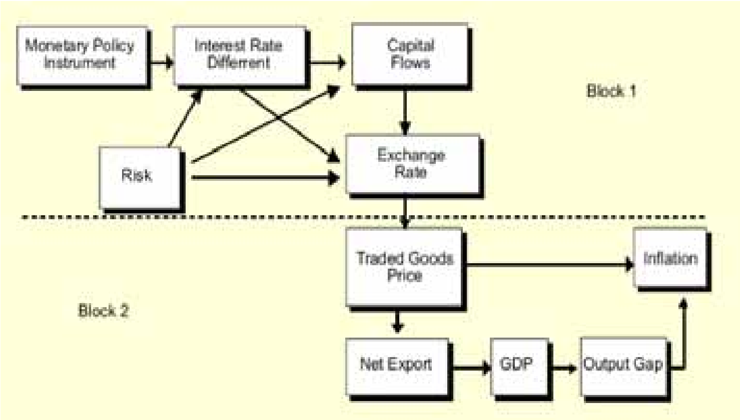
3.2 Exchange rate channel

In small open economies, the exchange rate becomes an important channel in transmitting monetary policy, in that exchange rate movements significantly influence the development of aggregate demand and aggregate supply, and thus output and prices. Its relative strength, of course, depends on the exchange rate arrangement of the country. Under a floating exchange rate system, for example, an easing monetary policy will depreciate the domestic currency, and increase prices of imported goods, thus raising domestic prices even when there is no expansion in aggregate demand. Meanwhile, in some countries with a managed floating regime, other monetary transmission channels than the exchange rate will have a relatively larger effect on real output and prices. Nevertheless, there are cases where the exchange rate has room to fluctuate, especially when there is a relatively wide band in a managed exchange rate system or if there is an imperfect substitution between domestic and foreign assets. In these cases, the exchange rate channel of monetary policy still has an influence on output and prices even with a smaller effect and longer time lag.

This section presents the study of Siswanto, et al (2001) and Astiyah (2006), on exchange rate channel of monetary transmission in Indonesia. The channel is decomposed into two blocks. The first block seeks to measure whether a monetary policy shock had a dominant influence on exchange rate movements compared to a risk factor. Dominance of the policy variable shock determines whether the monetary policy could be transmitted to inflation through the exchange rate channel. The second block is aimed at detecting the transmission of exchange rate changes to the inflation rate both directly, through price (direct pass-through effect), and indirectly, through output (indirect pass-through effect). The study is carried out using a structural vector autoregression (SVAR) approach. Variance decompositions measure the monetary policy impact on the exchange rate and inflation, and impulse response functions to analyze lag structures.

Figure 1

Exchange rate channel framework



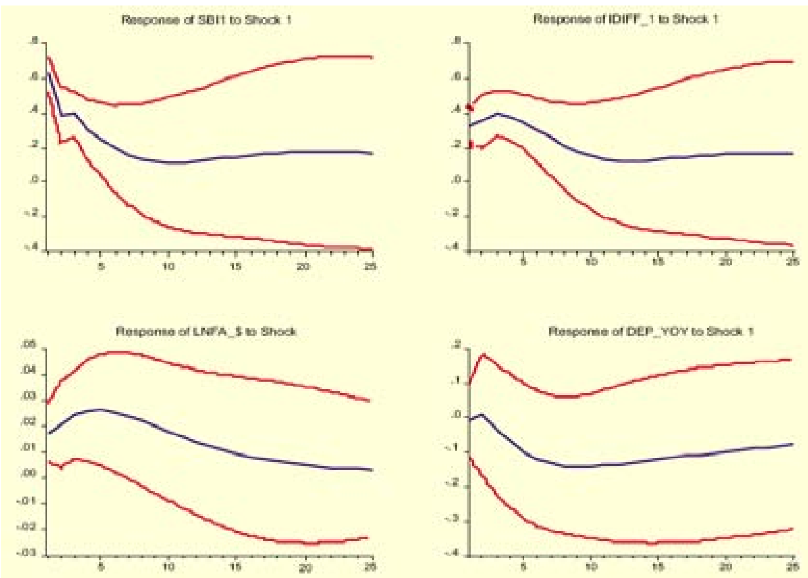
The findings from the SVAR analysis reveal that during the pre-crisis period, monetary policy transmission through the exchange rate channel was very weak. Monetary authorities' action to maintain exchange rate variability within a certain band had kept the exchange rate relatively stable and predictable. Under such conditions, the interest rate on the SBI instrument did not have a significant impact on the exchange rate, and the exchange rate was not an important determinant of inflation.

Pre-crisis period

The study on direct pass-through in this period revealed that a contraction as a monetary policy was followed by an increasing interest rate differential after two months, which then was followed by an appreciation of the exchange rate to a smaller degree. These responses were immediately followed by decreasing tradable goods prices and inflation rate and reached a peak at lag 8 before its effect diminished and faded after 25 months. The accumulated response of exchange rate and inflation rate to a BI rate shock was very small. This suggested that in the period of managed floating, economic agents found the expected depreciation easy to predict, so that the impact of the shock to inflation was relatively small.

Graph 1

Impulse response to policy rate (SBI) shock



Variance decompositions also show a very small contribution of interest rate shocks to exchange rate (less than 1%) and inflation rate variability (about 9% in 12 months). The variability of the inflation rate was influenced more significantly by tradable goods price changes. This proves that during the pre-crisis period under the managed floating system, the exchange rate channel of monetary policy transmission to the inflation rate was very weak.

Analysis of the indirect pass-through gave a similar result. The change of monetary policy through the SBI rate did not affect the exchange rate. In turn, net exports and GDP growth, as well as the inflation rate, were also not significantly affected as their accumulated response to an SBI rate shock was very small. Variance decomposition estimates also suggest a relatively weak contribution of the SBI shock to the variability of the exchange rate. In turn, the impact of an SBI rate shock to the inflation rate through aggregate demand was very weak. In the short run, an SBI shock only contributed 0.5% to the inflation rate, while in the longer run the relative contribution of an SBI rate shock increased, but only to 10%. This indicates that under a managed floating system, monetary transmission through indirect pass-through was also very weak, even weaker than through direct pass-through.

Post-crisis period and recent development

SVAR estimation of the model in the post-crisis period, and recent developments, reveal that the direct pass-through effect of the exchange rate to consumer prices is larger than the indirect pass-through. The pass-through effect of exchange rate to inflation varied from 0.05 to 0.14 (Table 1). However, the indirect pass-through effects are negative, but are lower in absolute value than the positive direct pass-through effects. As direct pass-through has a higher magnitude than indirect pass-through, a depreciation (appreciation) of the exchange rate will reduce (increase) GDP. The relatively high pass-through effect of the exchange rate on the domestic economy is related to the high import content of capital goods and raw materials in investment and production activity, as well as to the considerable amount of external debt (balance-sheet effect). Therefore, at this moment an appreciation of the exchange rate is more favorable for the Indonesian economy to boost GDP growth and to lessen inflationary pressure. Exchange rate appreciation will bring inflation down through its direct pass-through effect on production cost. In addition, the appreciation of the exchange rate could generate higher GDP growth through indirect pass-through, as the appreciation will encourage consumption and investment. Indeed, at a certain level, exchange rate appreciation would support exports of manufacturing products with high import content.

Table 1

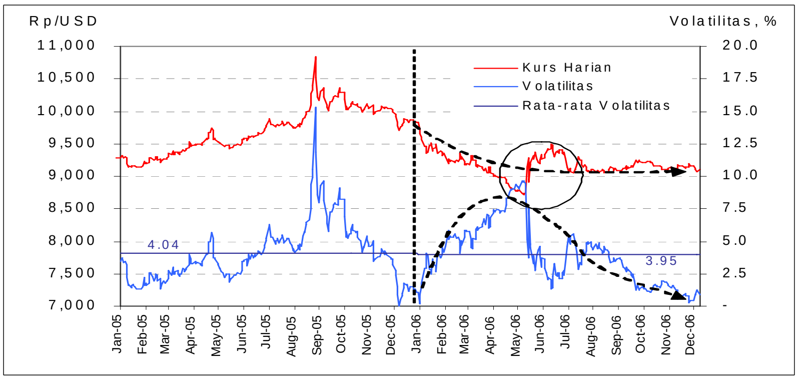
Exchange rate pass-through coefficients

No	Model	Estimation period	Pass-through coefficient		
			Direct	**Indirect**	**Total**
1.	Quarterly Small Macro (SSM)	1987:Q1–2001:Q3	0.1695	–0.0570	0.1122
2.	Quarterly Modified Small Macro (SSM-Mod)	1991:Q4–2001:Q4	0.0960	–0.0127	0.0833
3.	Quarterly Medium Scale Macro (SOFIE)	1983:Q1–2000:Q4	0.1567	–0.0186	0.1380
4.	Yearly Medium Scale Macro (MODBI)	1970–1997	0.3458	–0.2164	0.1294
5.	Quarterly Single Equation	1996:Q1–2000:Q2			0.1405
6.	Monthly Single Equation	1990:M8–2002:M7			0.0564
Average					**0.110**

More understanding of the behavior of the more flexible exchange rate regime adopted since August 1997 by economic agents has helped stabilize the exchange rate. Markets are beginning to establish a "band" to cushion the movement of rupiah exchange rate fluctuation in their daily activities. Exchange rate volatility has shown a decreasing trend for the last two years.

Graph 2

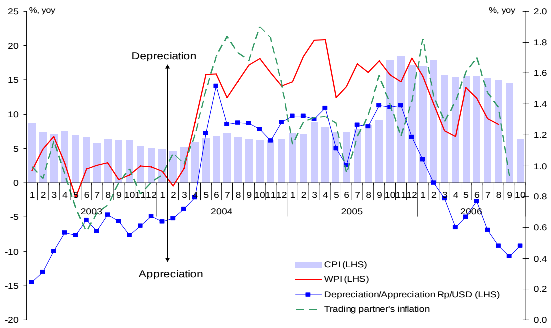
Exchange rate and volatility



Empirically, this is also seen in the discrepancy between the movements in the wholesale price index, the consumer price index, and the rupiah exchange rate (Graphs 3 and 4). Contrary to its historical data, the exchange rate movement is not transmitted as large as its coefficient estimation to the inflation rate. For example, only part of rupiah exchange rate depreciation in 2005 was transmitted to inflation. The hike in inflation was predominantly explained by the increase in domestic fuel prices and not the depreciation of the currency.

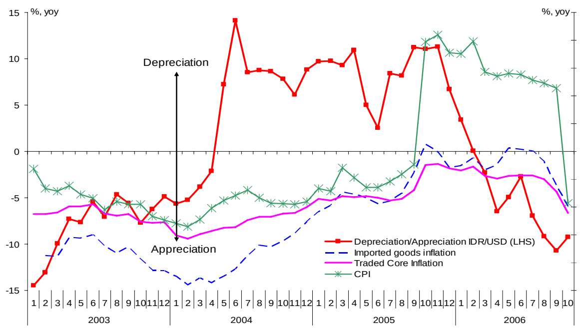
Graph 3

CPI, WPI and exchange rate



Graph 4

CPI, imported good inflation and exchange rate



Considering the impact of exchange rate movement on the price formation mechanism (inflation), Bank Indonesia has developed an exchange rate model using the Behavioral Equilibrium Exchange Rate (BEER) approach since 1999. This model focuses on the actual path of the real exchange rate and forecasts this path for one year ahead. There are five variables in this model: three long-run (fundamental) variables, namely the terms of trade (TOT), the relative price of non-traded to traded goods (TNT), and net foreign assets (NFA), and two short-run variables, namely the risk premium and the interest rate differential. All variables have a positive relationship with the real exchange rate, such that an increase in those variables will be followed by a real exchange rate appreciation and a decline in those variables will generate a real exchange rate depreciation.

Recent research on the BEER model (Budiman, Hendarsah, Nugroho, Sylviani (2002)) showed that among those variables that significantly affect the exchange rate, the risk premium had the highest coefficient. This result was different from previous research (Kurniati, Hardiyanto (1999)) which, using the same approach, found that the long-run variable, TNT, dominated the movement of the real exchange rate. As the risk premium has become an important factor in exchange rate movement, the assessment of risk premium indicators was improved by conducting a market expectations survey to form a risk composite index, thus reflecting market perception on Indonesia's country risk.

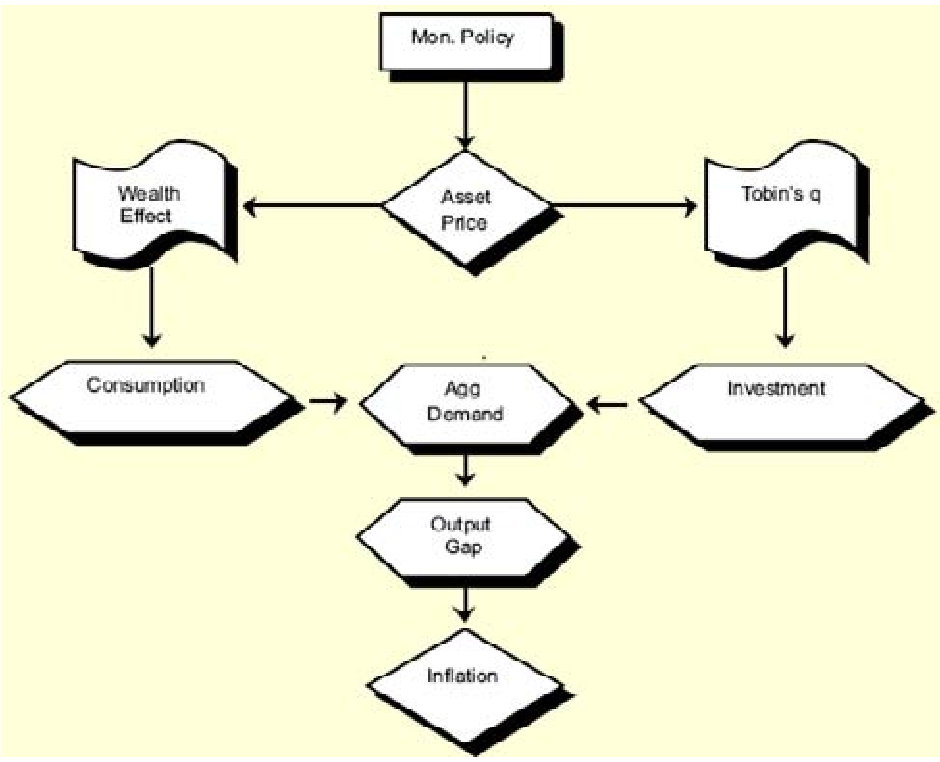
On the micro side, Bank Indonesia has developed and implemented an on-line monitoring system of foreign exchange to complement the macro model of the exchange rate. First, an International Transaction Reporting System (LLD) was developed in 2000 to improve understanding of the nature and magnitude of foreign exchange transactions involving banks, non-bank financial institutions, companies, and individuals. Second, the on-line analytical processing (OLAP) system was built in 2002 to monitor daily foreign exchange transactions in domestic market. The systems help Bank Indonesia to identify the sources of exchange rate fluctuation and take appropriate measures to avoid further fluctuations in the exchange rate.

3.3 Asset price channel

As is well known, asset price movements contain some information about future economic conditions as well as the future path of inflation. While these properties are true for some countries, they do not necessarily hold for others. Before the crisis, the role of asset prices in the transmission mechanism in Indonesia was not particularly strong or clear. In fact, there was no relationship between asset prices and the economy. Nevertheless, curiosity about the role of asset prices in monetary policy transmission mechanism continues to grow. Bank Indonesia, as the authority in conducting monetary policy, places special emphasis on this transmission mechanism and reviews it on a regular basis. Rapid changes in the economic structure after the crisis struck led to ongoing reexamination of the transmission mechanism.

Figure 2

Assets price channel



A study by Idris, et al employs VAR models with some structural restrictions. While housing or land prices would have been the best proxy for asset price data, constraints prompted the use of the Jakarta Composite Stock Price Index (JSX). For the pre-crisis period the study concludes that there is no strong evidence on the existence of the asset price channel of monetary transmission in Indonesia. For the post-crisis period up to recently, the study indicated that the asset price channel strongly transmits monetary policy through its impact on investment.

Estimate and variance decomposition of investment path

The study reveals that each parameter has the correct sign as predicted by economic theory, but is statistically not significant. The coefficient on the SBI rate in the JSX equation reflects the monetary policy impact on the JSX index. When Bank Indonesia raises the SBI rate, the deposit rate will rise and people prefer to put their money in the bank. Thus, demand for JSX as an alternative for people to hold their wealth decreases and the JSX index goes down. Moreover, it indicates the existence of a substitution effect. This result also holds for other sample periods, except for the post-crisis period. Although these coefficients are not significantly different from zero, they suggest that monetary policy affects the movement of the JSX index.

The coefficient on SBI in the investment equation for the pre- and post-crisis periods has a negative sign and is statistically significant for post-crisis. This result is consistent with economic theory. Increasing the SBI rate implies a higher cost of investment, therefore discouraging investment. On the contrary, when the policy rate is reduced, that will push activities on the stock market. Estimates of the investment equation reveal that the increase in the JSX index leads to higher investment. Our result shows that the JSX index is positively related to investment in all sample periods, as hypothesized. However, the relationship is significant in explaining the asset price channel.

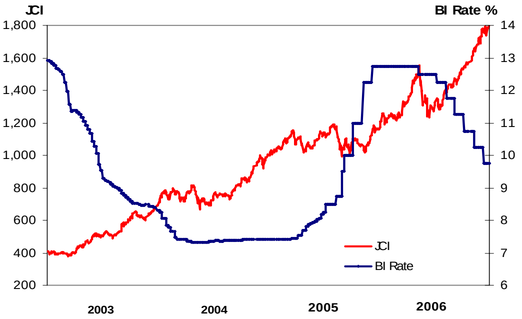
Model estimates indicate that an increase in investment will cause inflation, representing potential inflationary pressure. This phenomenon does not appear in the post-crisis period, when investment is negatively related to inflation and this is statistically significant. However, in the full sample and the pre-crisis period we find that investment could be inflationary, but it is not clear because the relationship of investment to inflation is statistically insignificant. It appears that the parameter estimates are not robust to explain the existence of the asset price channel. We put inflation variables into the JSX index equation in order to describe the phenomenon where people prefer to hold their wealth in assets at times of higher inflation, and vice versa. Higher inflation implies that it is more profitable to hold assets rather than cash or deposits.

Variance decompositions for investment, which quantify the percentage contribution of each shock to the variation in each variable, reveal that the variances are mostly determined by their own shocks. The variability of the JSX index due to a shock in SBI increases to 34% at 36 months after the shock in the pre-crisis period. Meanwhile, in the post-crisis period, the contribution of SBI drops to less than 25%. This indicates that monetary policy became less dominant in determining the variability of the JSX index in the post-crisis period. It appears that the movement of JSX is not only influenced by the policy rate but also affected by several other non-economic factors, such as global excess liquidity and political and social conditions surrounding Indonesia, which play more important roles in all activity, despite some possibilities of excluding the relevant variables from the model.

Impulse responses for the investment path to JSX only need five months for the pre-crisis period and are faster in the post-crisis period. These results suggest that monetary policy can affect the JSX index within the first five months, after which the impact starts to diminish. The impulse responses from the whole period 1 and 2 also appear to have similar results.

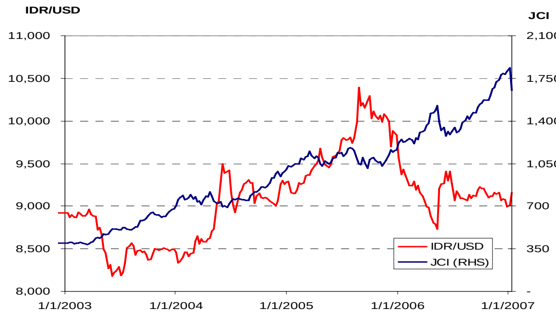
Graph 5

JSX and policy rate (BI rate)



Graph 6

JSX and IDR/USD



Source: Bloomberg

Meanwhile, investment does not respond immediately to the monetary policy shock. It takes approximately 10 months before the shock affects investment in the right direction in the pre-crisis period. A similar result appears in the post-crisis period, but with a more rapid and stronger response. It takes only five months before the monetary policy shock has its impact. Afterwards the effect is diluted. In general, this particular shock does affect investment in the right direction in all sample periods, except for the pre-crisis period.

The response of inflation to tighter monetary policy occurs with a lag. The full impact takes 15–20 months after monetary contraction. The result is in line with previous research regarding the lag of the response of inflation to monetary policy, which is between 18 and 24 months. However, the first response to the shock is to increase inflation. Thus, we can hardly say that SBI can lower inflation through this particular path.

Estimate and variance decomposition of consumption path

Estimate for consumption path. The coefficient on the SBI rate in the consumption equation has an insignificant negative sign, indicating that the contemporaneous substitution effect dominates the income effect. In other words, relatively higher returns from deposits could discourage spending for consumption. However, in the post-crisis period, the reverse result appears. During the crisis, higher consumption mainly came from windfall income resulting from increasing returns on deposits and fiscal expansion. Moreover, during the crisis period, growth was led by consumption.

The coefficient on JSX in the consumption equation indicates that an increase in the JSX index leads to higher consumption. However, the relationship is statistically insignificant. Meanwhile, the coefficient on consumption indicates that increasing consumption leads to higher inflation. This phenomenon appears in the post-crisis period, but in other sample periods the reverse is found. As stated earlier, consumption was the main engine of growth during the crisis, while investment dropped severely. The net result was a narrowing output gap, which led to an increase in general price levels.

The variance decomposition in this particular path shows that the variability of each variable is also mainly attributable to its own shock. The contribution of a shock in SBI variability in inflation is 8% in the pre-crisis period, and jumps to almost 40% after the crisis. In the pre-crisis period, the share of the SBI shock accounts for more than 40% of the variability of the JSX index. However, for other sample periods, the share of SBI shock is less than 11%. Substantial drops in the SBI contribution are due to the fact that the JSX index fluctuates almost independently from economic fundamentals. In other words, business decision-making was determined more by non-economic factors such as negative market sentiment, political upheaval, uncertainties in law enforcement, etc.

The impulse response of JSX to an SBI shock is quite similar to that resulting from the investment path. An SBI shock leads to the fall in the JSX index and reached its maximum impact within six months in the pre-crisis period. Meanwhile, in the post-crisis period, the impact of an SBI shock is not significant compared to the previous sample period. As mentioned earlier, those non-economic factors play an important role in the post-crisis period in determining the fluctuation of the JSX index. This suggests that monetary policy is less dominant in affecting the JSX index.

In the pre-crisis period, an SBI shock results in an immediate increase in consumption. But after three months, consumption starts to decrease as expected, and then the impact is fully reversed after 14 months. This pattern does not hold for other sample periods. Instead of experiencing an increase, consumption drops right after the shock and is fully reversed after approximately 25 months. More time is needed to fully reverse the impact of an SBI shock. This indicates the longer impact of monetary policy lingers in affecting the consumption pattern. Furthermore, a positive shock in monetary policy is unexpectedly followed by an increase in inflation, and fully reversed after 15 months. This pattern holds for all sample periods. It reflects once again that monetary policy cannot influence inflation as theory suggested.

Evidence from survey

The Household Assets Survey shows that over 33% of respondents choose bank deposits as their first priority to place their funds. Bank deposits are regarded as the most liquid asset, yet still provide quite attractive returns. Other investment alternatives are in land and housing; 29% and 28% of respondents respectively choose those assets as their first priority. Despite being not as liquid, housing and land have a long history of being a safe haven for long-term investment. On the other hand, only 1% of household respondents place their funds in stock as their first priority.

In line with this result, should respondents have additional funds, the order of preference is similar, except for those of land and housing. Bank deposits are preferred by 38% of respondents, while 36% and 18% of respondents chose housing and land respectively. Meanwhile, stocks are chosen as the prime priority only by 3% of respondents. This evidence fortifies our empirical results that stocks are not a good proxy for household wealth in Indonesia.

According to the survey, the majority of respondents (83%) are not responsive to a decrease in bank deposit rates. Over 80% of respondents will not withdraw their deposits unless the deposit rate decreases substantially. Furthermore, 60% of respondents will not withdraw their deposit even if the interest rate falls to 10%. We suspect this occurs because the majority of respondents spend a total of Rp 1 million to Rp 3 million each month. Consequently, they are relatively insensitive to changes in bank deposit rates. With regard to alternatives for fund placement, the survey suggests that over 37% of respondents place their withdrawn money in investment goods, 24% prefer to hold cash, and 18% prefer to buy foreign exchange. In contrast, only 10% of respondents use the withdrawn money for consumption purposes. Out of the 37% respondents that place their money in investment goods, 51% invest in land, 26% in housing, and only 7% in stocks.

Decreasing interest rates on bank deposits lower the cost return from deposits compared to other assets. Thus, the majority of respondents react by looking for investment alternatives with higher returns. The figure below identifies that land is the preferred alternative for respondents to hold their assets. This to some extent reflects the existence of a substitution effect. Meanwhile, if the deposit rate increases, 74% of respondents increase the amount of money in bank deposits, while 8% counter by enhancing their investments, and only 6% respond by reducing their purchases of investment goods.

The majority of respondents (72%) will also put the income generated from an increase in the deposit rate into bank deposits. 15% of respondents use their income for consumption purposes, and only 8% utilize their additional income to purchase land and housing. This shows that the income effect does not exist in this particular sample group. Furthermore, respondents need a substantial increase in the bank deposit rate before they place additional funds. Almost 80% of respondents require an increase in the deposit rate of more than 4%. All of these findings imply that households do not respond much to a change in the bank deposit rate. Should they withdraw their funds, they put their money in traditional investment alternatives, ie land and housing.

3.4 Interest rate channel

The monetary transmission mechanism through the interest rate channel starts from a change in the short-term interest rate, which will then be transmitted to all medium- and long-term interest rates through the balancing mechanism of supply and demand in financial markets. The change in the short-term nominal interest rate set by the central bank can induce changes in real short- and long-term interest rates. If prices are sticky, an expansionary monetary policy will drive down the short-term real interest rate. Subsequently, with the expectations hypothesis of term structure, which states that long-run real interest rate is the average of expectations of future short-term interest rates, the lower short-term real interest rate will cause a decrease in the long-term real interest rate. All these movements are expected to influence price variables in the financial market, real sector variables, and finally, inflation.

Kusmiarso, et al (2001) and Astiyah (2005) conducted analyses to see how the cost of capital, substitution effects, and income effects transmit the change in interest rate as a result of monetary policy. The relationship of the policy rate and real sector variables is investigated using the Granger test and VAR analysis. Furthermore, to have a deeper understanding of bank behavior in responding to the policy rate, several structural equations are also introduced, involving several micro factors on banks, ie the inter-bank overnight rate, deposit rate, and credit rate.

Pre-crisis period

Empirical evidence from the VAR analysis reveals that before the crisis, the real deposit rate and real investment credit rate were strongly influenced by the inter-bank rate. Investment growth, however, was influenced more by the high access to foreign borrowing than the real investment credit rate. Similarly, consumption growth was not significantly affected by changes in the real deposit rate, as the real deposit rate was relatively stable and low.

The structural models provide further evidence on the behavior of bank interest rates, especially the inter-bank rate, time deposit rate, and working capital credit rate. For the interbank interest rate, the central bank certificate (SBI) rate and bank liquidity have been the dominant factors in both the pre- and post-crisis periods, with a stronger impact by the SBI rate in the post-crisis period. Bank liquidity becomes relevant in determining the inter-bank interest rate for private national foreign exchange banks, private national non-foreign exchange banks, and regional development banks. However, liquidity is not a significant factor for state-owned banks, nor for foreign and joint-venture banks, as they have more access to funding.

The study reveals that the impact of the policy rate was faster in influencing the loan rate (within three months) than the deposit rate (within six months). The behavior is related to the fact that deposit rate represents banks' cost while the loan rate represents banks' revenue. The response and its direction of each variable in the VAR system show that during the pre-crisis period, the cost of capital worked well in transmitting monetary policy using the interest rate. This is explainable as during that period the banking and real sectors were still in normal circumstances, hence they could give proportional responses to the central bank monetary policy.

The real investment loan rate was also responsive during the pre-crisis period as the economy was booming and more funds were needed by the business sector. The weaker responses of the real investment loan rate after the crisis were caused by the negative return as inflation jumped to a much higher level, and banks' concerns about debtor default. Those factors make the non-price factors become stronger in influencing bank lending.

Post-crisis period

After the crisis, the real deposit rate and real investment credit rate response to the inter-bank rate was weaker as compared to the pre-crisis period. The increase of the inter-bank rate following the monetary shock was followed by an increase in the one-month deposit real interest rate with a smaller magnitude until the second month. Meanwhile, the increase of the inter-bank rate was initially followed by a negative growth of consumption for the same period. The real investment credit rate, however, does not correspond proportionately to changes in the real deposit rate because of banks' concern that a higher interest rate will lead to higher debtor default and non-performing loans. Investment growth has been significantly influenced by the real investment credit rate. Likewise, consumption growth has been significantly driven by the real deposit rate.

The real sector has responded significantly to the banking interest rate after the crisis period. Investment growth has responded more strongly as compared to the pre-crisis period to the real investment loan rate because investors have limited access to other sources of financing from domestic financing, ie credit from banks, from offshore borrowing and from other sources such as high-risk paper. The negative return leads to banking sector reluctance to disburse new credit. The existing credit is disbursed on the basis of long-term relationships, because after the crisis most sectors bear higher risk. Meanwhile, in the pre-crisis period, investors had high access to offshore borrowing. Consequently, investment growth was weakly influenced by the change in the real investment loan rate.

Consumption growth has been influenced significantly by changes in the inter-bank interest rate in the post-crisis period. The increase of the inter-bank interest rate was initially followed by negative growth in consumption, showing the presence of a substitution effect. However, when the deposit real rate started to decrease, household consumption also decreased with a lag indicating the presence of income effects.

The inter-bank rate, liquidity and its lag determine the time deposit rate. The time deposit rate responds to movement of the inter-bank rate, with the role of the inter-bank rate increasing after the crisis. Since the crisis, banks have been relatively liquid. The loan to deposit ratio (a proxy for liquidity) does not significantly influence the deposit rate, as all groups of banks are unwilling to lend money.

The time deposit rate and the liquidity condition are two determinants of bank behavior in determining the working capital credit rate. Liquidity has become a relevant factor for the loan rate in the post-crisis period as banks have limited access to funding. For non-foreign exchange domestic private banks, however, liquidity has been significant in all periods, because of their limited access to foreign funds and their relatively small asset size. On the other hand, liquidity never becomes a problem for foreign and joint-venture banks in determination of the loan rate as they have perfect capital mobility.

Evidence from survey

A survey of banks, households, and companies was conducted to investigate the response of the banking and real sectors to changes in the interest rate. The findings confirmed the preceding results. In particular, during the post-crisis period a change in the policy rate is transmitted to various retail-banking rates and to the real sector. The loan rate is determined by the deposit rate, borrowers' risk and the SBI rate. There is a significant bank response to substantial changes in policy rates. When SBI rate declines, banks reduce their deposit rates and portfolio holdings of SBI, and then increase their loan portfolios especially for working capital loans. In addition, banks tend to raise their loan rates and reduce their loan portfolios in the case of tight liquidity or a significant increase in the SBI rate.

The survey also reveals that the household decision to save is influenced by the interest rate. However, slightly different from the empirical finding, households maintain their saving rate even if there is a decline in the deposit interest rate, because of the presence of a government guarantee scheme on deposits. Similarly, households maintain their saving rate when the interest rate rises as they prefer to add to their deposit instead of spending for consumption. Finally, a firm level survey confirms the empirical finding that the growth of investment is not strongly related to movements in the credit rate. In the event of a rising policy rate, most companies choose to place their funds into their deposits with banks and reduce their loan demand. This is explicable by the fact that most respondents will turn to own funds for financing their business activities while others postpone their plans for expansion. The response becomes more pronounced if companies perceive that business prospects have become bleak and unprofitable.

3.5 Bank lending channel

There is widespread agreement among economists that banks or financial intermediaries have generally played an important role in transmitting monetary policy to the real economy. But the precise role of banks is still debated. In the standard view, known as the money or interest rate channel, banks play a special role on the liabilities side, ie, the banking system creates money (liquidity) by issuing deposits and plays no role on the assets side. In a monetary contraction, bank reserves decrease and, due to reserve requirements, the ability of banks to issue deposits is constrained. As a result, depositors hold less money (bank deposits) in their portfolios. If prices are sticky, real money balances will fall and both short-term and (through expectation effects) long-term interest rates will rise. Accordingly, demand for loans, investments and interest-sensitive spending such as housing all fall. So, three crucial conditions that must be satisfied for the existence of a money channel are: (1) prices must be sticky so that monetary policy can affect real money balances; (2) short-term interest rates must influence long-term interest rates; and (3) long-term interest rates must influence real investment expenditure.

The study utilizes a battery of tests to analyze the bank lending channel. It employs a vector autoregression VAR approach using aggregate and disaggregated data to see the effects of monetary policy on bank balance sheets. With disaggregated data, hypotheses underlying the bank lending channel can be analyzed. Complementary to the VAR analysis, long-run demands and supply equations of the Indonesian credit market are estimated, derived from a vector error correction model (VECM) in order to identify whether adjustment towards equilibrium in the credit market is dominated by supply, as suggested by the lending channel.

Overall, the study provides a comprehensive investigation on the existence of the bank lending channel of monetary transmission in Indonesia before and after the crisis. Given the existence of “bank dependent borrowers” as the secondary condition of the bank lending channel clearly satisfied, the study particularly focuses on the first condition for existence of the bank lending channel; that is, whether monetary policy affects the quantity of bank lending.

According to the “bank lending” (Bernanke and Blinder (1988)) monetary transmission mechanism, banks’ assets as well as their liabilities play an important role. In a monetary contraction, banks’ reserves decrease and given reserve requirements, their deposits fall. If the decrease in deposits is not offset by other funds which are not subject to reserve requirements, or by a decrease in securities, this will result in a decrease in bank loans. If bank loans fall and bank dependent borrowers are dominant in the economy, real investment expenditure will diminish. Since bank loans in many countries, especially developing countries, remain the main source of external finance for business enterprises, a disruption of bank loan supply can reduce economic activity. The necessary conditions for the existence of this channel are: (1) the central bank must be able to constrain the supply of bank loans; and (2) bank loans and securities must be imperfect substitutes for some borrowers.

Agung (1998) uses the money market interest rate (interbank money market) as the monetary policy variable by arguing that Bank Indonesia often indirectly targets interbank interest rates. An alternative is the SBI rates which have been widely used as the benchmark by the market, in particular since banks' holdings of SBIs increased dramatically. The problem with using the SBI rates is that the auction system has been changed three times. Before 1993, Bank Indonesia targeted the quantity of SBIs in the auction (cut-off rate), but since 1993 the system was changed to the stop-out rate, in which the monetary authority sets the interest rates on SBIs and the market determines the quantity of SBIs. The stop-out rate system was changed again into the cutoff rate in 1998. In practice, however, a mix of price and quantity targets has been frequently executed. Another alternative is base money, which has formally been used by Bank Indonesia as the operating target since 1998.

Pre-crisis period

Before the crisis, bank lending was almost not affected by tight monetary policy. This result is consistent with findings by Agung (1998) who also uses pre-crisis data. One reasonable explanation of the low sensitivity of lending to a monetary shock is that before the crisis, especially since the beginning of the 1990s, the access of domestic commercial banks to international sources of funds was relatively easy. Hence, in spite of tight money, banks could still provide loans to their borrowers. A survey conducted by Hadad (1996) also found a similar phenomenon. During the tight money period (eg in the aftermath of the so-called Gebrakan Sumarlin), the loan growth of state banks and large private banks was higher than their deposit growth. In fact, domestic banks were major issuers of bonds in international markets during the period. Large banks obviously have better credit ratings than smaller ones and are thus able to raise funds less expensively. This differential behavior of state and private banks is clearly reflected in the fact that loans of state banks are completely insensitive to a monetary shock, while those of private banks are more sensitive.

Post-crisis period

The relatively high sensitivity of commercial bank lending for the whole sample is partly influenced by the behavior of bank lending during and after the crisis. Given the weakening of firms' balance sheets amidst low economic prospects, a monetary tightening worsens firms' financial position and raises the probability of default, and hence reduces the willingness of banks to lend. This is consistent with a recent study by Agung et al (2001), who found the existence of "credit crunch" in the aftermath of the crisis. Under such circumstances, they argue, tight money exacerbates the unwillingness of banks to lend. This is also confirmed by a study on the balance sheet channel that concludes that there is a financial accelerator effect of monetary policy, especially after the crisis. Similar impulse responses are obtained if we use the PUAB rate as the policy variable, although the effect of a change in the SBI rate seems to be more pronounced than a change in the PUAB rate.

The lag of bank lending to a shock can be attributed to the fact that bank loans (especially investment loans) are mostly supplied on a loan commitment basis, instead of on a project or fixed-term basis. Under such a commitment, banks allow borrowers to draw down a line of credit at their discretion, and borrowers pay a fee for the credit line and pay interest on the actual loans that have been drawn. As a result of this system, banks cannot prevent borrowers from drawing credit even when monetary conditions are tightened. Banks can only reduce the supply of new loans, which presumably does not immediately lead to a substantial fall in aggregate lending.

A disaggregation of total bank loans into corporate lending and individual (household) lending, however, suggests that the insignificant response of aggregate lending stems from the loans to firms. By contrast, loans for individuals drop significantly in the aftermath of a monetary shock. This may be explained by the so-called “flight to quality” phenomenon. That is, in a monetary contraction, to compensate for the decline in cash flow, creditworthy borrowers have access to short-term loans, while loans to less creditworthy borrowers such as individuals or small firms will be rationed.

Evidence from survey

This section presents an analysis based on a survey of banks and firms. The survey is designed to generate answers to some important questions on the behavior of banks and firms in the aftermath of a monetary crisis. From the banking survey, the main issue examined is whether banks reduce their loan supply after a monetary crisis, as expected by the bank lending channel hypothesis. How do they reduce loan supply, by price or non-price mechanisms? If they reduce their loan supply with a lag, how do they maintain their funding? From the firm survey, the issues examined are: what are sources of funds, and what is the sensitivity of demand for bank lending after a monetary tightening? Are they rationed during tight money periods?

As outlined previously, the existence of the bank lending channel of monetary transmission depends on whether bank lending is a dominant source of external funds. The survey indicates that in conducting their business activities, firms use internal funds as the main source of financing (60.71%). Meanwhile, bank credit is still the main source of external funds. About 20.71% of firms use bank credit as the main source of funds. As found in many studies using pre-crisis data, banks are the main source of funds for at least 40% of firms’ financing.

Firms using internal funds as the main source of financing rely mainly on head/business group (46%) and retained earnings (44%). The income from deposit interest and foreign exchange profits are only around 4%. Referring to the credit crunch survey, the main reasons for using internal funds are the relatively high loan rate, underutilization of their own capital, tightness of credit procedures, and the existence of bank credit rationing.

Firms using bank loans as a main source of financing come from the manufacturing sector (37.9% share). Trade and property/construction each have about 20.7%, while the agriculture sector has only 13.8%. Classified according to business scale, the respective shares of bank financing are: large firms 55.2%, medium firms 41.4% and small firms only 3.4%. The agriculture sector and small scale businesses experience difficulty obtaining bank credit. Obstacles to obtaining bank credit are tightness of collateral condition, declining cash flow, and credit rationing.

Lending behavior after a monetary shock: The existence of the bank lending channel is determined by whether or not monetary policy influences loan supply. The survey indicates that in the case of tight money, the majority of banks (77%) will reduce their loan supply. As indicated by the quantitative study, foreign and joint-venture banks are less influenced by tight money than their domestic counterparts. The survey suggests that 50% of foreign and joint-venture banks will reduce their loans in the aftermath of tight money policy. Meanwhile, all private non-foreign exchange banks and regional banks reduce their loan supply. This supports previous empirical findings (eg Agung (1998)) that small banks’ reliance on deposits as the source of funds makes their lending more sensitive to a monetary tightening. By contrast, foreign banks and larger banks such as state banks and private foreign exchange banks that have access to non-deposit funds (eg foreign funds) are able to shield their lending supply from the shock. Furthermore, the banks’ holdings of securities enable them to protect their lending, at least in the short run.

In the case of monetary tightening reflected in an increase in the SBI rate, banks reduce bank lending supply either by price mechanisms, through increasing the loan rate or tightening credit conditions, and non-price mechanisms, through reducing new loans. The majority of banks (71%) raise the loan rate in the aftermath of tight money and around 21.4% of banks reduce the loan supply. A more interesting result is that private and regional banks reduce lending by rationing credit rather than by raising the loan interest rate. Meanwhile, state banks and foreign banks raise the interest rate in order to reduce loans. A similar result is found in the case of monetary easing (a fall in the SBI rate); that is, around 72% of banks reduce loan rates and around 20% raise the loan supply.

3.6 Expectations channel

As one of the channels in the monetary transmission mechanism, expected inflation plays a crucial role in increasing market appreciation of current and future inflation. Expected inflation has been developed in line with the dynamics of the economy and the availability of information. Monetary policy and economic development can influence the formation of expected inflation, which in turn will affect the behavior of economic agents. Theoretically, the change in behavior will be reflected in investment and consumption decisions and thus will influence change in aggregate demand and inflation, as well as price and wage setting.

Considering that an economic crisis has changed inflation expectation behavior in Indonesia, another study (Wuryandani, et al (2001)) focuses its studies on the period after the crisis. Problems in data availability pose challenges in identifying the appropriate expected inflation proxy. Several candidates for measuring inflation expectations are tested; they include the inflation assumption in the government budget, VAR estimation through the Fisher equation, OLS and interpolated expected inflation from the business survey (SKDU) data. By using some statistical methods such as correlation and Granger causality, the test of those candidates showed that the business survey (SKDU) data is the best proxy for expected inflation despite its limitations as interpolated data.

A correlation test between inflation and each candidate showed the following results: both SKDU and the Fisher theory showed a 92% correlation; on the other hand SEK, OLS, and fiscal assumptions showed lower correlations (47%, 46% and 24%, respectively). Using five months lag, Granger causality tests indicated that SKDU and the Fisher theory have a reciprocal relationship with inflation. Granger causality tests also revealed that there is no relationship between SEK and inflation. This might be due to the limited SEK time series data. Moreover, fiscal assumptions and the OLS estimation do not lead inflation at all. On the contrary, inflation leads both the fiscal assumption and OLS.

With the exception of SEK data, an OLS test for each candidate series exhibit indicates that using those variables sufficiently explains the inflation movement which is shown by a 99% R-squared value of each variable. Based on the tests above, interpolated SKDU is the best proxy of expected inflation.

The VAR analysis in the study concludes that in general there is monetary transmission through the expected inflation channel. The expected inflation itself is mainly determined by the exchange rate, past inflation (inertia), and the interest rate. The result confirms that expected inflation plays a role in inflation formation. However, it is not as strong as other variables such as inertia (past inflation). The significant effect of past inflation indicates that monetary authority credibility is a very important factor. People observe the credibility of the central bank and form expectations based on what they have learned. In turn, the credibility of the central bank will determine the effectiveness of inflation targeting.

The analysis of impulse responses shows that a change in monetary policy will have a similar effect on inflation expectations and inflation. Meanwhile, the SBI rate’s strongest influence on expected inflation is immediate, and stabilizes in the 24th period. This indicates that the SBI is seen as a signal of monetary policy by the market. The effect of the SBI on inflation begins in the 15th period, which implies that there is a time lag of monetary policy. Generally, the effect of monetary policy on inflation is stable after the 33rd period.

According to the outcome of accumulated impulse responses, the initial response of expected inflation to an SBI shock is significant. Meanwhile, the accumulated response of expected inflation on inertia is more significant than on the SBI. This result reveals that the market is still backward-looking in forming expected inflation. The accumulated impulse response of the SBI shock is highly significant in the 12th period. However, the response of inertia is more significant than the SBI shock over the same time horizon. The lag structure response shows that the maximum effect of SBI and inertia on expected inflation formation is relatively direct for four periods. The maximum effects of SBI and inertia on inflation have a 22 period and 18 period time lag respectively. The impulse response analysis supports the variance decomposition results.

Evidence from survey

The survey also shows that expected inflation and inflation formation are determined predominantly by the exchange rate, past inflation (inertia), and the interest rate. Nonetheless, the market response to those factors is not always symmetric. There is a downward rigidity in firms' price setting, regardless of depreciation or appreciation in the exchange rate. On the contrary, households react asymmetrically to exchange rate movements. An interesting result from the survey is that the market expects inflation to increase as the interest rate increases. The explanation for this result is that the market learned in 1998 that when the interest rate increased, inflation also increased; the opposite occurred in 1999. In this case, the market did not take into account the time lag of monetary policy. In projecting future inflation, the market uses past inflation as benchmark.

4. Conclusion

The financial crisis of 1997 brought about significant changes in the Indonesian economy, including the monetary policy transmission mechanism. Before the crisis, the Indonesian economy was in a "boom" period with ample foreign capital flows. Under these circumstances, the interest rate channel worked quite well in transmitting monetary policy into the deposit and lending rates. Nevertheless, its effectiveness in influencing the real economy was inhibited by the fact that both consumption and investment were not responsive to changes in interest rates because of the booming economy and ample foreign funds. This is confirmed by the finding that did not affect bank lending prior to the crisis due to banks' ability to access funds from international sources. In the meantime, the exchange rate channel was not very relevant before the crisis since the underlying exchange rate system was managed floating. As such, exchange rate movement was stable within the band with quite a predictable rate of depreciation, and thus did not induce significant pass-through effects to the real economy and prices.

After the crisis, however, the economy and financial system have undergone structural changes and the country has moved to a floating exchange rate system. This undoubtedly has fundamental implications for the functioning of the monetary transmission mechanism. Exchange rate movements become more pronounced in affecting the real economy and prices, while the effectiveness of monetary policy to influence the exchange rate has been undermined by the fact that exchange rate movements have been driven more by non-economic factors. Likewise, expectations have become more important in affecting inflation, but the behavior of inflation expectations has been driven mostly by price inertia and the exchange rate. The interest rate channel still works quite well in transmitting monetary policy, even though its magnitude has been affected by conditions in the banking system and overall higher uncertainty and risk factors. The finding is also confirmed from the bank lending channel, in that aggregate data show a monetary shock is able to affect bank lending with a lag due to the ability of banks to insulate the decrease in deposits by liquidating their securities holdings. Furthermore, empirical findings from disaggregated data indicate that bank lending is more sensitive to monetary shocks for private domestic banks, banks with low capital, and for individual lending.

Appendix 1:
Summary of transmission mechanism in Indonesia

Channel	Before crisis			Crisis 1997/1998 - 1999/2000	After crisis 2000:01 - 2005:03
	SBI/PUAB-channel	Channel - inflation	Total effect		
	Especially exchange rate and interest rate channels			Especially assets price, credit and balance sheet channel	Especially Exchange rate, asset price, interest rate and credit
Exchange rate			**Present but not strong**	Strong via direct pt	**The strongest channel for monetary transmission to core inflation, via direct pass-through**
- direct pt	Present	Present	8% variation inflation explained by rSBI after 25 months and around 42% each explained by exchange rate and tradable prices.	No comprehensive test 55% variation inflation explained by rSBI after 15 months	Present 59% variation in inflation explained by shock to SBI after 1 year
- Indirect pt	Present	Present	2% variation inflation explained by rSBI after 25 buland, 47% explained by itself and 35% by exchange rate	Not consistent with hypothesis	Not functioning well
Asset price	Present	Result not consistent: investment rises in response to SBI shock (others variables expected by hypothesis)	Not functioning well.	**Start functioning via investment channel (data 1996-2003)**	**The strongest channel for monetary transmission channel to headline (CPI) inflation, especially via investment channel** 43% variability of inflation explained by shock to SBI, 21% explained by deposit rate, and 17% by investment growth.
Interest rate			**Occurred but not strong**	Not functioning well	**Functioning well especially via cost of capital channel**
- cost of capital	Present through investment growth	No test in both investment deflator and CPI deflator	2.9% investment growth explained by rPUAB after 1 year, 83% explained by itself	Result not consistent as rPUAB increased, rKI declined so the investment growth also decreased 19% variation investment deflator explained by rPUAB, 41% explained by itself, 26% by investment growth	Occurring (functioning well) 60% variability of inflation can be explained by shock to SBI after 1 year
- subst / income	Present	Present through consumption deflator	1.6% consumption deflator explained by rPUAB after 1 year, 91% explained by itself.	Result not consistent: when rPUAB increases, rDEP decreases followed by positive consumption growth after 1 month 38% variation on consumption growth explained by rPUAB, 52% explained by itself	Occurring (functioning) well 54% variability of inflation explained by shock on SBI after 1 year
Balance sheet	Worsening debt/cap dan shortdebt/totdebt, precisely increase investment		Not effective	**Stronger, possibly due to extreme monetary contraction and high rupiah exchange rate depreciation.**	
Credit	Response of credit volume to SBI shock is low	Not present	Not effective		Present 41% inflation variability explained by shock SBI after 1 year.
Expectation	No test due to lack of data			Not effective Still backward looking (adaptive), 72% influence by the variable itself	

Appendix 2:
Impulse response function of inflation to shocks from policy rate (SBI) in the baseline model and in the models with each channel of transmission

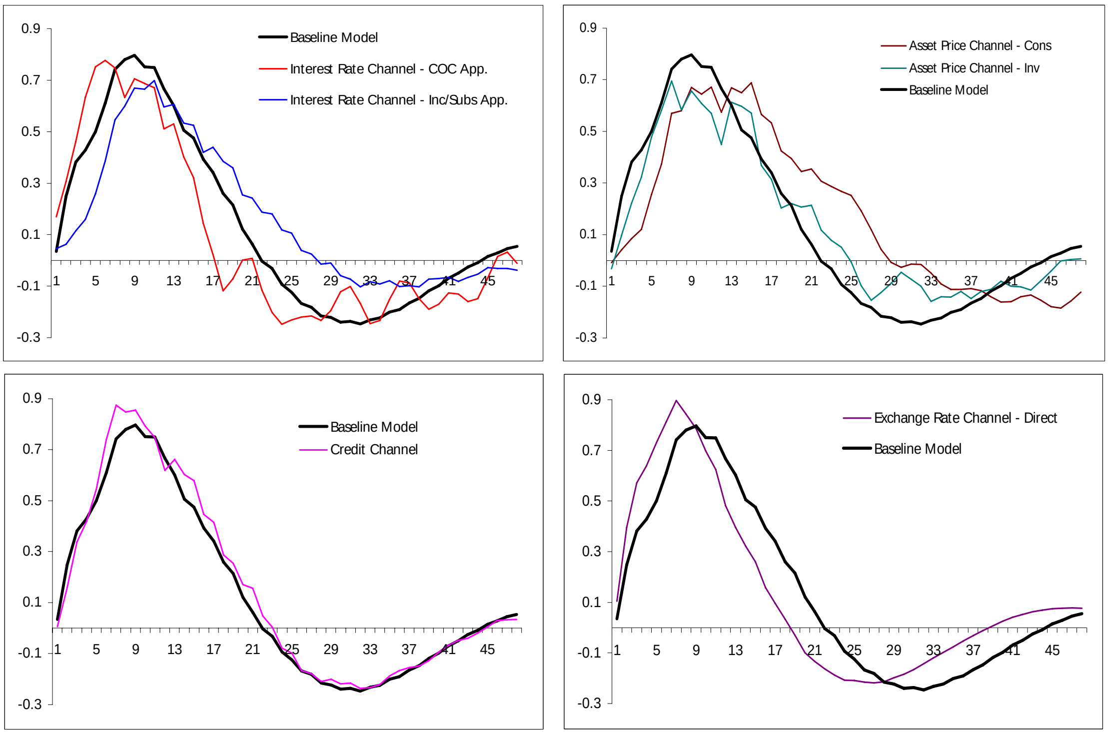


Table A1

Correlation between the impulse response function of the baseline model and each channel of transmission

	IR_Baseline Model
IR_Baseline model	1.000000
IR_Credit	0.926666
IR_Asset Price Inv	0.960693
IR_Asset Price Cons	0.803701
IR_Exchange rate	0.907771
IR_Interest Rate Inv	0.927826
IR_Interest Rate Cons	0.914049

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Exchange rate pass-through implications for monetary policy: the Israeli case

Zvi Eckstein and Yoav Soffer[1]

1. Introduction

The pass-through from the exchange rate to domestic prices is a key factor for monetary policymaking in Israel. In an inflation-targeting regime, the policy instrument is the interest rate, and the exchange rate is flexible without any intervention by the central bank. This has been the case in Israel since 1997. In this regime, movements in the exchange rate pass through to local prices via several channels. In Israel, apart from the effect of the exchange rate on the prices of tradables, there is a significant effect on the prices of non-tradables. This is mainly observed for housing prices that are set in US dollars, due to an indexation mechanism which began during the high inflation era (1978–1985). In this paper we provide recent evidence on the sources and extent of exchange rate pass-through to the CPI. Then we discuss the implications of these observations on monetary policy and the potential intervention policy in housing contracts.

From March to September 2006, the new Israeli shekel (NIS) appreciated against the US dollar by 7.5% (Figure 1). The CPI stayed almost constant between April and August 2006, rising by only 0.2% during these four months. In September, as the shekel/dollar rate reached an 18-month trough, the CPI decreased by 0.9% as compared to August, and the lower limit of the multi-year inflation target (1%–3%) is now in peril, as year-to-year inflation reached as low as 1.3%. In October appreciation of the shekel continued, and on certain days of the month the exchange rate was at its lowest recorded level in almost six years.

Figure 1

Monthly changes in the shekel/dollar exchange rate and the CPI, 2002:1–2006:9

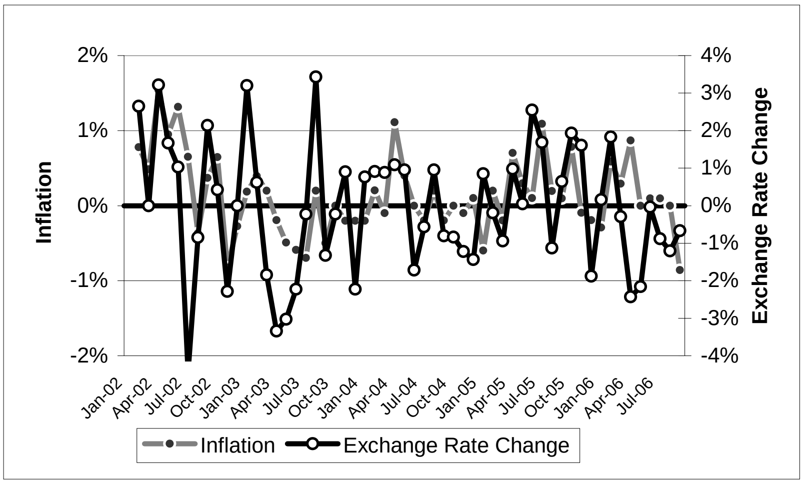

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Figure 1 clearly presents the very high correlation (0.43) between exchange rate changes and inflation. The correlation is not the same throughout the entire period: it is higher, for example, between 2002 and 2004, and lower during 2005 and 2006. Among several factors that have contributed to the recent decrease in the CPI, the exchange rate was the most important factor, just as it was on other recent occasions in which the Bank of Israel missed its inflation targets, such as in December 2002 (6.5% annual inflation) and December 2003 (–1.9% annual inflation). For a small open economy which relies heavily on imported goods and raw materials, changes in the price of foreign goods in domestic terms stemming from changes in the exchange rate can hardly be overlooked. However, it seems as if the role of the exchange rate in Israel exceeds this dimension. During years of high inflation, and especially during the decade of hyperinflation (which ended in 1985), the US dollar partially replaced the domestic currency as a unit of account and a store of value; widespread indexation to the exchange rate was exercised in many sectors of the economy. Since stabilization, some of these indexation habits have not yet disappeared, and they have a significant effect on the pass-through from the exchange rate to local prices. The exchange rate is therefore one of the main variables which the monetary policymaker needs to follow; moreover, it is also very closely monitored by the public. The shekel-dollar and shekel-euro rate are reported in almost every news broadcast, usually even before the weather forecast.

This paper presents the facts and implications of exchange rate pass-through in Israel, and then discusses the implications for the practical aspects of conducting monetary policy to reach price stability using the nominal interest rate. In the next section we present the main theoretical background for the pass-through phenomenon and an international comparison of empirical pass-through coefficients. In section 3 we briefly review Israel's monetary history in order to give the reader a background for understanding how pass-through has developed in Israel and what its implications are. The main fact is that during the first half of the 1980's, high inflation encouraged the indexation of housing contracts to the US dollar. This contractual practice has continued until today, although inflation for almost the past eight years has been very close to that of the US. We document the implication of this indexation practice based on findings from a recent study by Soffer (2006) who estimated the pass-through for disaggregate product data. The main findings are that pass-through of tradable goods is lower than that of several non-tradable goods and services. On average the pass-through is about 30%, not too different from that of many other small economies. However, for housing prices the pass-through is 70%.

In section 5 we address several issues related to the consequences of the observed pass-through for monetary policy, for monetary policymakers, and for the public. In the standard model, exchange rate changes affect the prices of tradable goods, and this is the main channel for affecting the relative price of tradable to non-tradable goods (real exchange rate). This is an efficient economic allocation of resources. However, when changes in the exchange rate have a significant effect on the price of (non-tradable) housing, the impact on resource allocation might be inefficient.

The high exchange rate volatility and the excessive impact of exchange rate changes on inflation have often caused annual inflation to deviate from the target range. As a result, it might be that the monetary policy that set the interest rate had to react too frequently to exogenous shocks. However, this phenomenon of fast pass-through from exchange rate changes to inflation enables monetary policy to bring inflation more quickly within the target rate.

2. Theoretical background and international comparison

The main theoretical basis for the existence of exchange rate pass-through is the law of one price (LOOP) and purchasing power parity (PPP). An exchange rate change which is not followed by a local currency change in the price of goods would be regarded as divergence from the LOOP. Demand and supply mechanisms are expected to bring about the necessary change in local prices in order to bring foreign and domestic prices back to the same level. According to this assumption, exchange rate pass-through should be complete, and might be close to 100% in the very long run. However, this is far from being the observed pass-through in most countries.

Driver and Westaway (2004) list several reasons for the fact that the LOOP and PPP are not actually observed. Some of the reasons they mention are relevant for discussing the extent of short-run and long-run pass-through. First of all, even if the LOOP does hold, it should hold only for tradable goods, and even for these products there is a significant component of locally sold services. Non-tradable goods and services account for 61%[2] of consumption in Israel. This is a good reason for incomplete pass-through to be recorded in Israel. To be sure, some of these non-tradable services are provided using a high proportion of imported inputs: electricity, public transportation, and other services could serve as examples. However, of this 61%, 22% consist of housing services, which will be discussed later. In general, the standard model based on the Ballassa-Samuelson hypothesis would show that a change in the exchange rate which results from a productivity shock would not pass through to the price of non-tradables, and thus would result in a change in the real exchange rate. An exchange rate change which results from a nominal shock due to monetary policy action would in the long run pass through to the prices of both sectors.

The LOOP may also not hold due to differences in taxation policy across countries, as well as trade barriers and transportation costs. An excise tax included in the price of fuel which is fixed in shekel terms, for example, reduces pass-through from the exchange rate and from the world price of fuel to the consumer price in Israel. As to trade barriers, in the extreme they could make any good non-tradable, thus once again driving a wedge between local and foreign prices.

Another reason we might not observe the LOOP in reality has to do with the degree of competitiveness of different markets. If firms have some monopolistic power, they could “price to market”, and that could result in different prices in each market. A well known theoretical and empirical application of this exists in equilibrium search models where the search friction provides some degree of rents for both sides of the market. As a result there exists an equilibrium price distribution for homogeneous products. In these markets the level of deviation from the LOOP might also depend on the macroeconomic conditions. For example, during a recession firms might have to reduce their markups, and thus the change in the price to the consumer might not be of the same magnitude as the change in the exchange rate.

As noted above, 100% pass-through is rarely recorded in empirical studies. In this context it is important to distinguish between pass-through to prices of imports and pass-through to all consumer prices. In the former case, the assumption of low non-tradable components together with the theory would predict close to complete pass-through, and indeed this is often recorded. In this paper, however, we focus on pass-through of changes in the exchange rate to all consumer prices.

The mainstream view among economists is that the exchange rate pass-through has decreased substantially “recently”.[3] However, there is still a substantial amount of research to be done on the topic. Table 1 summarizes evidence from several studies conducted during the last few years regarding exchange rate pass-through to the CPI.

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2 According to the consumption basket used by the Central Bureau of Statistics to measure CPI. The distinction between traded and non-traded goods and services is based on Ben-Bassat, 1992.

3 See, for example, Taylor (2000).

Table 1

Exchange rate to CPI pass-through: some recent international evidence

Country	Pass-through	Lag structure	Reference
Israel	29%	Within a quarter	Soffer, 2006
Croatia	30%		Billmeier and Bonato, 2002
Brazil	23%	Within 1 year	Belaish, 2003
Turkey	45%	Within 1 year	Leigh and Rossi, 2002
Romania	30–40%	Within 12–15 months	Gueorguiev, 2003
Canada	17%	"Long run"	Leung, 2003
Average of non-US G7 countries	19%	10 quarters	Choudhri et al, 2005

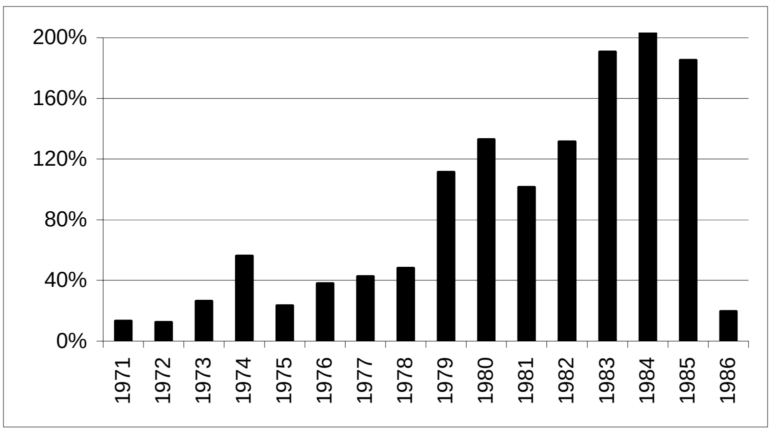
The evidence in Table 1 stands against the conventional wisdom in Israel that the pass-through in the country is exceptionally high. It is evident that the extent of Israel's pass-through is not unique. However, Israel might score among the leading countries if it were to compete in a pass-through speed contest. Moreover, in what follows we will describe some characteristics of the pass-through in Israel which we believe show that the mechanism of price changes between the exchange rate and local prices is somewhat different in Israel than in other countries.

3. Brief monetary history of Israel

During the second half of the 1970s inflation rates in Israel rose sharply, reaching three-digit rates during the beginning of the 1980s (Figure 2). The inflationary outbreak was accompanied by an increase in the use of indexation mechanisms. Although wage and financial indexation were prevalent prior to those years, high inflation caused the indexation of taxes and transfer payments and renewed indexation of long-term credits, and foreign-exchange denominated deposits were made available to the public. In general, indexation rates and frequency increased, and were expanded to numerous types of transactions, especially in the housing sector (Schiffer, 1999).

Figure 2

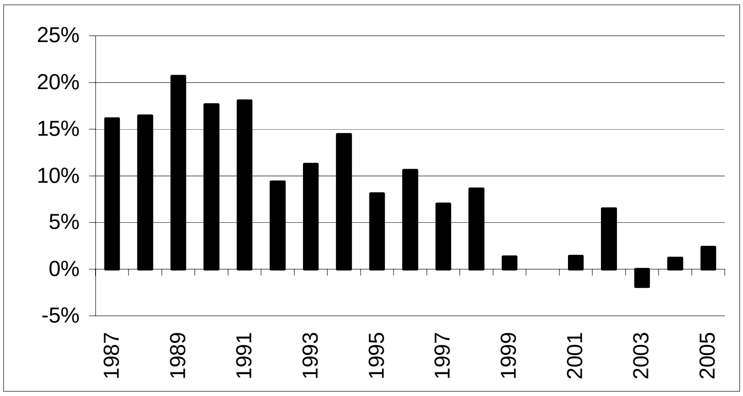
Annual inflation in Israel, 1971–1985



In 1985 the government, together with the Bank of Israel[4] and the labor unions, implemented a successful economic stabilization plan, which ended a decade of hyperinflation. Inflation went down from 445% in 1984 (and over 1000% in annual terms in specific months of 1985) to just 20% in 1986. However, inflation stayed high, in the range of 15–20%, and it took about 14 years to finally reach the inflation rate prevalent in industrial countries (Figure 3). During the first years following the economic stabilization plan, monetary policy was conducted mainly using the exchange rate as a nominal anchor. A fixed exchange rate against the US dollar, and later against a basket of currencies, was a crucial component of the stabilization. However, as inflation was not totally overpowered, the fixed exchange rate soon led to real appreciation of the shekel, and expectations for nominal devaluation evolved. The Bank of Israel was forced to devalue the currency several times, by a cumulative 30% from 1986 to 1989.

Figure 3

Annual inflation in Israel, 1987–2005



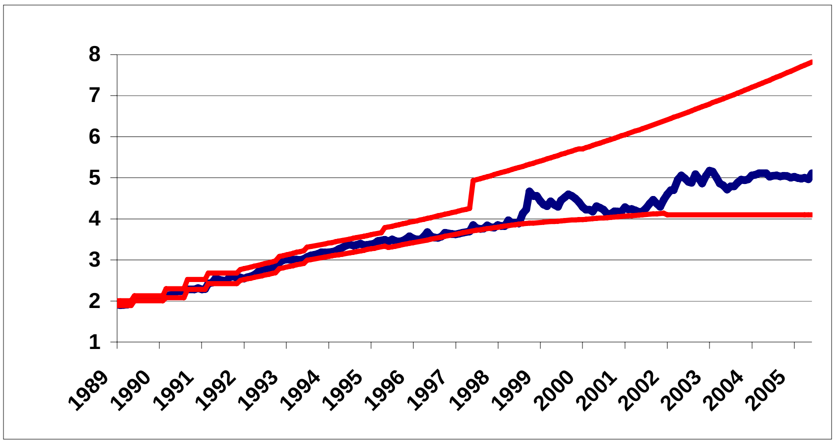
In order to maintain a stable and reliable monetary regime, an exchange rate band of 3% width was declared in 1989, in which the shekel could float freely against the basket (Figure 4). The width of the band was soon enlarged and its middle rate raised until 1991, when the horizontal band was replaced by a diagonal band, in order to make changes in the level of the exchange rate smoother and less unexpected.

The need to determine a slope for the exchange rate band as well as the adoption of inflation targeting in many small countries led Israel to the inflation targeting regime (Klein, 1999). The slope was intended to represent the inflation differential between Israel and its trading partners. But what inflation rate should be considered as the rate in Israel? Letting the change in exchange rate follow inflation would not be desirable – this would make inflation an anchor for the exchange rate, instead of the opposite. Therefore, an inflation target was set, so that the slope would be consistent with that target. In 1991 the Bank of Israel began publishing its monetary interest rate month by month, and inflation targeting was officially declared in Israel in 1994. Since then the government has announced, once a year, a target for the following year's inflation. In 2000 a long-run target of 1% to 3% was declared for 2003 and indefinitely thereafter. The exchange rate band gradually expanded. Since 1998 the Bank of Israel has not intervened even once in the foreign exchange market, and in 2005 the band was officially abolished.

[4] The 1985 "Non-Printing Law", which was amended as part of the stabilization plan, substantially increased the level of independence of the Bank of Israel. See Cukierman (2004) for a thorough description of the monetary history of Israel in the context of central bank independence.

Figure 4

Exchange rate of the shekel against the currency basket and the exchange rate band, 1989–2005



The disinflation process in Israel was a success. It was achieved during a long transition period starting from a state in which exchange rate depreciation and price inflation were in tandem in the late 1980s, to a situation in which the exchange rate fluctuates freely. The exchange rate today is near the level it was at the end of 1998, while the consumer price index has risen more than 10% during the same period. Have we broken the connection between the exchange rate and the inflation rate? Only to some degree.

4. Exchange rate pass-through in Israel: recent evidence

The exchange rate is known to have a major role in determining inflation trends in Israel. Figure 1 tells us that a large proportion of the volatility of inflation is closely related to exchange rate changes. The exchange rate is the most important single indicator in almost all policy and research papers that have been written on monetary policy in Israel. In some of these papers a coefficient of pass-through from the exchange rate to the CPI can be calculated from the estimated equations. Some recent examples can be taken from Elkayam (2003) and from Barnea and Djivre (2004): in both cases, the short-run pass-through is estimated at 28%. In general, exchange rate pass-through of around 20% to 40% was also the result concluded in other studies, and this magnitude is "common knowledge" among economists in Israel.

In this section we focus on recent results from Soffer (2006). The approach taken there breaks the CPI into 31 components, in an attempt to identify the sources of the pass-through. In addition to the standard division of the index into the main consumption components, here we also make the distinction between tradable and non-tradable goods, price-controlled (or price-supervised) goods and services, and goods the prices of which are free to be set by the market. These additional distinctions enable us to further examine the role of market interventions and "network" habits on the process of exchange rate pass-through. We provide simple regression equations where we use data from the years 1991 to 2004, and the exchange rate is set to the quarterly average shekel per dollar rate.

The main finding in Soffer (2006) is that the average pass-through from the dollar exchange rate to the CPI is about 30%, a result that is consistent with the findings of earlier studies, which were based on aggregate data. Most of the pass-through is immediate, taking place within the quarter in which the exchange rate change is recorded. However, the main contribution of the study lies in identifying the sources of the pass-through. Table 2 summarizes the main results.

Table 2

Selected items of the CPI and exchange rate pass-through on these items

	Weighting in the CPI 2005 (%)	Recorded pass-through coefficient (%)	Contribution to overall pass-Through (%)
Tradable items			
Travel abroad	3.6	63.7	2.3
Furniture and home appliances	4.3	42.9	1.8
Culture and entertainment	3.8	34.7	1.3
Other	3.2	35.2	1.1
Cars and maintenance	8.7	12.4	1.1
Fuel and oils for cars	3.4	29.0	1.0
Price controlled food items	0.8	14.6	0.1
Fruit and vegetables	1.1	9.2	0.1
Non-price controlled food items	5.7	0.0	0.0
Clothing and footwear	2.9	0.0	0.0
Home heating fuel	0.2	0.0	0.0
Medicines and medical equipment	1.7	0.0	0.0
Sub-total			8.9
Non-tradable items			
Housing	21.6	70.0	15.1
Electricity	2.8	68.0	1.9
Vacations, trips and functions	5.1	28.6	1.5
Sub-total			18.5
–	–	–	–
Total[1]	**100**		**29.0**

[1] Total weights do not sum to 100%, and the total pass-through does not sum to 29%, because only selected items of special interest are shown.

Source: Reproduced from Soffer (2006).

The surprising finding is that the pass-through to tradable goods and services is very low, and accounts for only 8.9% of the total 29% pass-through to the CPI. Of course, one main reason for this could be that the prices used for estimation are consumer prices, and a large non-tradable component of local sales and storage is reflected in the price. The tradable item with the highest pass-through coefficient is travel abroad, which is only 64%.[5] Other tradable items show much lower pass-through, and in several tradable items no pass-through was recorded at all. An interesting case is that of fuel products, the prices of which are set by the government at the gate of the refineries once a month, according to the relevant fuel prices at the Genova-Lavera Port in Italy and the end-of-month US dollar exchange rate. Pump

[5] One reason could be that the estimated pass-through is from the US dollar, whereas a significant share of Israeli tourism is to Europe. Thus, while some of the price volatility is due to the volatility in the shekel/euro rate, it is not caught by the estimation as exchange-rate volatility, but rather as volatility of the dollar price of traveling abroad. Nonetheless, air ticket prices in Israel are usually denominated in dollars.

prices for certain car fuels are subject to a maximum limit, and this rate is observed at almost all gas stations; in this case the pass-through is estimated to be 29%.[6] On the other hand, for prices of heating fuel, which are not regulated, the estimated pass-through is zero.

The other interesting finding is that most of the pass-through to the CPI is actually due to non-tradable items, and most of this is accounted for by housing prices. During the years of hyperinflation it became common for rental contracts to be denominated in US dollars. Twenty years later, 90%[7] of rental contracts are still indexed to the US dollar exchange rate. Usually, payment is in local currency, but the amount is indexed to the monthly change in the exchange rate. This type of contract is not common in countries where inflation is the same as that in Israel today. Therefore, one can argue that it is a result of Israel's history of high inflation. Is that an efficient contract for rental apartments and housing prices? Ex ante, both landlords and tenants expose themselves, month by month, to the shekel-dollar exchange rate, a position that is generally not hedged, for example, in basic dollar income for the tenant or by fixed dollar outgoings for the landlord. This might indicate that the housing market imposes an unnecessary risk on the written contract. It is an open question whether intervention in the form of forcing contracts to be stated in shekels would improve welfare. The effect on the CPI, however, is clear: a 15% pass-through from the dollar rate to inflation.[8]

Table 2 shows that dollarization accounts for the pass-through on other non-tradable items: the prices of electricity are also set monthly by a government authority, which takes exchange rate changes into account in its pricing formula. Although a substantial proportion of the cost of electricity production is made up of imported fuels, the cost of local labor is not at all negligible, and electricity prices would probably not have a higher pass-through than that of tradable items if they were not controlled with such a close relation to exchange rate changes. Prices of leisure activities are also often indexed to the dollar exchange rate, although there is clearly no economic sense in doing so.

Soffer (2006) verifies the total pass-through coefficient found in other studies, but locates its main source: the housing component of the CPI. The study finds that the total pass-through has decreased from 33% in the first years of the sample, when inflation was still prevalent and exchange rate depreciation was dictated by the diagonal band, to 24% since 1999, as inflation decreased and the exchange rate became de facto flexible. The housing component, however, kept its pass-through coefficient across all these years; the decrease in the pass-through, therefore, is mainly in tradable goods.

5. Exchange rate pass-through and monetary policy

The Israeli economy is subject to frequent and large geopolitical uncertainty. During the summer of 2005 internal political instability was behind the foreign exchange market uncertainty. This was reflected in an increase in the implied volatility derived from shekel/dollar derivatives and in a 4.2% devaluation against the dollar. Devaluation then continued for a few months. A year later, when the monetary forum submitted its biannual

6 The pass-through in this item is far from complete, due mainly to the above-mentioned excise tax which is fixed in local currency.

7 According to the sample used by the Central Bureau of Statistics (CBS) for constructing the housing component of the CPI basket.

8 The home rental item actually weighs only 4.3% in the CPI. However, prices of owner-occupied dwellings, accounting for 16.7%, are computed by an alternative cost approach, based on the same sample of rent contracts used in the home rental item, thus increasing the pass-through to the total housing item. The rest of this item is composed of “other housing expenses”, accounting for 0.7%.

inflation report, it had to explain the 0.5% deviation of the annual inflation rate above the upper limit of the target (3.5% annual inflation from June 2005 to June 2006). The report stated the following:

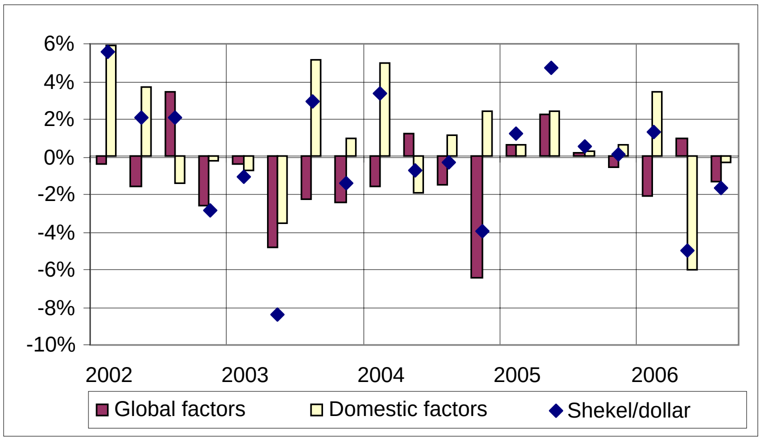
> "An acceleration of the rate of inflation calls for deviations from the price stability target to be addressed. For most of the period reviewed inflation over the previous twelve months was higher than 3 percent (the upper limit of the target range). The main reasons for this deviation from the upper limit seem to be the depreciation of the NIS …"[9]

It is likely that when the inflation report for July–December 2006 is written, we will once again need to explain the deviation from the target. Only this time, just six months after deviating from the above, we will miss the lower limit of the target range. Inflation from December 2005 to September 2006 was only 0.8%, and a negative rate of –0.4% is expected for October. Once again, the exchange rate is the main source for the high volatility in the CPI and the inability of monetary policy to set stable inflation within the target range.

The volatility in the exchange rate is due in many cases to exogenous shocks to the Israeli economy. Several recent changes in the exchange rate of the dollar against world currencies have been an important source of the variability in the shekel/dollar rate. Figure 5 shows the outcome of a method used by the Bank of Israel to distinguish between global and domestic factors that affect the shekel/dollar rate.[10] In several periods global factors have had a significant effect on this rate. Sometimes they offset the domestic factors, thus leaving the shekel/dollar rate unchanged, such as in the third quarter of 2004. At other times they join the domestic factors in increasing the change in the shekel/dollar rate, such as in the second quarter of 2003. But developments in worldwide exchange rates sometimes dominate the shekel/dollar rate. In the last quarter of 2004, for example, the dollar depreciated significantly against world currencies. The Bank of Israel had to react against an appreciation of the shekel against the dollar,[11] although domestic factors actually acted to weaken the shekel.

Figure 5

Quarterly breakdown of change in the shekel/dollar exchange rate, I/2002–III/2006



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9 Bank of Israel Inflation Report 2006, January-June.

10 For a description of the method see Box 2.1.1 of the Bank of Israel Annual Report, 2004, Foreign Exchange Activity Department, page 97.

11 The appreciation probably contributed to the fact that the Bank of Israel interest rate was gradually reduced from 4.1% in November 2004 to 3.5% in February 2005.

The CPI reacts to the shekel/dollar rate more than to other currencies due to the dollar indexation of housing rental prices. If this were eliminated – the practice of indexation is not so prevalent in most low-inflation countries – the effect of the global foreign exchange market on local inflation would be much milder. This is the case since the trade-weighted index of the exchange rate is less volatile than the dollar rate in this particular case. In Israel the characteristics of the housing sector enhance the effect of the shekel/dollar rate on the local CPI.

Should decreasing the exchange rate pass-through be a policy objective of monetary policy at the central bank? Currency markets are very unstable, partly due to domestic conditions, but partly also because of factors that are totally exogenous to a small economy. Passing this instability on to local prices, and from there to the local policy interest rate, is not a desired development. This might lead to a positive answer to the above question.

However, one should note that pass-through results from fundamental market forces acting to prevent price differentials and to clear international markets. For example, we all know that the global economy is waiting for a significant appreciation of the Chinese yuan. This is expected to raise the price of Chinese goods for the American consumer, and thus contribute to balancing the US current account. But if there is no pass-through, appreciation of the yuan would not raise the price of the Chinese shirt at the American dock, and the desired improvement in US competitiveness would not occur. Edwards (2006) discussed the exchange rate pass-through as a "shock absorber" mechanism for the economy. In this context, the economy converges to a new equilibrium after a shock by an "expenditure switch effect". Prices of tradables are more sensitive to the exchange rate than those of non-tradables. Thus, a change in the nominal exchange rate is capable of delivering the desired change in the real exchange rate. In Edwards' own words:

> "In particular, once the role of the real exchange rate is explicitly introduced into the analysis, it is important to distinguish between two notions of exchange rate pass-through: pass-through into non-tradables, and pass-through into tradables. In this context, and from a policy perspective, a desirable situation is one where pass-through coefficients for tradables and non-tradables are low and different, with the pass-through for tradable goods being higher than that for non-tradables."

Should we adopt this argument, then, the high pass-through to the non-tradable items of the CPI in Israel is not desired. However, note that most of this pass-through is in the housing sector, and is actually a result of the dynamics of home rental contracts, which are indexed to the dollar exchange rate. The increase in rent prices following devaluation is less likely to disrupt the "expenditure switch effect" mentioned by Edwards, and if it did, it would only be in the long run. It is difficult to justify the high pass-through in housing prices based on an efficient market mechanism.

Fischer (2006) addressed the topic of exchange rate pass-through in Israel, saying that a high and quick pass-through coefficient from the exchange rate to prices can actually increase the effectiveness of monetary policy. The increasing openness of the foreign exchange market following its liberalization has made the exchange rate highly sensitive to interest rate differentials. In an inflation targeting regime, this increases the ability of the bank's policy instrument to affect the exchange rate and, due to exchange rate pass-through, increases the speed by which the policy instrument affects inflation. In the face of an unanticipated shock to prices, the governor could quickly change the interest rate in order to bring inflation back to its target range.

The above argument seems very relevant for economies where inflation is primarily affected by shocks which do not stem from the exchange rate. One could imagine, for example, that the Fed would be happy to have an efficient tool which could act quickly on inflation to offset an oil shock, or to react to the strong impact that volatility in US housing prices could have on consumption and prices through the asset price transmission channel. In Israel, however, inflationary shocks most often are the result of exchange rate shocks.

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The monetary transmission mechanism in Malaysia: current developments and issues

Ooi Sang Kuang[1]

1. Introduction

The Malaysian financial system has evolved in line with the changing structure of the economy. The changes in the economic structure and financial system in turn have had an important influence in shaping the increasing complexity of the relationship between monetary policy and the real economy. In this regard, as policymakers, it is important to first and foremost understand how the economic transformation affects the nature of the monetary transmission mechanism, in addition to evaluating the relative potency of transmission channels.

Specifically, the influence of the changing forms and characteristics of financing, the diversity and depth of financial markets, the spread of financial inclusion of households and corporates, as well as the degree of openness of the economy, are key features that determine the effectiveness of the monetary transmission mechanism in Malaysia. In this paper, five key issues are highlighted and their implications for the conduct of monetary policy are discussed. First, there has been a transformation of the Malaysian financial system that has raised the level of competition and improved the level of efficiency in the banking system. Second, a more diversified financial system and, in particular, the rapid growth of the bonds market have increased the alternative sources of financing available to both households and businesses. Third, the country has seen the emergence of an increasingly influential Islamic financial system. Fourth, the financing avenues for small and medium-sized enterprises (SMEs) that are mostly centered outside the formal banking system, and fifth, the openness of the Malaysian economy and the growing integration with the global economy and financial system.

Therefore, it is useful to analyse these features of the Malaysian economy to uncover the key issues that will have implications for the conduct of monetary policy. The next section will discuss the developments in these five key areas while the following section discusses the implications arising out of these developments.

2. Key developments in the financial system

2.1 Transformation of the banking system

Malaysia's financial system is characterised by the widespread availability of banking services across the country, a growing capital market and a high degree of international openness. As at end-2005, the total assets of the financial system were equivalent to 386% of GDP. With more than 50% of total financial assets, the banking institutions are very

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[1] Deputy Governor, Bank Negara Malaysia. The author acknowledges the contributions from Raja Syamsul Anwar, Norhana Endut, Ho Sui-Jade and Zainab Haji Murat.

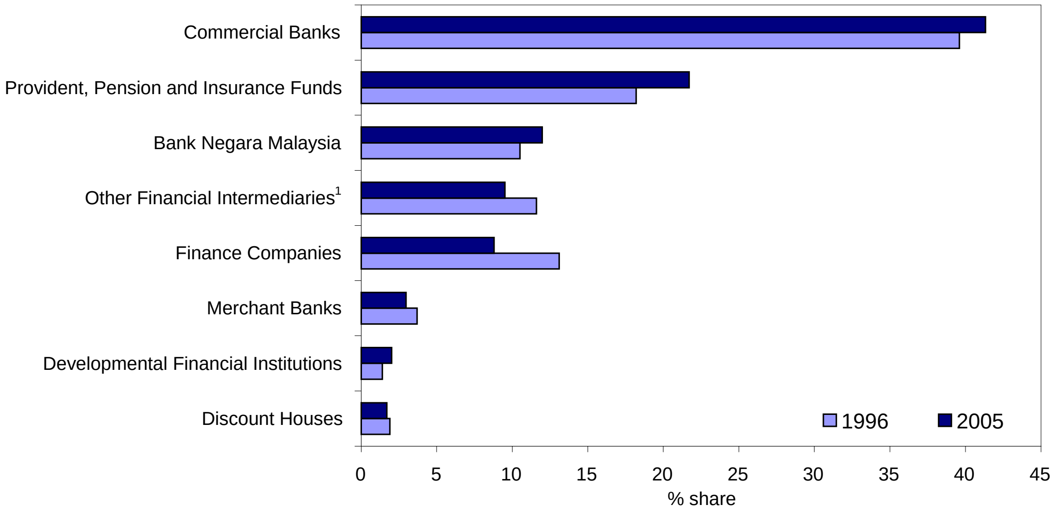
The views expressed in this paper do not necessarily reflect those of Bank Negara Malaysia.

important financial intermediaries and the dominant participant in the financial system (Chart 1).

Since the Asian Financial Crisis in 1997, significant changes have taken place in the Malaysian banking sector. Prior to 1997, the banking sector was characterised by a large number of small institutions. However, the wave of consolidations and mergers of financial institutions since 1998 has led to the emergence of nine domestic banking groups by 2006. More importantly, these developments have helped create a financial sector that is more resilient, efficient, competitive, and responsive to changing economic requirements.

Chart 1

Assets of the financial system



[1] Includes savings institutions, co-operative societies, unit trusts, building societies, Pilgrims Fund Board, Credit Guarantee Corporation, Cagamas Berhad, leasing companies, factoring companies and venture capital companies.

The completion of the financial restructuring, and the resulting stronger balance sheets, have enabled the banking institutions to focus on harnessing their operational efficiency and meeting the needs of their customers. Using a non-parametric method (DEA – Data Envelopment Analysis) to benchmark the banking industry, an internal study by Bank Negara Malaysia (BNM) finds that, on a macro basis, bank efficiency has increased since 1996.[2] This result is further supported by the declining trend of the banking system's net interest margin[3] (Chart 2). While many factors could influence interest margins, tighter interest margins are typically associated with greater competition and efficiency. The move by BNM to the New Interest Rate Framework in 2004 has resulted in a further liberalisation of the pricing of bank assets, thereby increasing the level of competition.

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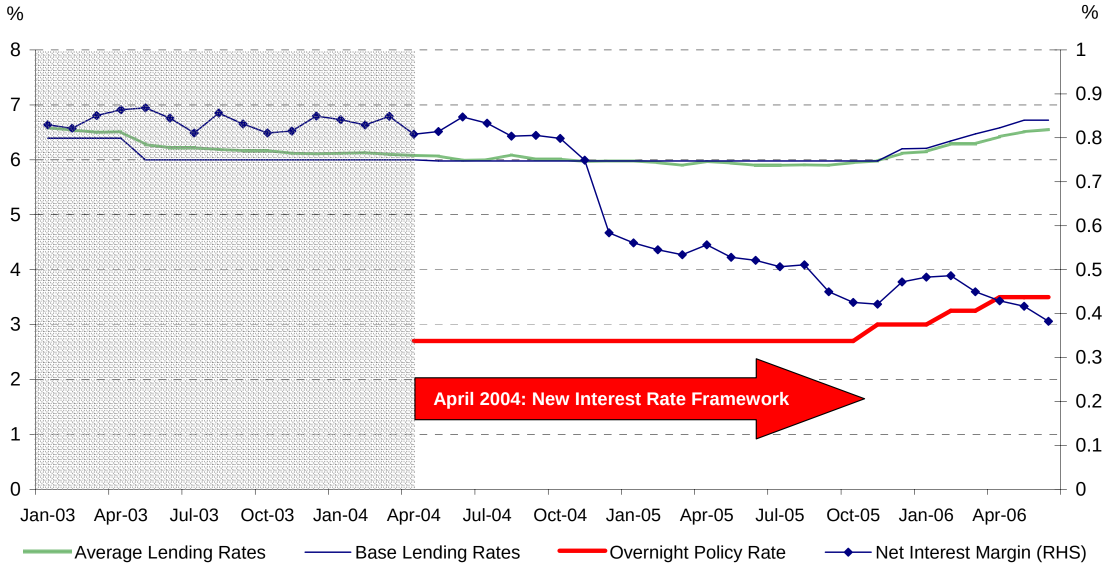
[2] This study computed the X-efficiency, which measures how managers are able to minimise cost and maximise profit by input allocation and exploration of technological opportunities alongside given output and input prices.

[3] Net interest margin is calculated as interest income net of overhead costs and provisions, as a percentage of total interest-earning assets.

Chart 2

Net interest margin and key interest rates



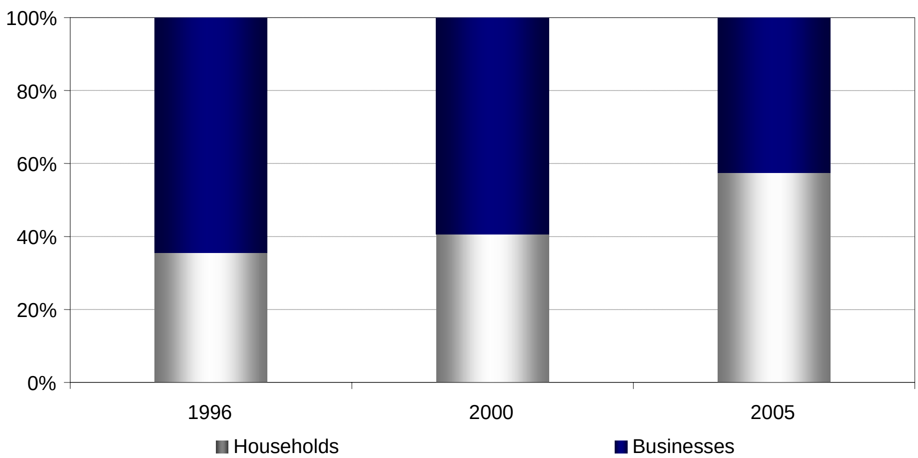
2.2 Increasingly diversified financial system and financial markets

Globally, changes in the financial system have transformed the opportunities for borrowing and saving that are facing households and businesses. Households have access to a broader range of financing and investment facilities. Since the crisis, the proportion of loans extended to the household sector has increased progressively (Chart 3). Businesses have greater options to diversify their financing away from banks through the issuance of bonds and equities – a move that has been facilitated by the growing role of the capital markets.

Chart 3

Profile of borrowers

Banking System



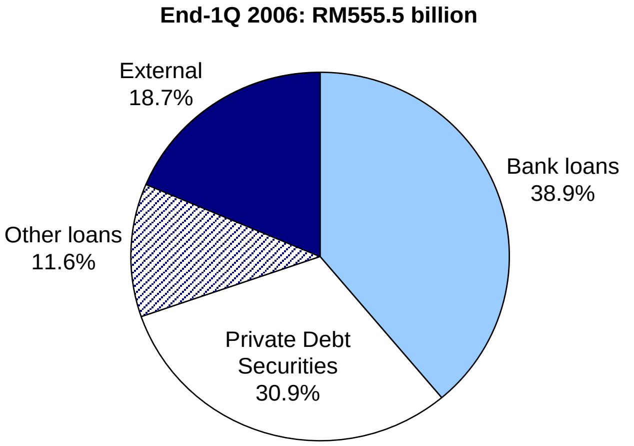
The increase in financing taking place via the equity and bond markets has been facilitated by policymakers' efforts to ensure greater depth and breadth in these markets. Numerous measures have been introduced to increase liquidity in the domestic bond market and improve the price discovery process. These include utilising repos as a monetary instrument as well as shortening the timeframe for the review and consideration of initial public offering (IPO) applications in order to improve delivery efficiency, effectiveness and transparency to the market. Over the last decade, the maturity and sophistication of the Malaysian capital market has enabled market participants to price risk and return more efficiently and in the process has enhanced the transmission of monetary policy.

As a result of the authorities' efforts to develop the capital market in order to diversify the sources of financing away from the banking system, large corporations have increasingly had recourse to the capital market for their financing needs. While the banking system remains the major source of financing (Chart 4), a significant amount of funds obtained by businesses since the end of 2003 have been in the form of private debt securities, external borrowings, and new equity – significantly higher than the increase in bank lending to businesses, (Chart 5).

Chart 4

Sources of financing for large corporations

Outstanding amount (% share)

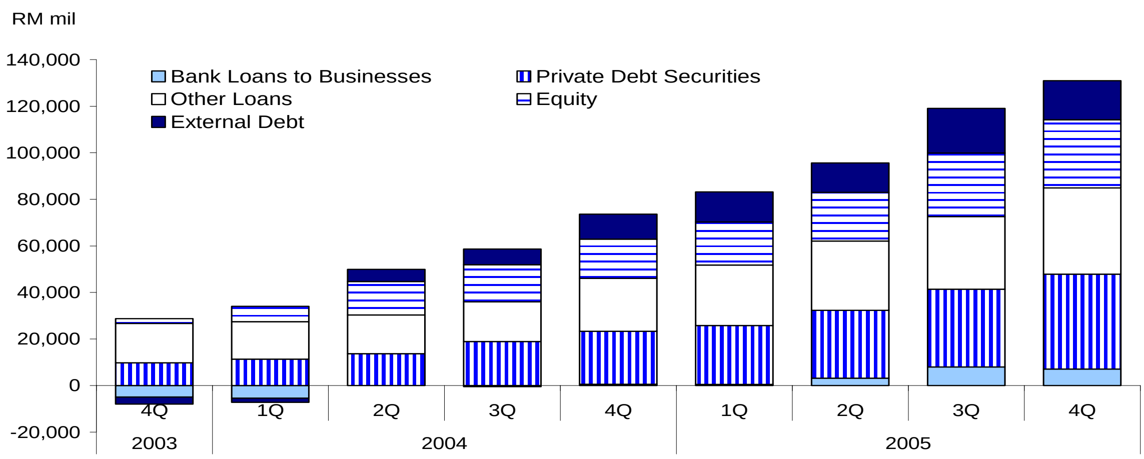


* Funds raised in the equity market is a flow variable and is shown in Chart 5.

Chart 5

Sources of financing for large corporations

Cumulative changes in total outstanding amounts



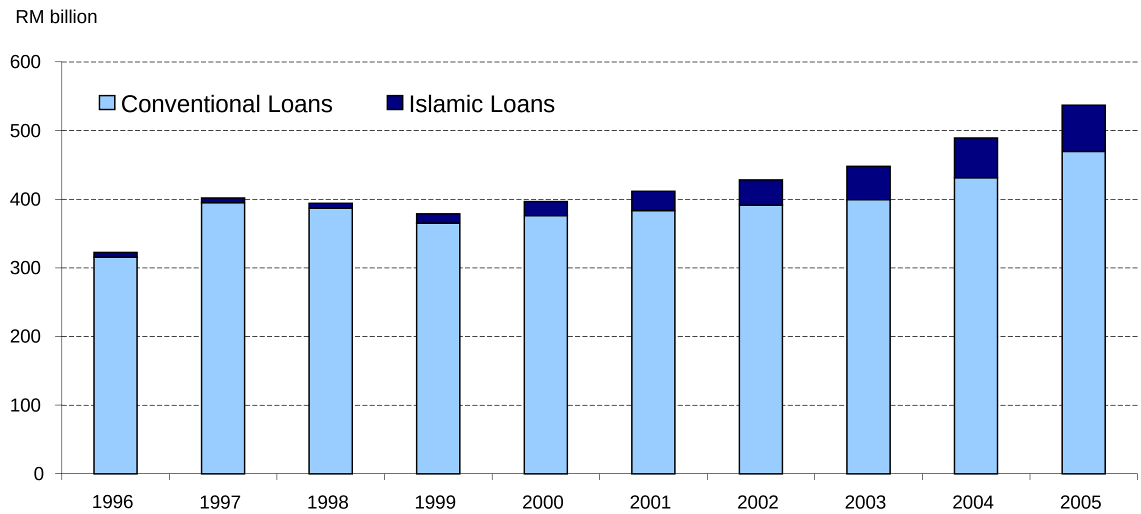
2.3 Emergence of a stronger and more influential Islamic financial system

An important feature of the Malaysian financial system is its dual banking system, where the non-interest rate based Islamic banking system operates alongside the interest rate based conventional banking system. The Islamic banking system is made up of independent full-fledged Islamic banks, Islamic banking subsidiaries and Islamic windows within the conventional banking institutions.[4] In the last decade, the Malaysian Islamic banking industry has grown rapidly. Total assets of this industry increased from RM17.9 billion in 1997 to RM43.5 billion in 2005.

In terms of financing base, the share of Islamic banking system financing in total loans (both conventional and Islamic) has increased, from 2.1% in 1996 to 12.5% in 2005 (Chart 6). As Islamic financing gains greater prominence, the monetary transmission mechanism needs to be re-examined. Generally, the structure of Islamic financing requires the sharing of risks and profits in some pre-agreed ratios. Given that the cost of a large proportion of existing Islamic financing is not directly linked to changes in the cost of funds, changes in monetary policy would have only a limited impact on the cost of existing loans of this type (Chart 7). Indeed, in the future, the extent to which Islamic returns change in response to changes in the policy rate will be a crucial factor in understanding how fast and effective is the monetary transmission via the Islamic financial institutions.

Chart 6

Total banking system loans

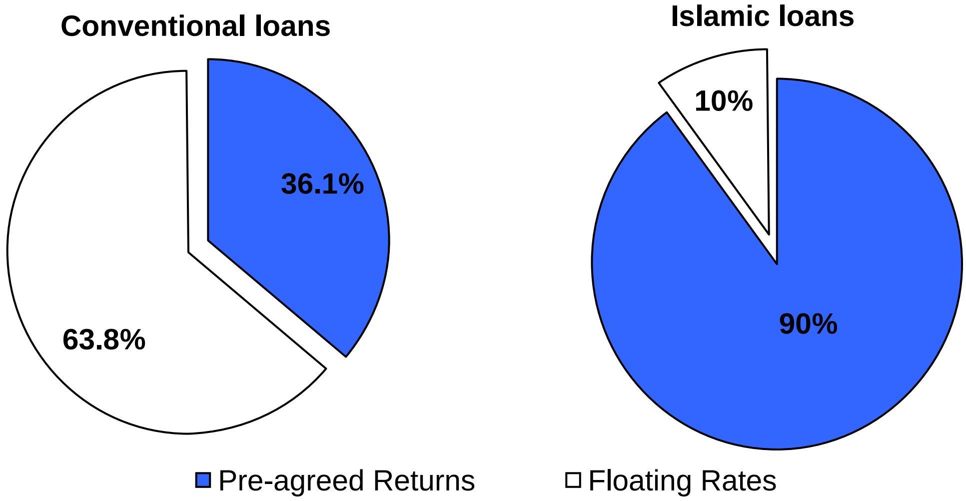


4 As at end-November 2006, five banking groups have established Islamic subsidiaries while five banks have Islamic window operations.

Chart 7

Interest rate structures

Average for 1999–2005



2.4 Increased financing for small and medium-sized enterprises (SMEs)

Small and medium-sized enterprises (SMEs) are becoming an important driver of investment and growth in Malaysia. Given the SMEs' limited access to the capital market, their share in total outstanding loans of the banking system has grown over the past decade (Chart 8). However, the banking system still provides only 13% of total SME financing, most of which goes into micro SMEs and SMEs in the services sector (Chart 9). Therefore, roughly 87% of SME financing is sourced from outside the banking system. In addition, the SMEs can also make use of various specific-purpose special funds set up by the Government, although this represents a very small share of the financing of SMEs. The SMEs are also dependent on the Development Financial Institutions (DFIs), which may differ in terms of cost and capital structure, as a source of their financing. As such, a large portion of SME financing may be less sensitive to changes in the policy rate but the impact of the special funding on the effectiveness of the monetary transmission to this sector is slowly being diluted by the increasing participation of the banking system in financing the activities of SMEs.

Chart 8

Outstanding banking system loans: by borrower

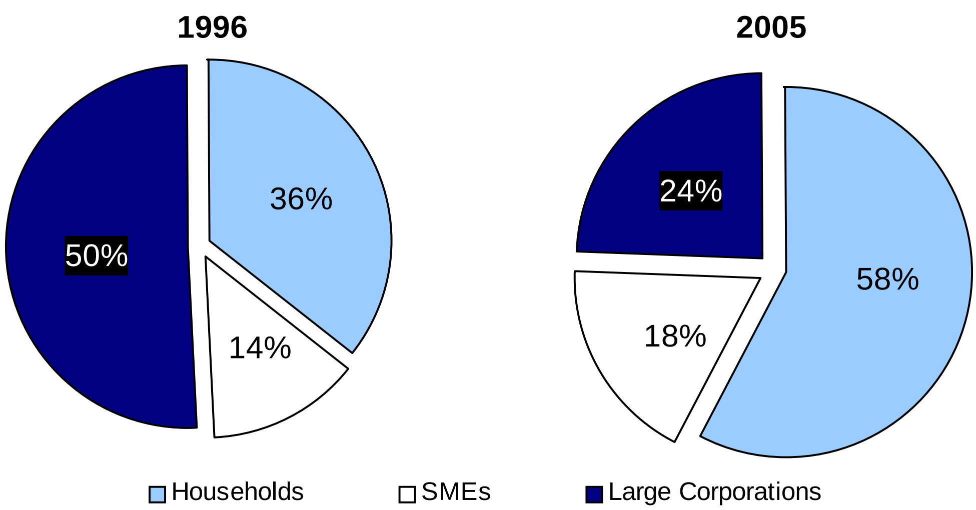
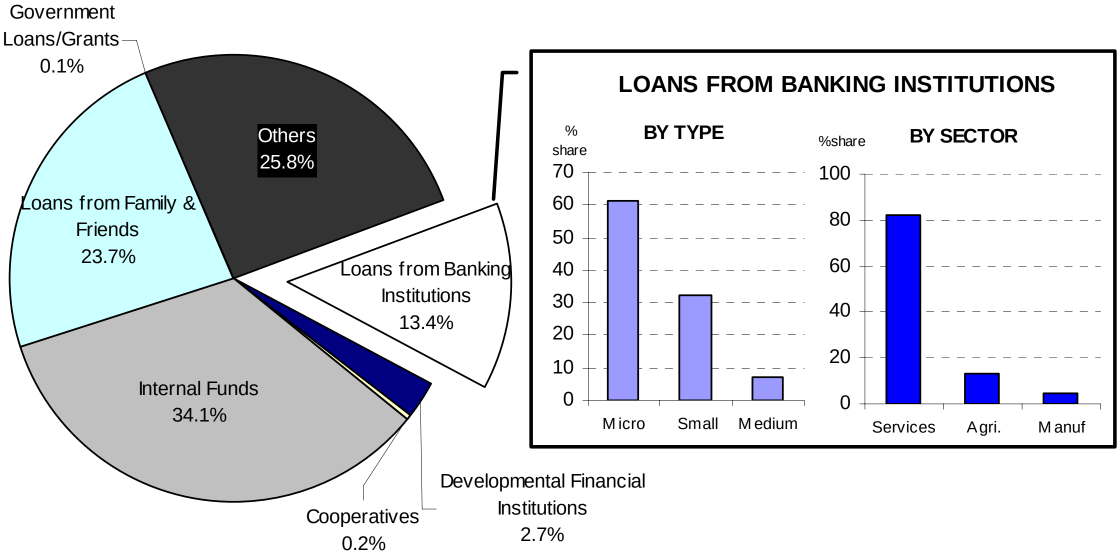


Chart 9

Sources of financing for SMEs



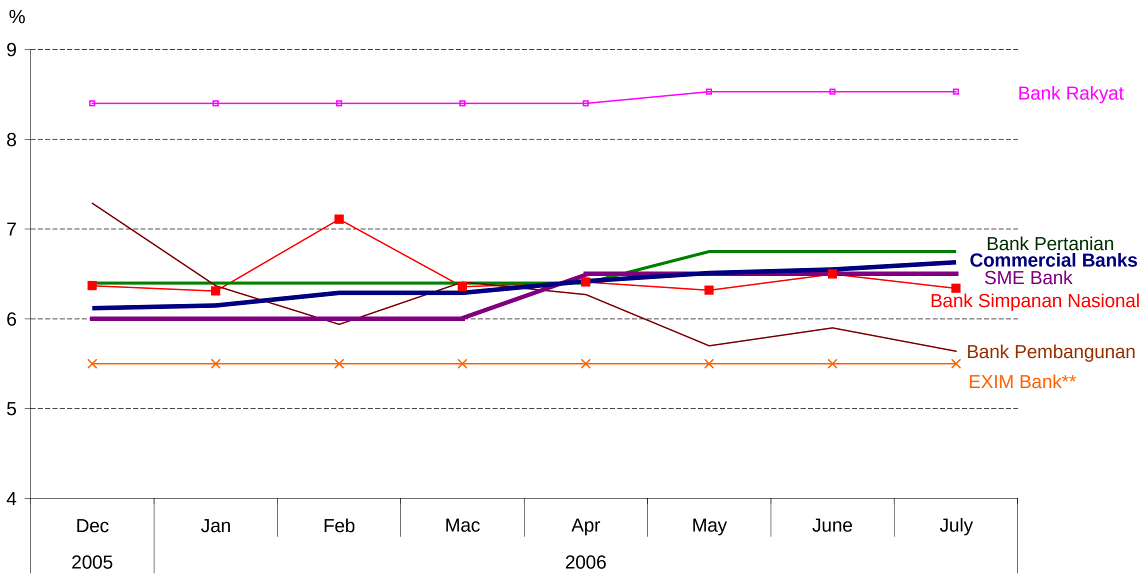
Source: Department of Statistics, Malaysia and Bank Negara Malasia.

About 6.7% of total loans are disbursed via the Development Financial Institutions (DFIs), whose objective is to provide financing for certain sectors of the economy. About 2.7% of SME financing is obtained from DFIs. The various DFIs serve the financing needs of specific sectors of the economy. Several DFIs' loan structures are heavily skewed towards individuals, specifically for consumer credit, while others are focused on specific businesses and industry. With the differences in the direction and focus of lending, there are also significant differences in the interest rates offered by the DFIs (Chart 10).

Chart 10

Average lending rates

Commercial banks and development financial institutions



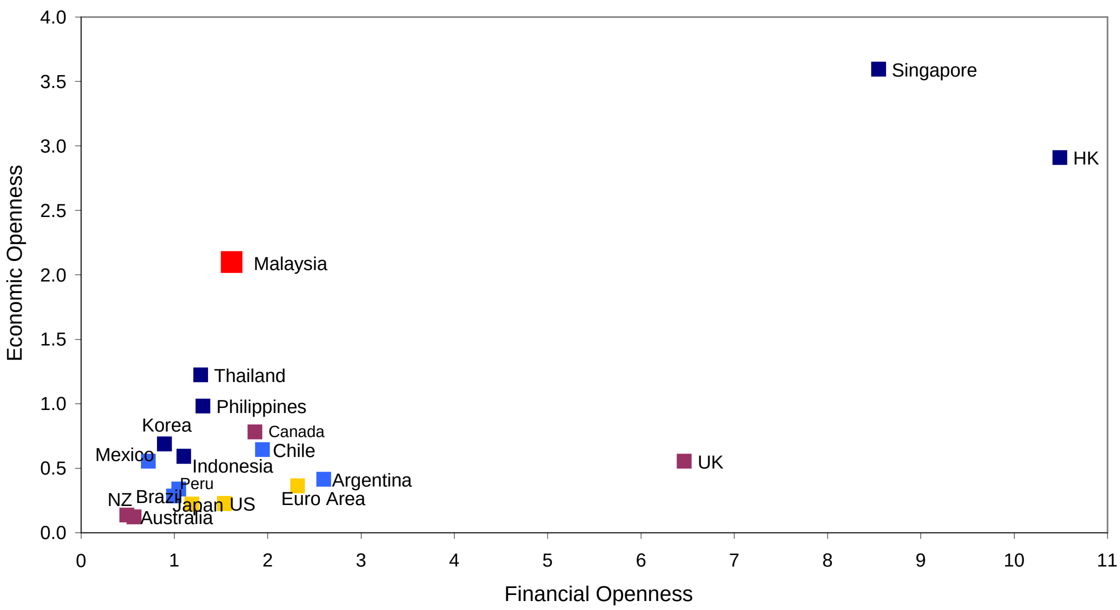
2.5 Openness of the Malaysian economy

Another distinguishing feature of the Malaysian economy is its high degree of economic and financial openness.[5] In 2002, total trade was more than twice the size of the economy, making Malaysia among the most economically open nations in the world. The total stock of international investment credit and debit was also significant, at more than 1.5 times the size of the economy. Chart 11 maps out the relative openness of the Malaysian economy compared to eighteen economies representing East Asia, the Western Hemisphere and the developed nations.[6] Chart 12 shows that the degree of openness of the Malaysian economy has also increased over time. Given the small and highly open nature of the Malaysian economy, conventional theory suggests that the exchange rate is likely to be a significant channel of the monetary transmission mechanism.

Chart 11

Economic & financial openness of selected countries

2002



Source: BNM calculations; data from IMF International Financial Statistics June 2006.

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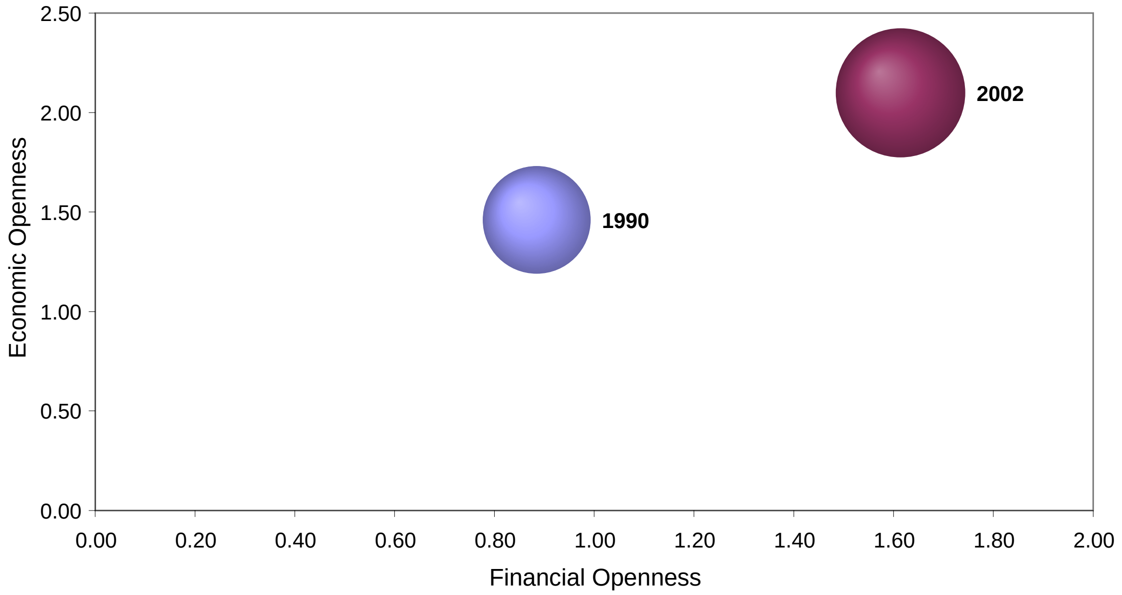
5 Economic openness is defined as the sum of exports and imports relative to GDP, while financial openness is defined as the sum of international investment credit and debit positions relative to GDP.

6 East Asia is represented by Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand; the Western Hemisphere is represented by Argentina, Brazil, Chile, Mexico and Peru; the developed countries are represented by Australia, Canada, Japan, New Zealand, the United Kingdom and the United States.

Chart 12

Greater openness of the Malaysian economy



Source: BNM calculations; data from IMF International Financial Statistics June 2006.

3. Implications for the monetary transmission mechanism

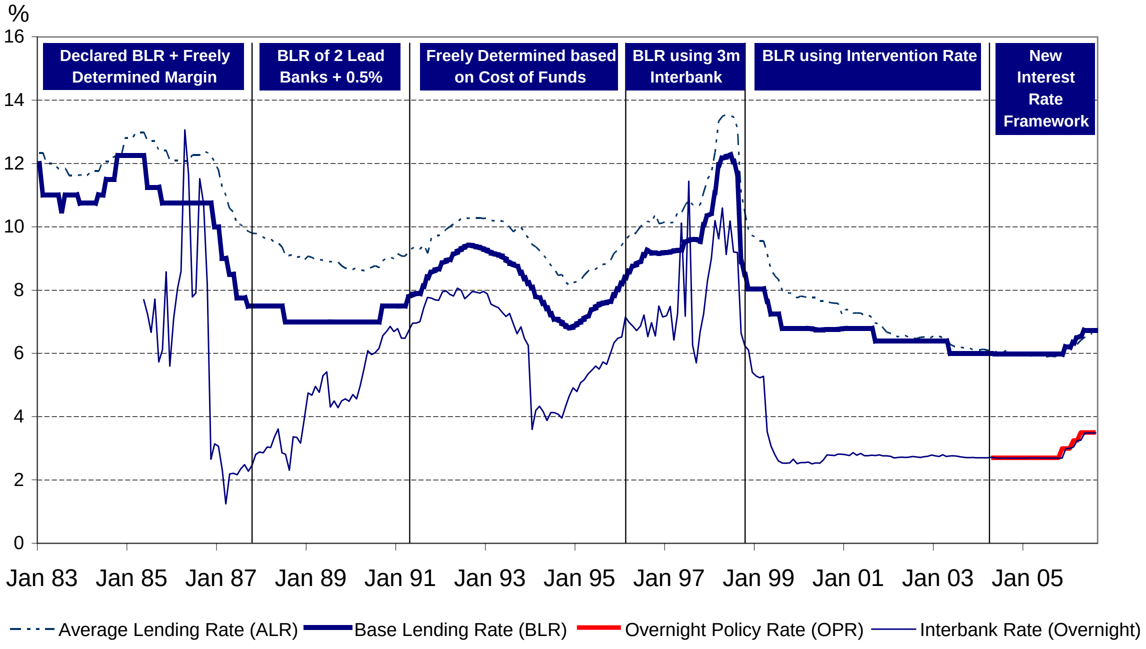
The effectiveness of the transmission mechanism at any point in time is influenced by the structural developments that shape the financial intermediation process. In particular, the availability of alternative sources of financing, the depth of financial markets, as well as the emergence of new financial instruments and financial institutions, have changed the way businesses and households obtain financing and park their savings. These changes could impact on the effectiveness of the monetary transmission mechanism by increasing or decreasing the lags from changes in the central bank policy rate to the cost of funds to businesses and households, as well as to the relative returns of different asset classes for savers and investors. The changing structure of the financial system and the spread of financial instruments and products may lead to different sectors of the economy being impacted differently by changes in the central bank policy rates. In this section, the possible implications for the monetary transmission mechanism of the five key developments outlined above are explored sequentially.

3.1 Efficiency of the banking system and greater interest rate pass-through

The emergence of a more diversified and competitive banking system allowed BNM to move towards a more market-driven interest rate framework in April 2004 (Chart 13). The new interest rate framework also enhanced the effort to improve banking system efficiency by encouraging more efficient pricing of risk within the banking system. As a result, with greater pricing efficiency, the speed and size of interest rate pass-through, both from the policy rate to the interbank rates and from the policy rates to the retail rates, have risen significantly.

Chart 13

Key interest rates under different regimes



Estimates show that the pass-through from the overnight policy rate[7] (OPR) to other interbank rates and retail market rates has remained high since April 2004 and has increased significantly during the most recent increases in the OPR (Chart 14). As the level of competitiveness in the banking system has increased over the past decade, long-run interest rate pass-through has also increased and has generally remained high, at between 0.6 and 1.[8] The pass-through to deposit rates is generally higher and faster than that for lending rates. Indeed, the high level of pass-through in Malaysia during and after the Asian financial crisis was crucial in ensuring that monetary policy impulses were effectively transmitted to the real sector. With the new interest rate framework in place, it is also possible to see the higher short-run pass-through (impact pass-through), which has risen from about 0.4 in 2000 to 0.9 during the most recent interest rate increases.

Therefore, ***changes in the financial infrastructure and policy framework during the past several years have led to significant improvements in the level of efficiency in the banking system and have contributed to the greater speed and magnitude of interest rate pass-through***.

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[7] Since the OPR was only instituted from April 2004, the interbank overnight rate was used to proxy for the central bank policy rate for the period prior to April 2004. Prior to 2004, the policy rate was the 3-month interbank rate. Results using the 3-month interbank rate also showed a similar increase in interest rate pass-through.

[8] Long-run pass-through may exceed 1 for certain periods, especially during crises, when risk aversion is high.

Chart 14a

Long-run interest rate pass-through

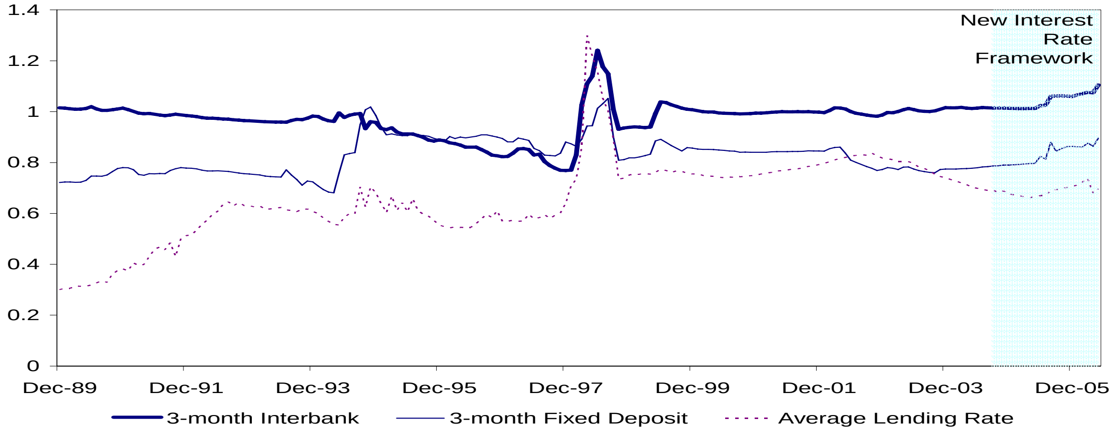
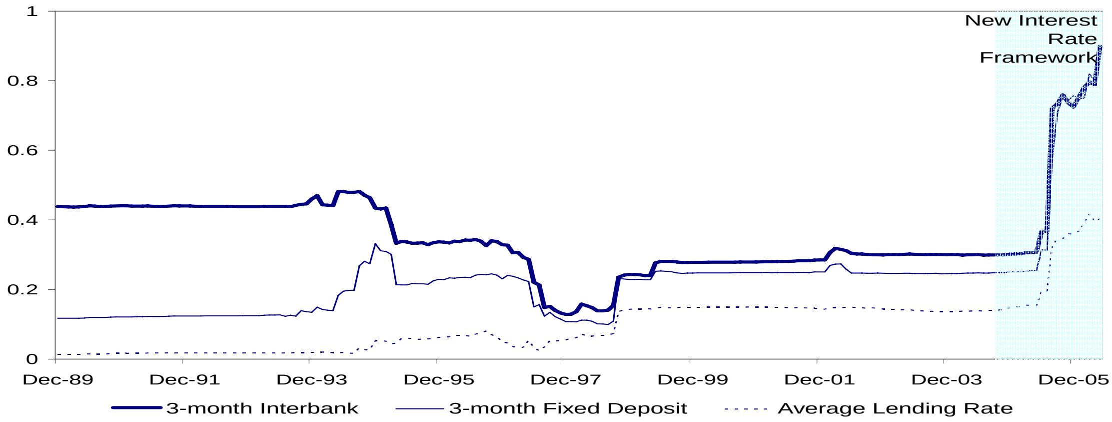


Chart 14b

Short-run interest rate pass-through



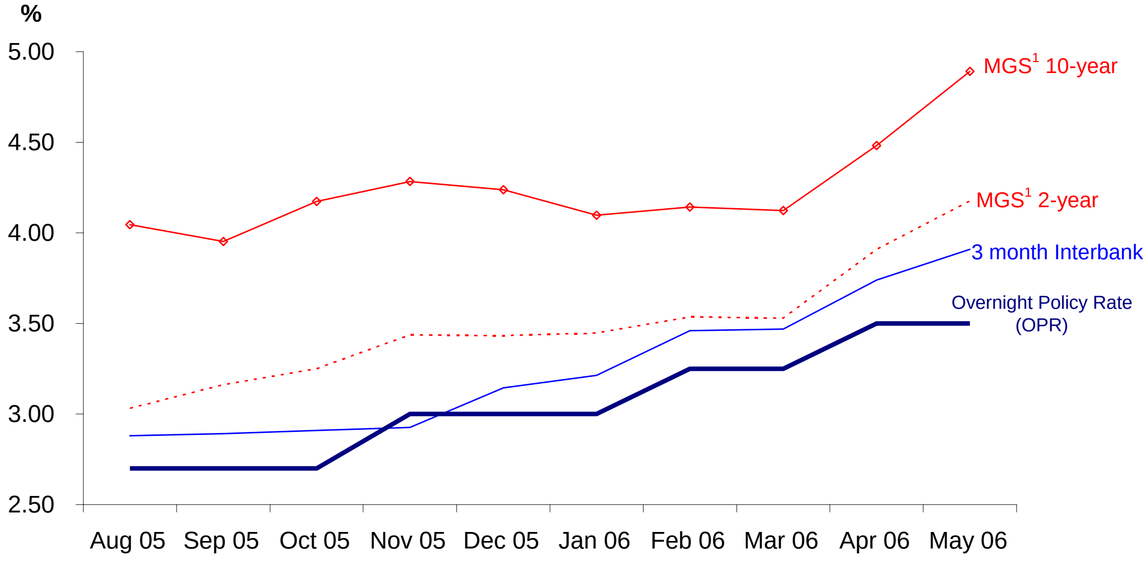
3.2 Emergence of a diversified financial system and financial market

The greater reliance on alternative sources of financing, by both small businesses and larger corporations, may delay the speed and magnitude of the transmission of policy rates to the actual cost of financing. This is especially the case if these alternative sources of financing have significantly different funding structures that are not directly influenced by the central bank's policy rate.

However, in a well-developed and sophisticated financial market that prices risks efficiently, the cost of most types of financing would still be benchmarked on the cost of financing via the banking system. Thus, the opportunity cost of financing would still be influenced to a large extent by the central bank policy actions. With an efficient financial market, the influence of monetary policy would likely be larger and faster. For Malaysia, aside from some short-term volatility, changes in the bond yields, which reflect the cost of debt financing, generally follow closely changes in the policy rate (Chart 15). Therefore, one can conclude that ***the emergence of alternative sources of funding has not had an adverse effect on the pass-through from the policy rate to market rates, but rather has increased the pace and magnitude of the pass-through across all segments of the economy***.

Chart 15

Interbank rates and bond yields



[1] Malaysian Government Securities (MGS)

Indeed, the increasing influence of the capital markets as a source of financing, especially through the bond market, has certainly enriched the monetary transmission mechanism in Malaysia by expanding the possible transmission channels. As the financial markets develop, the increase in financing via the equity and bond markets means that the transmission of monetary policy impulses via the asset price and expectation channels has become relatively more important. This is in fact an expected stage in the development of any monetary system, whereby the traditional credit and interest rate channels of monetary transmission are complemented by the expectation and asset price channels that work through the capital markets. The more sophisticated financial markets have enabled market participants to not only price risk and return more efficiently, but also to shift asset allocation speedily in markets which have become more liquid. In addition, to the extent that the prices of financial products, such as bond yields, reflect market participants' risk preferences over the near future, an active and efficient capital market helps the central bank in gauging and influencing market expectations. More and more, the ability of the central bank to affect market expectations relies on the efficiency with which financial markets correctly transmit central bank actions into financial asset prices and the effectiveness with which the central bank communicates its message to the financial markets.

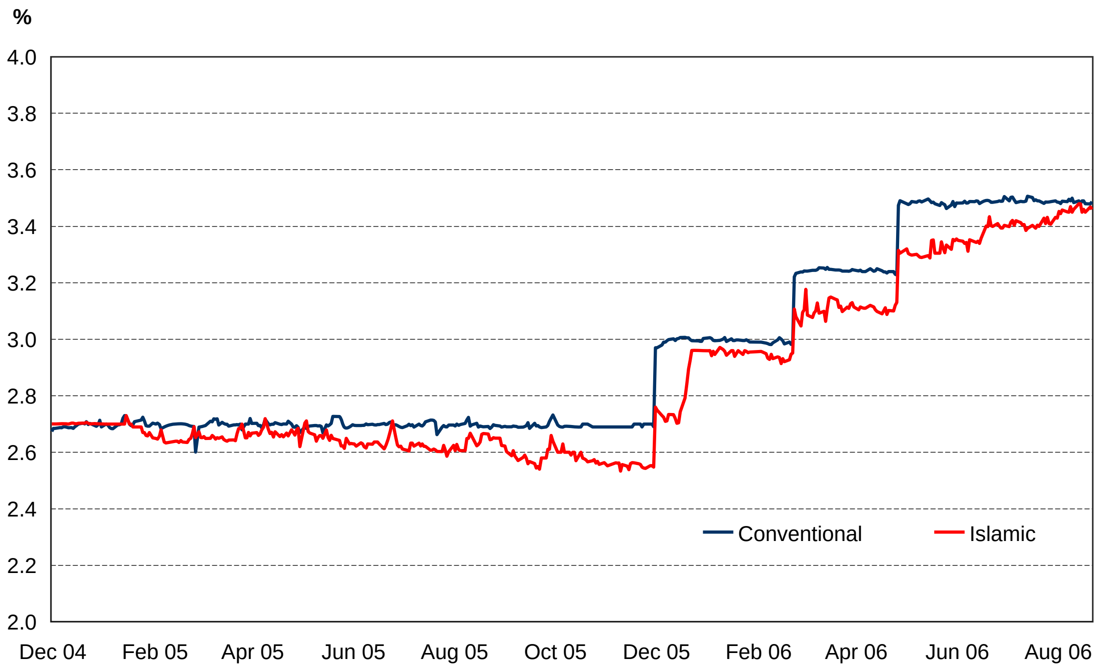
3.3 Emergence of a stronger and more influential Islamic financial system

The greater proportion of existing financing with returns that are not directly linked to changes in the cost of funds suggests that assets structured under Islamic financing would be less sensitive to policy rate changes. As a result, interest rate pass-through could be diluted. With the proportion of Islamic loans as a share of total loans, presently at 10%, expected to increase in the future, the issue would be an area for further study going forward. Nonetheless, in estimating the pass-through from the policy rates to the Islamic money market, BNM estimates suggests that the pass-through is fast and sizeable and consistent with those of conventional estimates (Chart 16). However, the estimates for pass-through from policy rates to Islamic banks' retail rate of returns suffer from a lack of reliable data on the rate of returns (the proxy measure of the average lending rate for conventional banks) for

Islamic loans. As such, the estimates do not show any conclusive evidence on pass-through from policy rates to the Islamic retail rate of returns.

Chart 16

Overnight rates: conventional and Islamic



The significant presence of different methods of determining returns within the Islamic financial system also raises possible issues regarding the transmission of policy rates to market rates. It is possible that Islamic loans may be priced higher or lower than their conventional counterparts depending on their structure and risk profile. Although Islamic deposits are expected to provide a rate of return that is somewhat comparable to conventional deposits, increases in interest rates could result in a lowering of the margins between the rate of return on Islamic loans and the cost of Islamic deposits. While Islamic banks do utilise their profit equalisation reserves, which are built up to smooth the fluctuations in their margins by helping Islamic banks to pay depositors when the rate of return on deposits is rising, the reserves are still capped at 30% of their capital fund.[9] If policy rates continue to increase, the margins will eventually be affected as the reserves are depleted. As a result, to manage this risk, the pricing of Islamic loans could be significantly different than that of their conventional counterparts, although the differential may again be determined by the structure of risk and return sharing, and also constrained by competitive pressures. The implication is that the impact of monetary changes could be magnified or diluted for Islamic financial institutions relative to the conventional financial institutions.

Unfortunately, the absence of reliable data on the structure and sharing of returns on Islamic loans across the banking sector makes it difficult to assess the impact of policy rates with certainty. In Chart 17, the base financing rates (BFRs) of two major Islamic banks do move fairly closely with the BLRs of conventional banks. For a clearer analysis, however, a

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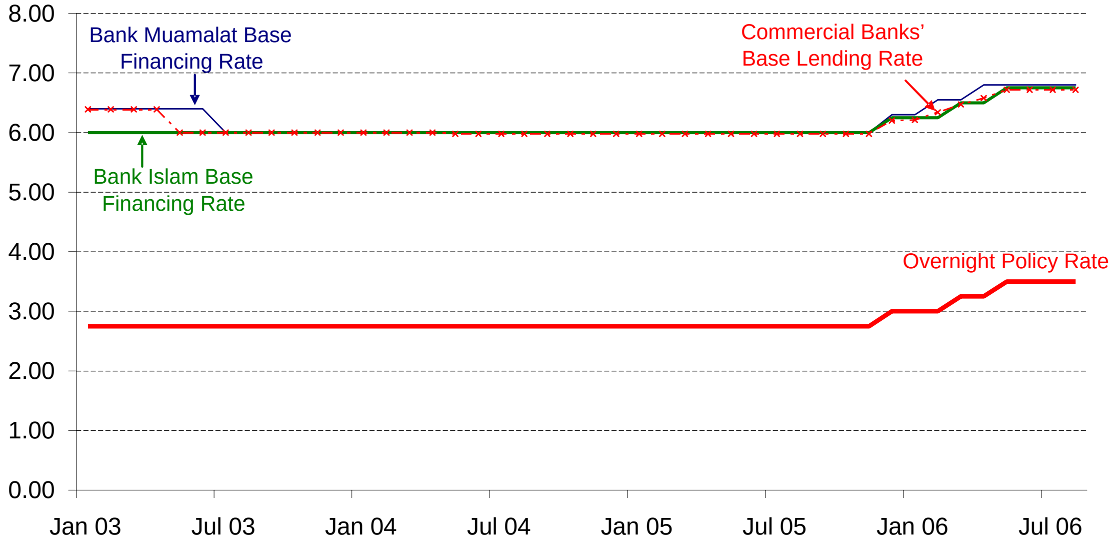
[9] The Islamic banking institutions are allowed to make monthly provisions up to 15% of the gross income plus net trading income, other income and irregular income such as recovery of non-performing financing (NPF) and write-back of provisions.

comparison needs to be made of the differential between the cost of new Islamic loans against rates on new conventional loans to determine if Islamic loans are priced higher to compensate for the interest rate risk, particularly in a rising interest rate environment like the one experienced recently.

Chart 17

Islamic & commercial banks prime lending rates



At present, the relatively smaller size of the Islamic banking system has limited its overall significance in the monetary transmission mechanism. However, this will change over time. It is projected that the Islamic banking and takaful industry could represent about 20% of the banking and insurance market share by 2010. Consequently, it is imperative that more research is undertaken to better understand the implications of the Islamic banking system for the speed and magnitude of transmission of monetary policy.

3.4 Increased financing for the SMEs

As shown in Chart 9, almost 87% of SME financing comes from sources other than the banking system. The rest of the funding comes from the informal sector, self-funding, special government funds, and the developmental finance institutions. The differentiated market rates offered to the SME sector, some at below market rates and on fixed terms, may result in a slower transmission of policy rates to this sector. The straightforward implication is that changes in the policy rate do not easily transmit to these rates and therefore do not affect the cost of financing for this class of borrowers. This is true for special funds set up by the government whereby the rates offered on the loans are fixed and mostly set below market rates. For DFIs, their lending rates may differ from the commercial banks' average lending rates not only in terms of the levels, but also in terms of their movements in response to policy rate changes (Chart 10). In part this reflects the different management and capital structure of the DFIs, which influences their cost structure. However, the size of funding from DFIs remains small relative to funds sourced from the banking sector.

SMEs now account for close to one fifth of bank loans and their share is growing rapidly. Moving forward, the bulk of their funding will increasingly be from sources that are directly affected by changes in the policy rate.

3.5 Openness of the Malaysian economy

The standard view on the role of the exchange rate in the transmission mechanism of monetary policy is that the larger the external sector of an economy, the greater would be the role of the exchange rate as a channel of monetary transmission. Nonetheless, many studies of open economies find that the exchange rate does not play as significant a role in transmitting monetary policy as predicted by standard theory. BNM's estimates show that the ratio of the exchange rate channel to the interest rate channel is 1:4 for Malaysia. In other words, the interest rate channel is as much as four times more important than the exchange rate in transmitting monetary policy impulses.

According to the standard theory, changes in monetary policy lead to changes in nominal and real domestic interest rates. These changes affect capital flows and portfolio reallocation and hence lead to changes in the nominal and real exchange rate. In essence, this theory assumes a perfect transmission from real domestic interest rates to the real exchange rate. However, the transmission from domestic real interest rates to the real exchange rate is far from perfect. Changes in domestic real interest rates are not the only factor that drives capital flows and other determinants of the exchange rate. The relative valuation and performance of domestic and foreign equity markets, political developments, trade shocks, inflation expectations and currency speculation are some of the factors that have an impact on the exchange rate. Hence, the dominance of these other factors in more open economies will result in changes in domestic real interest rates having a relatively weaker impact on the real exchange rate, making this channel of less importance in the monetary transmission process despite the large size of the external sector.

The sample correlation[10] between exchange rate and interest rate for Malaysia is rather small (0.09) compared to comparatively closed economies such as the United States (0.27), Australia (0.67) and Japan (0.49).[11] The relatively weak relationship between exchange rates and interest rates indicates, to some extent, that in some cases the connection between monetary policy and the exchange rate is not strong. Despite the economy being very open, the actions taken by the authorities to mitigate the impact of large capital flows and exchange rate changes on the domestic economy affect the impact of external developments on the exchange rate channel.

For countries with a high degree of trade openness, it can be shown that the exchange rate is important in influencing the real economy. Chart 18 depicts the scatter plot of the changes in output due to changes in the exchange rate relative to the changes in output due to changes in the interest rate.[12] With the exception of Japan,[13] it can be deduced that as countries become more open, exchange rate changes relative to interest rate changes have a greater influence on the variation in output. It follows that there exist incentives for authorities to intervene directly in the foreign exchange markets to smoothen the exchange rate, which to some extent may mitigate the impact of changes in monetary policy on the exchange rate. In countries like Malaysia that have a relatively shallow foreign exchange market (Chart 19), it does not take a very large transaction to drive the exchange rate to some level that may not be reflective of and consistent with economic fundamentals.[14] Such

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[10] Apart from the sample correlation, the pass-through from interest rate to exchange rate was also estimated. However, the results are not statistically significant and hence are not reported.

[11] The sample correlations are estimated using data from 1990:Q1–1997:Q2.

[12] Bank Negara Malaysia's estimates using data from 1990:Q1 to 2006:Q1.

[13] The result for Japan is within expectations, as its interest rates were kept relatively stable during the period under review.

[14] An example would be the repatriation of profits and dividends abroad of a large multinational firm operating in Malaysia.

distortions can often last for prolonged periods. In this case, central banks may have to intervene to moderate the impact of such transactions.

Chart 18

Exchange rate changes have a bigger impact on more open economies

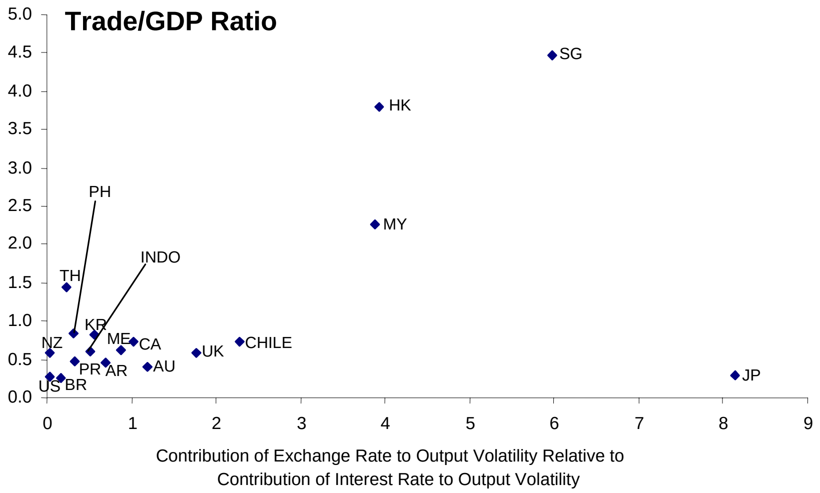
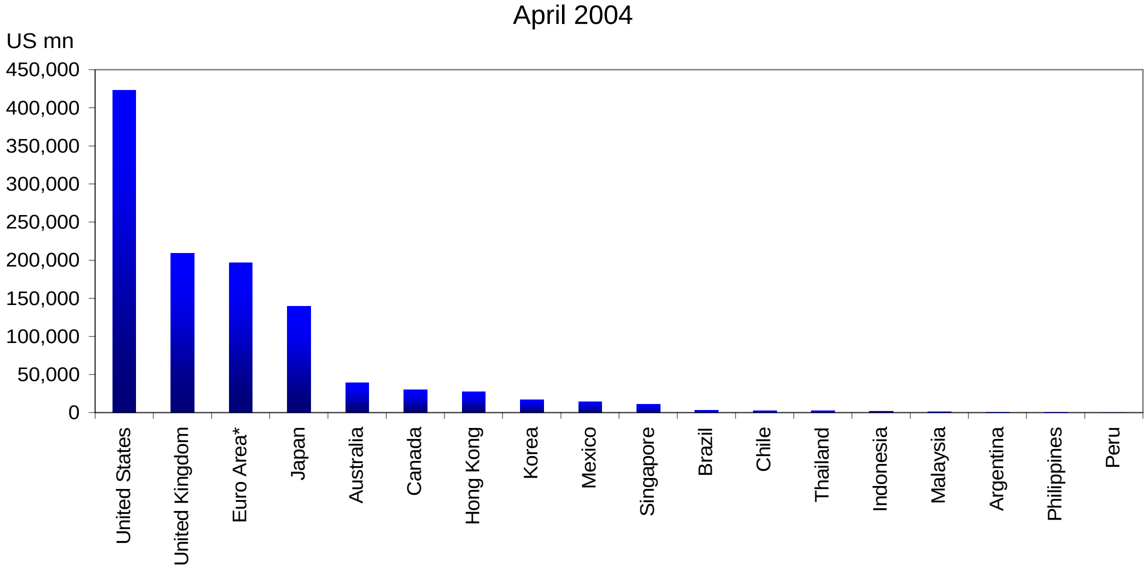


Chart 19

Daily average foreign exchange turnover in selected countries

April 2004



Source: BIS Triennial Central Bank Survey 2004.

Therefore, ***in more open economies the role of the exchange rate as a channel of transmission of monetary policy may not be of the magnitude traditionally postulated by the conventional theory of the monetary transmission mechanism***. This is the outcome of both the impact of other non-monetary factors that influence capital flows and the exchange rate, and of policymakers' intervention to mitigate large exchange rate volatility, given the significant impact of exchange rate developments in more open economies.

4. Conclusions

The paper highlights some key developments in the Malaysian economy and financial system that could have important implications for the channels and relative magnitude of monetary transmission in Malaysia and, hence, the conduct of monetary policy. These developments include the evolution of a more resilient, efficient and competitive financial system, the development of diversified sources of financing, the emergence of a stronger and more influential Islamic financial system, the increasing importance of financing the SMEs as a major driver of investment and growth as well as the high degree of economic and financial openness of the Malaysian economy.

The results show some mixed evidence on the transmission mechanism:

- Positive developments in the financial sector had permitted Bank Negara Malaysia to move towards a market-based interest rate determination framework, which has helped to increase the level of interest rate pass-through in Malaysia. This in turn has contributed to the increased effectiveness of monetary policy.
- The diversified sources of financing, especially from the capital markets, have not impacted monetary transmission in a significant way. Changes in the policy rate have been effectively transmitted and reflected in the costs of raising new funds from the capital market and in financial asset prices.
- At present, the impact of different structure and returns under the Islamic financial system has not had any discernible impact on the effectiveness of the monetary transmission, with pass-through remaining high from policy rates to Islamic money market rates. However, at this stage we can only conjecture about the impact on retail Islamic rates, due to the paucity of data. However, given the growing importance of the Islamic financial system, the implications for monetary policy deserve careful study.
- For the SMEs, the present financing structure is expected to change moving forward as the SME sector increasingly obtains more of its financing from sources whose costs are directly influenced by the policy rate.
- Finally, for open economies, the exchange rate has an important impact on the economy, but its role as a monetary transmission channel may not be as significant as conventional theory tells us.

The monetary transmission mechanism in Mexico: recent developments

José J. Sidaoui and Manuel Ramos-Francia[1]

I. Introduction

Monetary policy actions are transmitted to the economy through several channels. The relative importance of the different channels and how they change through time, along with the lagged effect of these actions on key variables, are crucial for monetary policy decision making. This paper provides an overview of the transformation of the Mexican economy in recent years and analyzes its implications for the inflation process and the monetary transmission mechanism. After a brief review of the macroeconomic policies and financial reforms that have taken place over the past decade, we summarize recent research undertaken at Banco de México that suggests significant changes in inflation dynamics and in some of the channels of monetary policy transmission have taken place in the last years. We also present estimates to illustrate the increasing importance of the credit and expectations channels of monetary policy transmission, using VAR analysis and a small-scale macroeconomic model.

During the last decade, the inflation process and the monetary transmission mechanism in Mexico have undergone important changes. The decade was marked by the recovery from the 1995 financial crisis. Fiscal and monetary policies have been oriented towards the attainment of macroeconomic stability as a necessary condition for sustainable growth. Macroeconomic stability, together with financial reforms and other measures to improve the regulatory and supervisory frameworks of the financial system, have allowed the restoration of credit and the development of deep and liquid financial markets.

The level and volatility of inflation have not only declined in recent years, but also its persistence has decreased notably (Capistrán and Ramos-Francia (2006)). Moreover, evidence suggests that inflation has switched from a non-stationary to a stationary process (Chiquiar, Noriega and Ramos-Francia (2007)).

The adoption of macroeconomic policies conducive to stability (ie fiscal discipline, a floating exchange rate regime, financial sector reforms, and an inflation targeting framework to conduct monetary policy) have improved the functioning of the economy's nominal and real systems, thus, reshaping the channels of monetary transmission. The transmission mechanism of monetary policy indeed seems to have changed (Gaytán and González-García (2006)).

With respect to inflation targeting, there is empirical evidence of the benefits of this policy framework in anchoring inflation expectations (Capistrán and Ramos-Francia (2007)). Inflation targeting has not only implied a change in the policy reaction to different shocks that affect inflation but, as the functioning of the economy's nominal system, and thus that of the real economy, have markedly improved in recent years, it has also contributed to change the

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[1] Banco de México. The views and conclusions expressed in this paper are solely those of the authors and do not necessarily reflect those of Banco de México. We would like to thank first Alejandro Gaytan, whose help proved invaluable in this task. We would also like to thank Ana Aguilar, Alejandro Díaz de León and Alberto Torres for helpful comments and suggestions. Finally, Jorge Mejía, Claudia Ramírez and Gabriel Ruíz provided excellent research assistance.

way in which the stance of monetary policy is transmitted to other variables. Regarding the exchange rate, the information content about inflationary pressures derived from changes in this variable has decreased considerably. On the one hand, real exchange rate shocks are now absorbed more by the nominal exchange rate and less by domestic inflation (Gaytán and González-García, op cit). The results presented in this paper show that there has been a significant reduction in the pass-through from the exchange rate to prices and, thus, in the relative importance of the exchange rate channel in recent years.[2]

Two additional channels of monetary transmission are explored in this paper: the credit and the expectations channels. Regarding the effects of monetary policy on lending, the results are still mixed. Firms' financing through securities has recently become more responsive to interest rate fluctuations. Nevertheless, statistical exercises suggest that the interest rate does not seem to have the expected effect on bank credit to households. Possible explanations for this result concern both the demand for and the supply of credit. On the demand side, after several years of tight credit constraints, households in Mexico are rapidly increasing their demand for consumption and mortgage credit, possibly implying a temporary relatively-low sensitivity of demand to the interest rate. On the supply side, the restitution of soundness to the banking system, enhanced credit information and contract enforcement, and a greater availability of financial resources have also complicated the evaluation of the effects of monetary policy on banks' supply of credit. However, as households approach their desired level of indebtedness and the one-off effects of the improvement in financial conditions start to wear off, the traditional interest rate (intertemporal substitution of consumption) and credit channels of monetary policy transmission will tend to strengthen.

Monetary policy has been able to induce a stronger and faster reduction of inflation in recent years. However, the traditional interest rate, exchange rate, and credit channels of monetary policy transmission cannot account completely for this change. The expectations channel of monetary policy has also contributed substantially to this result. Ramos-Francia and Torres (2006) use a New Phillips curve framework to analyze whether in recent years, as the economy has converged to a low inflation environment, the relative importance of the backward- and forward-looking components of inflation in explaining its short-run dynamics has changed. In effect, under the assumptions used in that approach, evidence suggests that the fraction of firms that set their prices using a backward-looking rule of thumb has decreased, and that the forward-looking component of the inflation process has gained importance. This paper extends the analysis on the change in relative importance of these two components by using a rational expectations small-scale macroeconomic model. We find an increasing role of expectations in determining the response of the economy to shocks. The change in the importance of expectations has contributed to allow a faster reduction of inflation at a lower output cost.

The structure of the paper is as follows. Section II presents a review of macroeconomic policy and financial reforms over the last decade. Section III presents a first attempt to intuitively explore the consequences of these policies on the operation of the different channels of the monetary transmission mechanism. Section IV presents statistical evidence of the changes that have taken place in the inflation process and in the transmission mechanism of monetary policy. For this purpose, Section IV.1 summarizes recent research undertaken at Banco de México and introduces new estimations of the nominal exchange rate and the credit channels. Section IV.2 presents evidence of the changes in the expectations channel of monetary transmission. Concluding remarks are made in Section V.

2 Previous research found a large exchange rate pass-through, even after the adoption of a floating exchange rate, concluding that the exchange rate channel was the main channel of monetary policy transmission.

II. Macroeconomic stabilization and financial reforms

II.1 Fiscal and monetary policies

At the end of the eighties and beginning of the nineties, stabilization efforts were undertaken to end the recurrent financial problems that the Mexican economy had undergone since the 1982 external debt crisis. The main elements of this stabilization program were: a fiscal retrenchment effort, a renegotiation of Mexico's external public debt, negotiations to limit and coordinate price and wage increases, and the use of the exchange rate as the nominal anchor of the economy, through a quasi-fixed exchange rate regime. Initially, the new policy framework was successful, as annual inflation decreased from 159.2 percent in 1987, to 8.0 percent in 1993.

The signing of NAFTA, the liberalization of the capital account, and financial sector changes, such as the privatization of the banking system, the abandonment of forced loans, reserve requirements, and interest rate ceilings, led, in a context of high liquidity in international markets, to large capital inflows. These capital inflows fed a lending boom,[3] which transformed into an expenditure boom and an increasing current account deficit.

Financial liberalization, however, was not accompanied by adequate regulation and supervision of banks. The combination of weak regulatory and supervisory frameworks and ample liquidity in the market generated a credit portfolio of dubious quality and the accumulation of significant currency and maturity mismatches in banks' balance sheets. In addition, as several shocks affected the economy, deteriorating Mexico's macroeconomic situation, the federal government changed the composition of its debt to short-term dollar-denominated securities in an effort to stave off the adjustment that would have otherwise led to a financial crisis.

With the sudden reversal of capital flows at the end of 1994, defending the exchange rate became unsustainable. Mexico was forced to abandon the peg, generating a significant exchange rate adjustment that fed inflationary expectations. As a result, interest rates escalated and economic activity fell sharply. These developments, together with the currency and maturity mismatches of commercial banks' balances and the profile of the government debt, threatened the viability of the financial sector. In order to avoid a systemic run on banks, depositors were backed in full by the federal government. Several programs were put in place to attain this objective: (i) short-term dollar financing to commercial banks; (ii) subordinate debt programs to capitalize banks; (iii) interest rate discounts for debtors on performing loans; (iv) purchases of bank loans at book value if banks brought in additional resources to increase their capital; and (v) intervention of non-viable banks.

On the fiscal front, two immediate measures were implemented after the crisis. First, the government negotiated an international financial assistance package of over 50 billion dollars, to meet the large amount of its short-term dollar-denominated liabilities. Second, to induce an orderly macroeconomic adjustment consistent with the sudden stop of capital flows, fiscal policy was oriented to increase public savings through a rise in indirect taxes and public prices, and a contraction of public expenditures (Ramos-Francia and Torres (2005)). In addition to the necessary reduction in absorption, in the following years fiscal policy had to deliver additional margins to absorb the cost of the programs that were put in place to cope with the banking and financial crisis. Since then, the fiscal balance has remained in equilibrium. The economic deficit has represented, on average, 0.58 percent of GDP and, in 2006, –0.1 percent, as compared to an average of 9.87 percent during the eighties. A broader definition of the fiscal deficit, the public sector borrowing requirements (PSBR),

3 Bank credit to the private sector reached record high levels, accounting for 34 percent of GDP in December 1994.

which includes the change in contingent liabilities – PIDIREGAS, IPAB, FARAC liabilities, and debtor programs has represented, on average, 3.3 percent of GDP during the last ten years, and 0.87 percent in 2006.[4]

Fiscal discipline has allowed for an important reduction of public debt in recent years. For example, while in the mid-eighties Banco de México's definition of Broad Economic Debt reached levels close to 90 percent of GDP, by December 2006 it accounted for only 18.3 percent of GDP.[5]

Moreover, public debt management has been oriented to improve the amortization schedule and to reduce both financial costs and exchange rate vulnerabilities. Nominal stability, financial integration, and the reduction of the market's perception of risk for investments in Mexico have made possible the development of liquid markets for government bonds of different maturities.[6] These factors have allowed the federal government to rely less on external debt markets and to attain a significant increase in debt maturity and duration, reducing the vulnerability of public finances to changes in interest rates and to exchange rate fluctuations.

With the abandonment of the peg in late 1994, monetary policy had to become the nominal anchor, in an environment of severe financial distress and widespread uncertainty about the central bank's ability to achieve price stability.[7] In this context, after the crisis monetary policy at first established a strict limit on the expansion of net domestic credit and a non-negative international assets accumulation target. The objective was twofold: first, to signal that the central bank would not validate further runs on the currency and, second, that the economy could only remonetize through its external accounts.

After the initial turmoil of the crisis, Banco de México introduced transparent and non-discretionary mechanisms of intervention in the foreign exchange rate market (Ramos-Francia and Torres (2005)). The purpose was to avoid excess volatility and to build up the stock of international reserves, while at the same time to prevent these interventions from affecting the floating exchange rate regime, which could be misinterpreted as signals of changes in the stance of monetary policy.

The general strategy of monetary policy relied on three main elements: to maintain a clear restrictive bias in order to induce sustainable reductions of inflation and inflation expectations; to respond appropriately to inflationary shocks; and to improve its transparency (Ramos-Francia and Torres (2005)).

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[4] These items are not recognized as public debt. However, since they are guaranteed by the government, they represent contingent liabilities. PIDIREGAS are long-term productive infrastructure projects assigned to a third party to make the investment on behalf of the public entities, which in turn pay for the finished projects with the resources generated by the same infrastructure. IPAB is the Mexican deposit insurance corporation. The definition of PSBR includes the service of the net liabilities of this entity that were generated during the 1995 banking crisis. FARAC includes the service of net liabilities of the rescue program of private highways. Until now, the trust has not required fiscal subsidies. Debtor programs are credits that private banks transferred in 1995 to the federal government, on behalf of private debtors which were unable to fulfill their financial obligations with the banking system during the 1995 crisis.

[5] A broader definition of public debt, the Ministry of Finance (SHCP) definition of the Historical Balance of Public Sector Borrowing Requirements (HBPSBR), which includes the aforementioned stock of contingent liabilities (PIDIREGAS, IPAB, debtor programs, and FARAC), available from 1990 to 2007, went from 45.7 percent of GDP in 1990 to 35.9 percent in 2006.

[6] Prior to 1995, the government could not borrow at non-indexed fixed rates using long-term securities. Since 2000, it has been possible to issue government bonds at long maturities and fixed rates. The first issuances of 3-year and 5-year bonds took place in January and May 2000; in July 2001, 10-year government bonds were issued; in October 2003, 20-year bonds were introduced; and, finally, in October 2006, 30-year bonds were auctioned for the first time.

[7] Banco de México gained autonomy in a constitutional reform in December 1993.

By 1998, once the biggest challenges posed by the crisis had been mainly dealt with, Banco de México started to signal a clear bias towards a restrictive monetary policy stance through a negative overdraft target on the cumulative balance of commercial banks' current accounts at the Central Bank (the monetary policy instrument known as the "corto"). In addition, the conduct of monetary policy started a gradual process of convergence towards an inflation targeting framework.

In 1999, Banco de México set a medium-term target for the inflation rate for the first time, ie, its convergence to the levels of those of Mexico's main trading partners by the end of 2003. During 2000, other measures were taken: (i) core inflation was defined; (ii) the communication strategy was strengthened through the publication of Quarterly Inflation Reports; and (iii) an explicit inflation target of 3 percent by the end of 2003 was mentioned for the first time. At the beginning of 2001, inflation targeting was formally adopted. In 2002, an annual inflation rate of 3 percent from 2003 onwards was defined as the long-term inflation target, with a variability interval of plus/minus one percentage point.

Ramos-Francia and Torres (2005) document the policy response to demand and cost-push shocks for the 1998–2003 period. They find that the response of monetary policy was consistent with the inflation targeting framework, as the central bank tightened its policy in response to demand pressures, doing likewise in the case of supply shocks when the latter affected inflation expectations.

Significant progress in abating inflation has been attained as a result of the macroeconomic policies implemented after the 1995 crisis. Annual CPI inflation declined from 52 percent in 1995, to 4.05 percent in 2006.[8, 9]

An important element of the macroeconomic framework has been the floating exchange rate regime. In a context of macroeconomic stability, a floating exchange rate adjusts much faster to different shocks, and real shocks are absorbed by the economy more through nominal exchange rate fluctuations and less through changes in inflation differentials. Of course, a floating exchange rate also reduces the incentives for excessive risk taking and thus for speculative capital inflows.

II.2 Financial policies and reforms

A sound financial system is important not only to foster financial intermediation, but to maintain the effectiveness and credibility of fiscal and monetary policies.

The 1995 crisis uncovered several deficiencies in the regulatory framework of banks. In particular, this framework did not provide proper incentives for the healthy development of

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[8] Global conditions have been favorable for emerging economies in recent years, contributing to disinflation, lowering risk spreads, and improving the terms of trade. In developing countries, annual inflation fell from 36.7 percent in the eighties, to 5.1 percent in 2005. Stabilization efforts in Mexico and other countries have clearly benefited from a benign global inflation outlook. Among the microeconomic factors underlying this process, the following deserve mention (Rogoff (2006)): (i) greater competition in goods and services as a result of increasing trade; (ii) increased labor supply worldwide as a result of the greater presence of countries like China and India, which has helped to reduce labor costs and the price of labor-intensive goods and services; and (iii) technological progress, which has fostered productivity growth in several advanced economies. While this benign global environment has probably helped macroeconomic stabilization, sound macroeconomic policies have been fundamental for this outcome. In addition, an environment of ample liquidity and high risk appetite in global markets have allowed for a reduction of emerging markets' risk spreads to record low levels.

[9] More recently, the benign effects of globalization on inflation seem to be wearing off, while the adverse effects through high commodity prices seem to have gained in relative importance. Additionally, the sub-prime housing credits episode in the US could trigger a reverse of favourable conditions in credit markets.

the financial system. Full deposit insurance, poor information disclosure requirements, inadequate risk valuation, and underestimated capital requirements generated perverse incentives for excessive risk taking. Among the main financial reforms undertaken in the last decade, the following should be highlighted:

(i) With the abandonment of the rigid exchange rate regime, immediate measures were implemented to develop the foreign exchange market and thus guarantee the effective functioning of the new regime.

(ii) Prudential regulation and effective supervision of financial intermediaries, among others, have been put in place, to create the right incentives for financial institutions, debtors, and creditors. Within these reforms, the following deserve mention:

   (a) To mitigate moral hazard problems, limits to deposit insurance and to related lending were established, and stricter capital adequacy regulations were adopted.

   (b) Some measures were undertaken to improve information on both borrowers (credit bureaus) and financial intermediaries (disclosure requirements, accounting standards).

   (c) Improved evaluation systems of financial institutions' risk management standards (value-at-risk, stress tests, etc.), and measures to upgrade financial supervision and increase market discipline were implemented.

(iii) A new bankruptcy law was enacted. The crisis unveiled that the existing law was not efficient in enforcing contracts, especially in a situation of systemic risk, because it implied large and costly legal disputes, creating incentives for borrowers to renege on their debts.

(iv) The banking law was amended, eliminating ownership restrictions on foreign individuals, as long as they comply with certain legal requirements. This change allowed a faster capitalization of banks.

(v) The development of financial instruments and markets for risk coverage was encouraged. Banco de México lifted the legal restrictions that limited the use of derivative instruments by commercial banks, and published the guidelines and standards of prudent risk management for financial intermediaries operating in these markets.

(vi) The reform of the pension system (SAR) modified the system from a pay-as-you-go to a defined contribution scheme.[10] This reform improved the long-term sustainability of the pension system and has been of great relevance for the development of the financial sector in Mexico, as it has increased the level of private financial savings to record highs.[11]

[10] The SAR refers to the pension system. The new pension system law (Ley del SAR) was enacted in 1996 and covers only pensions of private sector employees/workers. Federal government, state, county, and public enterprise employees/workers were not subject to the new law. Recently, in March 2007, the federal government pension system law (Ley del ISSSTE) was changed to a defined contribution scheme.

[11] At the end of 2006, SAR savings accounted for 13 percent of GDP and 34 percent of household savings.

III. The channels of monetary policy transmission

The monetary transmission mechanism can be broadly defined as the way in which policy-induced changes in short-term interest rates or the money stock affect economic activity and inflation (Ireland (2006)). Although monetary policy is neutral in the long run, in the short and medium term, it can affect economic activity through several channels. The operation of these channels changes across countries due to differences in openness, financial system development, inflation history, constraints on monetary policy, etc.

This section explores the effects of the macroeconomic policies and financial reforms undertaken over the last decade in light of the different channels of transmission of monetary policy, to provide an intuitive exploration of the operation and possible changes of these channels. A crucial element leading to these changes has been the reduction of inflation and inflation uncertainty. Low and stable inflation provides certainty to financial contracts, reducing the risk premium in interest rates and allowing for longer term contracts (Figure 1). This has lowered borrowing costs for the private and public sectors alike, making it possible to obtain credit at longer maturities, and therefore fostering the development of the domestic financial system. Macroeconomic stabilization and financial reforms have also allowed a continuous increase in financial savings. While in the eighties financial savings in domestic assets (M4) represented, on average, 26.5 percent as a proportion of GDP, in 2006 they represented around 50 percent (Figure 2).

A key issue associated to the monetary transmission mechanism is the extent to which monetary policy is able to induce changes in the complete spectrum of interest rates. In principle, the transmission from a policy-induced change in the short-term interest rate to the entire yield curve is done by the markets, through trading based on investors' expected returns on financial instruments at different maturities. Thus, the effect of monetary policy on the term structure is strongly influenced by the depth and liquidity of security markets.

As a consequence of inflation stabilization and fiscal discipline, in recent years, the government has been able to issue long-term securities at fixed rates, allowing a longer yield curve and, therefore, extending considerably the average maturity and duration of government debt bonds. While in December 1994 the average maturity of government debt was 230 days, by December 2006 it was 1,559 days (Figure 3). Long-term government securities have also served as a benchmark for the development of other private long-term instruments.

Since long-term interest rates reflect risk-adjusted expectations on future short-term rates, when inflation expectations are well anchored, a monetary tightening can be associated with a flattening of the yield curve. In this respect, ongoing research at Banco de México shows that the effects of monetary policy on the term structure of interest rates have changed. In the past, a policy-induced change in the overnight rate seemed to generate parallel movements in the yield curve, possibly because of problems of signal extraction or lack of credibility. Indeed, in a context of uncertainty about inflation, it is more difficult to disentangle movements in the cost of funds from the adjustments in risk premium. However, forthcoming research suggests that, in recent years, there is a flattening of the yield curve after a monetary policy tightening (Cortés et al (2007)).

III.1 The traditional interest rate channel

The traditional interest rate channel works directly through aggregate demand. A policy-induced change in the interest rate is transmitted to the entire yield curve and, in the presence of nominal rigidities, leads to a change in real interest rates. Consequently, the cost of borrowing for firms changes, affecting operating capital and investment expenditure plans and, thus, aggregate demand. On the other hand, an increase in the interest rate generates a change in the relative price of present and future consumption and, therefore, an intertemporal substitution of consumption that reduces current aggregate demand. It is noteworthy that in economies with high and volatile inflation, the level of the real interest rate is uncertain, which, among other factors, reduces the effectiveness of this simple channel.

In recent years, households' demand for credit in Mexico has shown a low sensitivity to interest rate movements. An explanation of this fact is that after the 1995 crisis, households faced several years of tight credit constraints and, as these constraints have started to loosen, households have increased their pent up demand for credit.

III.2 The credit channel

There are two main channels of monetary transmission that rely on credit market frictions: the bank-lending or narrow credit channel, and the balance sheet or broad credit channel. The bank-lending channel associates the effects of monetary policy to movements in the supply of bank credit, reducing economic activity through its effect on expenditures (investment, working capital, and consumption) of bank credit-dependent borrowers. There are two main explanations for the reduction in the supply of credit. The first view is related to adverse selection. An increase in the interest rate leaves a riskier pool of households and firms willing to borrow, which increases monitoring costs and induces credit rationing. The second view assumes that a monetary tightening drains liquidity from the banks (Bernanke and Blinder (1988)), inducing a reduction in banks' liabilities and increasing the costs of intermediation. A monetary policy tightening is usually assumed to reduce the ability of banks to obtain deposits. If banks cannot adjust their balance sheets by reducing their holdings of non-credit short-term assets, the supply of credit will decrease. Thus, the relevance of this mechanism depends on banks' ability to substitute deposits with other funds.[12]

The significance of the bank-lending channel depends on the number of bank-dependent borrowers and the quantitative impact of monetary policy on the supply of bank loans. Thus, in countries with no alternative sources of financing other than bank credit, this channel is likely to be more important. On the other hand, banking crisis episodes that generate a severe reduction in the supply of loans reduce the relevance of the credit channel of monetary policy.

With respect to the broad credit or balance sheet channel, the effects of monetary policy are derived from a propagation mechanism through the financial health of firms. In the presence of financial market imperfections, firms must pay a premium on external financing (from banks or any other external source), and this premium depends on the strength of its balance sheet. A firm with a higher net worth faces a lower cost of external finance. A monetary tightening can affect a firm's balance sheet in different ways: it increases the payments that the firm must make to service its debt, it reduces the firm's cash flow, and it reduces the net worth of the firm when the increase in interest rates reduces the price of borrowers' assets (equity, real estate, etc.). Therefore, the change in the cost of borrowing faced by a firm can differ from the change in the interest rate induced by monetary policy. The balance sheet channel has been termed the financial accelerator as it amplifies the initial effect of monetary policy (Bernanke et al (1999)).

In Mexico, the significant and lasting disruption of credit markets generated by the financial crisis of 1995 thwarted the operation of the traditional interest rate and credit channels of monetary transmission. A severe credit crunch took place after the crisis, and credit in some markets, like the mortgage market, practically disappeared for several years. This implied a

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[12] Romer and Romer (1990) argue that following a monetary tightening, banks may issue money market liabilities to offset the drop in deposits. Nevertheless, the costs of these funds are generally higher than the cost of deposits.

severe tightening of credit constraints for firms and households. Commercial banks' direct credit to the non-financial private sector (households and firms) went from 39.5 percent of GDP in December 1994, to 7 percent in June 2002, and, excluding non-performing loans, these figures accounted for 35.9 percent and 6.1 percent of GDP, respectively.[13]

In recent years, commercial bank credit to the non-financial private sector has recovered significantly. In particular, credit to households has been the most dynamic component of commercial bank credit, with an average annual real growth rate of 30.2 percent during 2002-2006 (albeit from a still relatively low base). This expansion has implied a change in the structure of banks' portfolio, as the stock of credit to households has become, since the beginning of 2006, the main component of bank credit to the private sector.

Macroeconomic stability and the restoration of banks' financial health, among other things, have contributed to the recovery of bank credit to the private sector. Nevertheless, there are two important recent developments that deserve mention: (i) the reduction of banks' financing to the public sector borrowing requirements have freed bank resources, which, in turn, have been shifted towards credit to households and, more recently, towards small and medium enterprises (Figure 4);[14] and (ii) the development of financial markets has allowed large corporations to obtain financing at lower interest rates by issuing domestic securities.

These two developments have various outcomes. First, they imply an efficient reallocation of resources as both the government and large corporations can obtain cheaper financing in security markets, and banks can use their comparative advantage in monitoring and reducing information frictions, which, usually, are not as important when dealing with the government and large firms. Second, the reallocation of bank funds generates a loosening of credit constraints for households and medium and small firms. Since these sectors are the traditional bank-dependent borrowers, the bank-lending channel should strengthen. In addition, the easing of credit constraints has allowed households to maintain a smoother consumption pattern during the last business cycle. Finally, the development of private sector security markets is likely to strengthen the balance sheet and the asset price channels of monetary policy.

Households' low-levels of indebtness and greater access to credit help explain why their demand for credit has exhibited small interest rate elasticity in recent years. For example, the short-term interest rate increased by slightly more than 400 basis points during 2004, but credit to consumption continued to grow vigorously. On the supply side, the restoration of health to the banking system, improving credit information and contract enforcement, the increasing importance of non-bank financial intermediaries, lower financing needs from the public sector and the development of financial markets that allows large corporations to obtain financing through securities, have increased the resources available to finance the private sector. Ample liquidity in international financial markets has also played a role in increasing the supply of funds. These developments pose some challenges when attempting to evaluate the credit channel of monetary policy, as will be shown in the next section. Nonetheless, these should be transitory phenomena. As households approach their desired level of indebtedness and the one-off effects of the improvement in financial conditions wear off, the intertemporal substitution of consumption and the credit channel of monetary policy will tend to strengthen.

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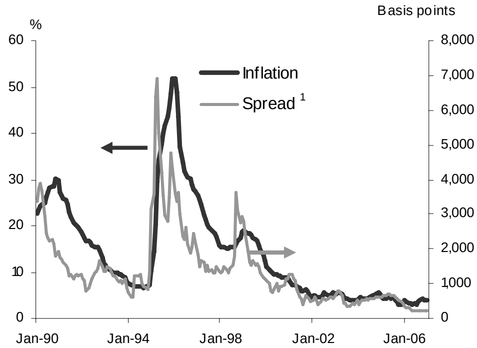
[13] These figures exclude the credit portfolio bought by Fobaproa to the commercial banks (Fobaproa is the Mexican deposit insurance corporation, now IPAB).

[14] The reduction of bank financing to the public sector borrowing requirements is a consequence of smaller public sector deficit, and the reduction of the stock of public sector contingent liabilities (mainly IPAB and debt restructuring programs) with commercial banks.

Figure 1

Inflation and spread of CETES and US 3-month T-bills



[1] Domestic interest rate (CETES) minus foreign interest rate (3-month T-bills).

Figure 2

Inflation and ratio of M4 to GDP

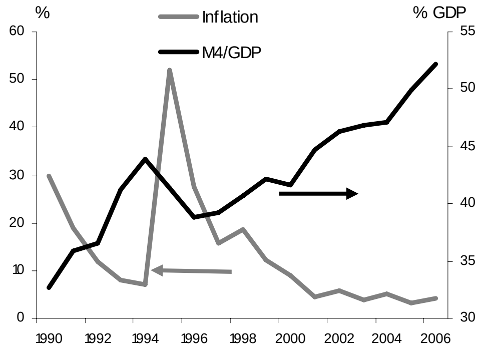


Figure 3

Average maturity and duration of government securities

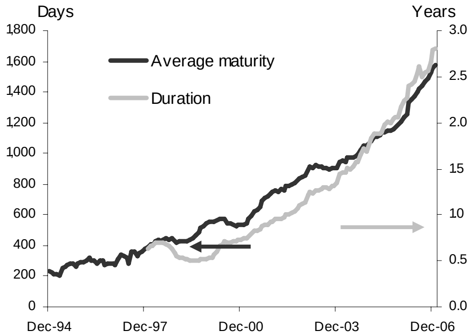
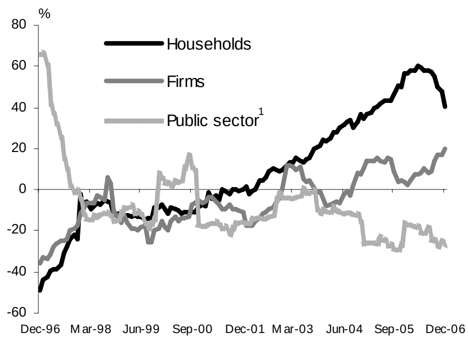


Figure 4

Commercial bank credit annual rate of growth



[1] Includes federal government, states and municipalities, IPAB, FARAC, PIDIREGAS, and debt restructuring programs.

III.3 The asset price channel

There are four categories of asset prices that provide important channels through which monetary policy affects the economy: securities' prices, stock market prices, real estate prices, and exchange rates. The exchange rate channel is treated separately due to its importance in emerging economies. The remaining asset price channels work mainly through wealth and balance sheet effects on households and firms.

In developed economies, the asset price channel is important for the household sector. Access to a broad set of financial and physical assets generates a large wealth effect when these prices move. The reduction in asset prices generated by a policy-induced increase in the interest rate depresses households' expenditure, particularly of consumer durable goods and housing.

For firms, Tobin's *q* measures the ratio of the value of the firm to its replacement cost of physical capital. Therefore, the lower the Tobin's q, the more costly financing of the firm will be, and a reduction in the price of its equity, generated by an increase in interest rates, makes investment more costly. On the aggregate level, a reduction in equity prices reduces investment, aggregate demand, and output. As mentioned before, a reduction in firms' value may also have an effect on economic activity as it implies a deterioration of their balance sheets and an increase in their cost of external financing.[15]

In developed economies, a change in the stance of monetary policy is transmitted through a rebalancing of agents' portfolios that affects the prices of other financial and durable assets and, thus, their rates of return. In many developing countries, the menu of assets available to private agents is more limited. Securities and equity markets lack the depth and capitalization to have a significant effect on the spending decisions of agents.

In the case of Mexico, the development of government and corporations' securities markets might produce a stronger asset price channel in the future. On the other hand, with respect to equity markets, the low level of market capitalization limits the effectiveness of this channel. In 2006, market capitalization represented 41 percent of GDP, while in economies like Chile and Brazil, it accounted for 120 and 67 percent of GDP, respectively.

With respect to real estate prices, although the mortgage market has shown a vigorous recovery in recent years, the current stage of development of financial markets still does not allow for a significant asset price channel through housing prices. The asset price channel of illiquid assets – such as real estate – requires agents to have wide access to financial markets and to be able to use their real estate equity to finance expenditures. Development of these markets in Mexico is still in its early stages. Nevertheless, in recent years, the development of the financial system has allowed other non-bank financial intermediaries to securitize mortgages, thus increasing the funding possibilities and allowing them to concentrate on generating mortgage credits.

III.4 The exchange rate channel

The conventional transmission mechanisms of the exchange rate work directly through its effect on import prices and through its impact on aggregate demand via net exports. When a monetary policy tightening increases the domestic interest rate relative to the respective foreign rate, equilibrium in the foreign exchange market calls for a gradual depreciation that reestablishes the no arbitrage condition. The expected future depreciation requires an initial appreciation that, when prices are slow to adjust, makes domestic goods more expensive relative to foreign produced goods, reducing net exports and, therefore, aggregate demand.

Nevertheless, the exchange rate appreciation may also have some other effects that counteract, at least partially, the reduction in net exports. In particular, movements in the exchange rate may have an impact on the balance sheets of financial and non-financial firms. When firms have important net liabilities denominated in foreign currency, an

[15] A recent debate related to the asset price channel is whether monetary policy should respond to movements in asset prices. Bernanke and Gertler (2001) argue that monetary policy should ignore movements in asset prices except insofar as they affect inflation expectations within the inflation targeting horizon. An opposite view is held by Cecchetti et al (2003), who argue that central banks should respond preemptively to asset price misalignments. Bean (2003) takes an intermediate position between both of these views, and argues that the macroeconomic implications of asset price movements and/or financial imbalances can be adequately embraced within an appropriately flexible and forward-looking concept of inflation targeting. Thus, monetary policy should take into account asset price fluctuations, to the extent that they provide information about the shocks affecting the economy or have implications for inflation and output in the medium term, beyond the usual inflation targeting horizon.

exchange rate appreciation may improve firms' net worth, reduce their cost of external financing and thus, increase aggregate demand.

Another mechanism by which movements in the exchange rate are transmitted to inflation works directly through their effect on inflation expectations. In particular, in some developing countries, a history of high and volatile inflation and unsuccessful exchange rate stabilization programs led to a strong indexation of inflation expectations to the exchange rate.

Most previous research about the transmission mechanism in México found that the exchange rate was the most important channel of monetary transmission, even after the adoption of a floating exchange rate regime. The estimated exchange rate pass-through to prices was considerably high. For example, Garcés (1999) estimated that after 12 months, 80 percent of a nominal depreciation was transmitted to prices. There is, however, growing evidence that the convergence to a low and stable inflation equilibrium has reduced the importance of the exchange rate in the formation of inflation expectations and in the price setting of agents.

III.5 The expectations channel

In recent years there has been a growing recognition of the importance of expectations about the future stance of monetary policy in improving monetary policy effectiveness in stabilizing inflation and output. Since there are costs in changing prices and renegotiating contracts, agents show forward-looking behavior in their setting of prices and wages.

When the commitment of monetary policy to reduce inflation is credible, its effectiveness is enhanced by its possibility to shape inflation expectations. Agents' expectations of the future stance of monetary policy feed back into the present, reducing the need for sharper movements in the interest rate to stabilize the economy. In the face of an expansionary demand shock (e.g. a temporary increase in public expenditure), if the commitment of monetary authorities to lower inflation is credible, agents anticipate a monetary policy response that will increase short-term interest rates to offset inflationary pressures. This perception anchors inflation expectations and thus, wage negotiations and the process of price determination are not contaminated. Since wages are in fact contained, there are no further increases in consumer demand nor in firms' labor costs (no second round effects). Furthermore, since the response of monetary policy to offset the shock is anticipated, firms' do not face a signal extraction problem, in the spirit of Lucas (1972), and their price setting process is not affected. On the other hand, in the presence of a cost-push shock, the credibility of monetary policy and the anchoring of expectations become more important as the central bank can accommodate the shock with fewer concerns about inflation expectations being contaminated. Credibility allows monetary policy to face an improved trade-off between stabilizing inflation and output, reducing the sacrifice ratio of inflation stabilization (see Clarida et al (1999) and Woodford (2001)). An important element in shaping inflation expectations is transparency of monetary policy, as it allows agents to have a better understanding of the central bank's reaction to different inflation pressures.

In Mexico, monetary policy's commitment to reduce inflation has gained credibility by responding in an appropriate manner to inflation shocks and a restrictive bias of monetary policy (Ramos-Francia and Torres (2005)). The benefits of this type of policy have been reflected in the anchoring of inflation expectations.

The way agents form their expectations has changed in recent years. While in the past inflation expectations seemed to be significantly affected by exchange rate fluctuations, the adoption of a floating exchange rate regime, the development of a foreign exchange rate market, and increased credibility of monetary policy have, among others, reduced the information content of nominal changes in the exchange rate for the formation of inflation expectations. All these developments point towards an increasing importance of the expectations channel of monetary transmission in Mexico.

IV. Inflation and the monetary transmission mechanism in Mexico

The stabilization measures and financial reforms undertaken in Mexico have increased the flexibility of the economy to adjust to different shocks. As previously stated, the resilience of the economy has been particularly enhanced by the adoption of a floating exchange rate regime and the inflation targeting framework, fiscal discipline and by the development of the financial system. Macroeconomic stability and an improved financial system have induced changes on the basic economic decisions of agents regarding expenditures, savings, labor, production, and price setting. In this respect, it is likely that the determinants of the nominal system of the economy, and thus the monetary transmission mechanism, have changed along with the policy changes and reforms.

Research on the monetary transmission mechanism has been scarce in Mexico. This is in part a consequence of the context in which monetary policy functioned in the past, and of the large disruption caused by the 1995 crisis. During the seventies and eighties, episodes of fiscal dominance, financial repression, and rigid exchange rate regimes, severely constrained monetary policy. Del Negro and Obiols-Homs (2001) studied the period 1975–1997 and did not find a significant effect of monetary policy on prices and output, while foreign shocks were the main determinants of these variables. As mentioned before, the exchange rate was considered to be the most important channel through which monetary policy was transmitted to the economy.

After several years of stable macroeconomic conditions and better functioning financial markets, it has become possible to perform empirical work about how these conditions have affected inflation and the channels of monetary policy transmission. The possibilities of analysis have greatly improved with respect to a decade ago. For example, in Gil (1998), the proximity of the 1995 crisis limited the possibility of a quantitative exploration of the transmission mechanism. The analysis in that paper was mainly concerned with explaining the monetary policy instrument "el corto".[16]

The following sections present evidence that suggests that the inflation process and the transmission mechanism of monetary policy have changed. First, we present statistical evidence of these changes. For this purpose, we summarize Banco de México's recent research that studies the properties of single variables (inflation and inflation expectations) and VAR analysis applied to the monetary transmission mechanism. The statistical analyses are complemented with a VAR exploration of the pass-through of the exchange rate to prices and of the credit channels of monetary transmission. Finally, we present evidence of the expectations channel of monetary transmission by recurring to the estimation of a small-scale macroeconomic model.

IV.1 Statistical evidence

This section summarizes research undertaken at Banco de México regarding the changes in the functioning of the nominal system of the economy, and provides new empirical work on some of the channels of monetary policy transmission.

[16] More recently, Baqueiro and Sánchez (2001) show some evidence on the operation of the credit channel in Mexico. They show that an increase in real short-term interest rates is associated with an increase in the spread between lending and deposit rates, and the change in the spread has an effect on the output gap. In addition, using firm level data, they explore the effect of the interest rate on suppliers' trade credit using firm level data. They find that increases in the interest rate are associated with an important reduction in suppliers' trade credit.

IV.1.1 Inflation dynamics

Inflation in Mexico has changed significantly. Research at Banco de México shows that, in recent years, inflation has undergone an important reduction in its mean and variance and has become less persistent.

Capistrán and Ramos-Francia (2006) show that these results are not exclusive to Mexico. These authors evaluate the stochastic process of inflation for a group of ten Latin American countries. Of this group, five countries have adopted inflation targeting (Brazil, Chile, Colombia, Mexico, and Peru), while the other five (Argentina, Bolivia, Ecuador, Uruguay, and Venezuela) have not.

Table 1

Inflation persistence in Latin America

Country	1990:01–199–12			2000:01–2006:06		
	α	90% confidence interval		α	90% confidence interval	
		Lower	Upper		Lower	Upper
Argentina	0.72	0.61	0.83	0.75	0.60	0.83
Bolivia	0.29	0.71	0.45	0.82	0.66	0.87
Brazil	0.83	0.66	0.95	–0.06	–0.52	0.81
Chile	–0.21	–0.57	0.58	0.18	0.01	0.42
Colombia	0.62	0.52	0.77	0.67	0.57	0.89
Ecuador	1.00	0.90	1.11	0.59	0.38	0.72
Mexico	0.95	0.88	1.02	0.31	0.17	0.54
Peru	0.25	0.01	0.69	0.28	0.12	0.50
Uruguay	0.22	0.02	0.55	0.85	0.67	0.97
Venezuela	0.79	0.72	0.93	0.96	0.83	1.13

Source: Capistrán and Ramos-Francia (2006).

Inflation persistence is measured by a scalar indicator "α", the sum of autoregressive coefficients of an AR(12) model for the CPI inflation rate. Table 1 presents this persistence measure for the countries under analysis using two samples, the first being for the period from January 1990 to December 1999, and the second from January 2000 to June 2006. The fact that the current degree of inflation persistence is, by historical standards, relatively low in at least six of the ten countries analyzed contrasts with the common view that high inflation persistence is a structural part of an economy, and favors the alternative that changes in monetary policy regime can affect inflation persistence. For example, except for Colombia, inflation persistence seems to have decreased or remained low in all inflation targeters, while it seems to have increased only in non-targeters. Thus the change in inflation persistence cannot be solely attributed to improved global economic conditions. The reduction of inflation persistence in Mexico seems to be significant, as the (point) measure of persistence moved from 0.95 during the nineties, to 0.30 after 2000.

Another important issue related to inflation persistence is whether the inflation series can be represented by a stationary process around a constant mean or a decreasing trend, or whether it is a non-stationary process that follows a stochastic trend. This question is particularly relevant for a country that has adopted an inflation targeting framework, since the main objective of an inflation-targeting central bank is to deliver an inflation rate that is stationary around the target. Chiquiar, Noriega, and Ramos-Francia (op cit) study the change in persistence of the inflation process in Mexico and find that after the end of 2000, CPI inflation can seemingly be characterized as a stationary process around a decreasing trend, while before it was non-stationary. Similar results hold for core inflation.

IV.1.2 Structural changes in the monetary transmission mechanism

The change in the dynamics of inflation raises further questions on whether there have been changes in the reaction of monetary policy and in the overall transmission mechanism of monetary policy. These questions can be explored using vector autoregressive estimations. VARs are commonly used statistical methods to obtain a broad picture of the monetary transmission mechanism.

Before presenting our VAR estimation to identify some channels of monetary transmission, we present previous research done at Banco de México that uses a Markov Switching VAR (MS-VAR) analysis. MS-VARs are useful because they help to identify different regimes (structural breaks) that have prevailed over time. These regimes are identified according to three criteria: the level of the variables, their volatility, and the dynamic relationship between them, captured by the VAR, which is set to describe the monetary transmission mechanism. If a change in the policy rule results in a significant change in the listed criteria, it will be identified as a regime change. In this way, this methodology, at least partially, is less subject to the Lucas Critique than a traditional VAR framework for the study of the monetary transmission mechanism.[17]

Gaytán and González-García (op cit) study the monetary policy transmission mechanism in Mexico using an MS-VAR model, and present evidence that suggests that an important structural change in this mechanism took place around the beginning of 2001. Their model includes the real exchange rate, a measure of activity (the output gap), core inflation, inflation expectations, and the interest rate. In addition, it includes some exogenous variables to control for certain world outcomes: the federal funds rate, the rate of growth in the US manufacturing sector, US commodities (merchandise) inflation – to control for global disinflation – and some measures of international commodity and oil prices.[18]

The regime that prevails at each point in time is given by the probabilities that the estimation assigns to each of the different regimes. Figure 5 shows that the methodology is able to identify clear regime shifts over the sample period September 1993 to February 2005.[19] Although the regimes estimated are for the system as a whole, it is illustrative to see core inflation in light of the different regimes identified.[20]

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[17] In addition to changes in the policy rule, during periods of financial turbulence it is possible to observe both an increase in the variance of the shocks and an exceptional response of monetary policy. The proposed methodology is helpful in avoiding the problems associated with these cases.

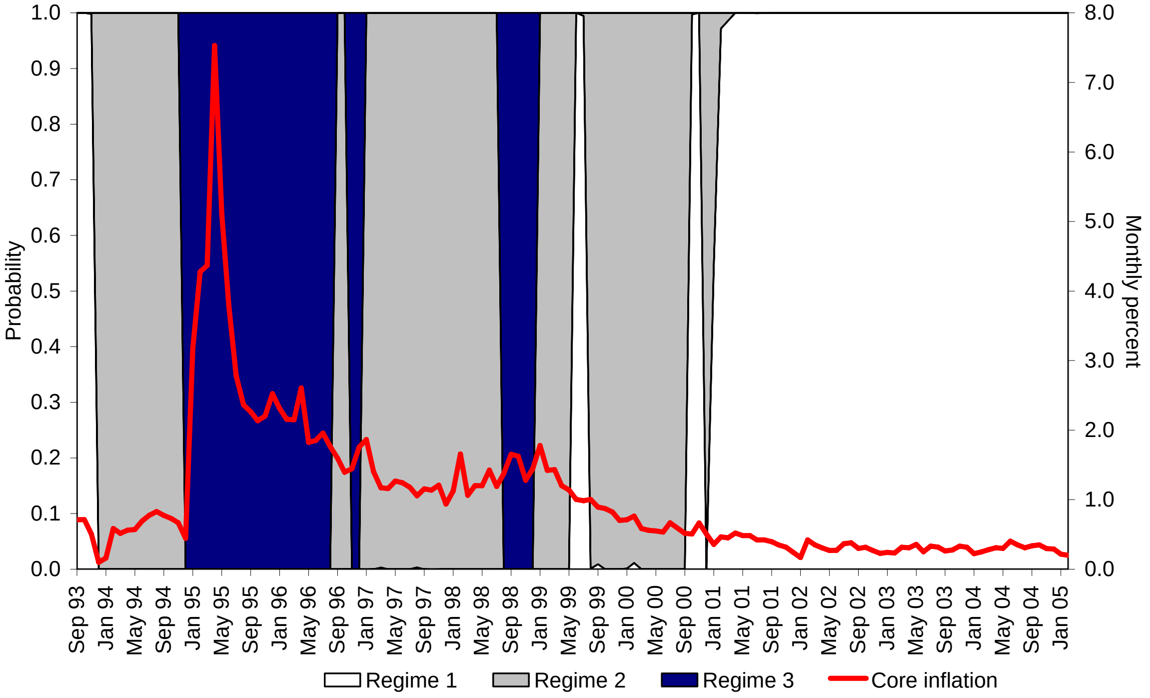
[18] The set of variables included is consistent with a large class of small open economy models (Galí and Monacelli (2002) and Svensson (2000)) that include an uncovered interest rate parity condition, an aggregate demand (IS) equation, a Phillips curve, and a policy reaction function of the central bank.

[19] The regimes identified in this paper are robust to the use of an updated sample.

[20] The inflation data is the seasonally adjusted monthly core inflation rate.

Figure 5

Regime probabilities and core inflation



Regime 3 is characterized by periods of financial turmoil; the aftermath of the 1995 crisis, and the period of international financial turbulence observed during the second half of 1998. Thus, the regime is associated with unstable macroeconomic conditions.

Regime 2 prevailed mainly after the worst of the turmoil associated to the 1995 crisis and up to the end of 2000 (except for the period of financial turbulence of 1998). Under this regime, both the level and volatility of inflation are intermediate, and there is a process of disinflation. Finally, Regime 1 has been the prevalent regime since January 2001. In terms of the inflation process, the regime is characterized by low, stable, and less persistent inflation. It is interesting to note that the change to the stable regime coincides with the change in inflation persistence as reported in Chiquiar, Noriega and Ramos-Francia (op cit).[21]

The analysis of the implications of the changes in regimes on the monetary transmission mechanism is performed using impulse responses to different shocks. Since Regime 3 was very unstable, only Regimes 1 and 2 were compared, corresponding broadly to the differences in the transmission mechanism after and prior to 2001.

After 2001, the response of all variables to real exchange rate shocks has diminished. In particular, the response of inflation and inflation expectations to these shocks has decreased significantly. Figure 6a shows the impulse-response of inflation to a 1 percent real exchange rate depreciation: after 2001, inflation responds less to real depreciations than in the previous period. A greater proportion of real exchange rate shocks have been accommodated through changes in the nominal exchange rate rather than by changes in inflation differentials, thus suggesting a less costly adjustment mechanism to real shocks.[22]

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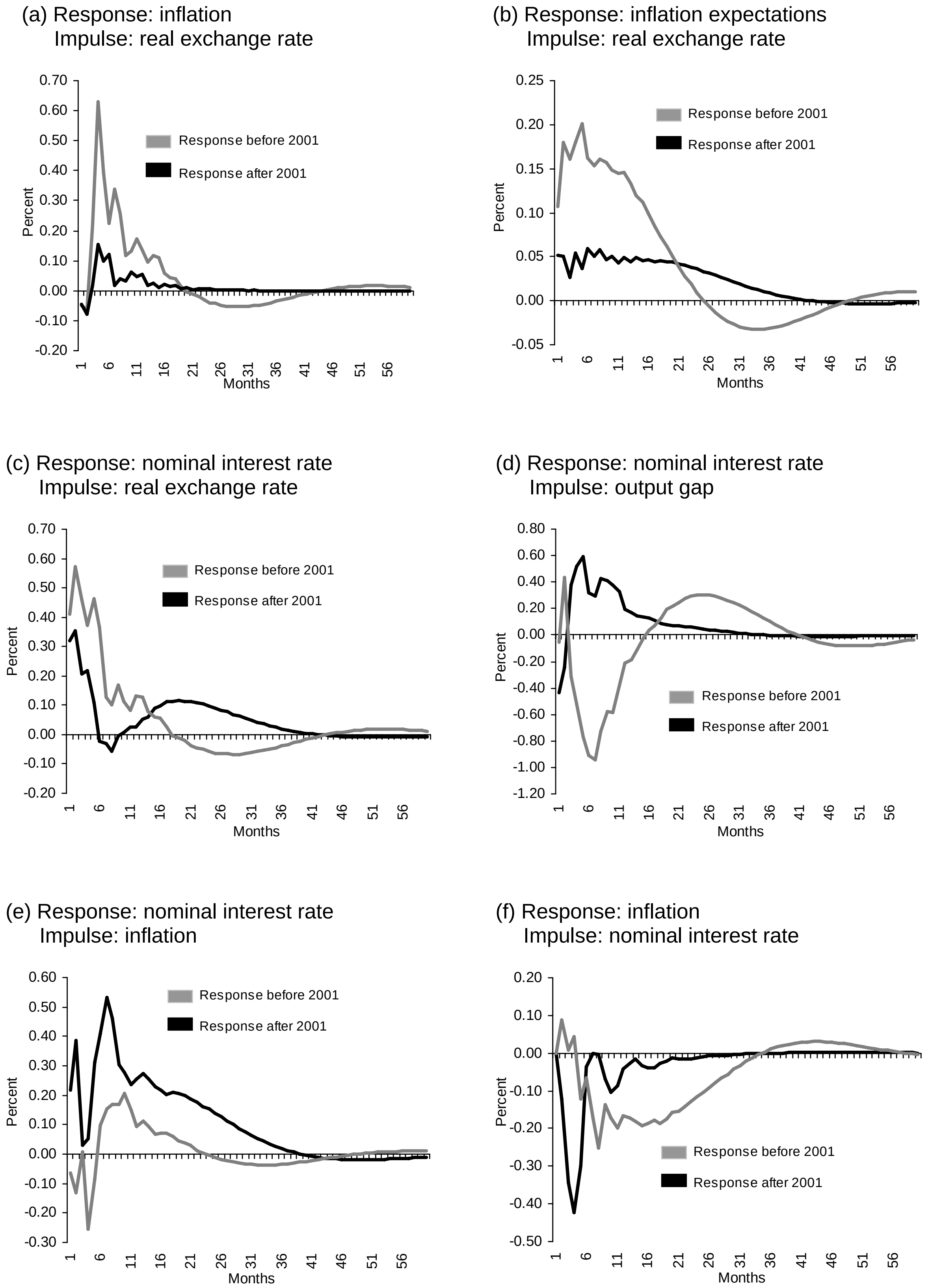
[21] An important remark is that, although the date of this change also coincides with the formal adoption of inflation targeting, it does not mean that the adoption of this policy regime prompted the aforesaid regime change. By the time inflation targeting was formally adopted, the macroeconomic policies and financial reforms undertaken in previous years had consolidated macroeconomic stability and contributed to change the dynamics of the inflation process and the monetary transmission mechanism.

[22] These results do not mean that the adoption of inflation targeting prompted the aforesaid change in the inflation regime, only that the change in regime took place around the time inflation targeting (IT) was formally implemented.

Figure 6

The monetary transmission mechanism MS-VAR response to a 1% impulse



Source: Gaytán and González-García (op cit).

The response of inflationary expectations to real exchange rate shocks has also decreased (Figure 6b). As the nominal exchange rate becomes a shock absorber variable, a real depreciation is now perceived more as a change in relative prices and less as a signal of movements in the general price level. Therefore, as real exchange rate shocks generate less inflation pressures and do not contaminate inflation expectations, we would expect the central bank to react less to these shocks. Figure 6c shows that in Mexico the response of the interest rate to this type of shock has also become milder.

Deviations of output from its potential level call for a response of the interest rate, as otherwise this situation would lead to inflation deviating from its target. In this context, there has been an important change in the reaction of monetary policy to output gap shocks. After 2001, output gap pressures generate a strong reaction of interest rates (Figure 6d). The response of the interest rate to inflationary shocks has also become stronger and more persistent (Figure 6e).

This research also shows that interest rate changes have become more effective in producing a faster and stronger reduction of inflation (Figure 6f). Nevertheless, in the estimated model, an interest rate increase generates a reduction in the output gap only after six periods. Therefore, the traditional interest rate channel, which is the main channel embedded in this VAR model, cannot account for the strong and fast reduction of inflation after an interest rate movement. This last result calls for further exploration of other channels of monetary transmission, which are presented in the next sections of this paper.

IV.1.3 Changes in inflation expectations

Some of the recent research undertaken at Banco de México has been devoted to study the changes in the anchoring of inflation expectations and of the relative importance of the forward- and backward-looking components of the inflationary process in explaining its short run dynamics.

Regarding the anchoring of inflation expectations, Capistrán and Ramos-Francia (2007) show evidence that suggests that inflation targeting has contributed to the anchoring of inflation expectations. The anchoring of expectations is analyzed by studying the reduction in the dispersion of expectations among market forecasters. Under inflation targeting, if agents have confidence in the central bank policy, the optimal inflation forecast – for horizons larger than the control lag of monetary policy – is the inflation target itself. Since this principle applies to each forecaster, under an inflation targeting regime, the variance among forecasters should decrease and the distribution of forecasts should eventually collapse around the target. The paper shows, using 16 years of monthly data from 14 inflation targeters and 12 countries that have not adopted this policy framework, that the dispersion of inflation expectations is lower in targeting regimes, and that this effect is driven by emerging economies. These results are obtained after controlling for country-specific effects, time-specific effects, initial dispersion, the level and the variance of inflation, disinflation periods, and global disinflation.

Ramos-Francia and Torres (2006) use a New Phillips curve framework (Galí and Gertler (1999)) to analyze whether in recent years, as the economy has been converging towards a low inflation environment, the short-run dynamics of inflation have experienced significant changes. In particular, they analyze the changes in the relative importance of the backward- and forward-looking components of inflation for two samples, the first being the complete sample for the period from January 1992 to June 2006 and, the second, the sub-sample January 1997 to June 2006. According to the model used, the results suggest that the fraction of firms that sets their prices using a backward-looking rule of thumb has decreased, and that the forward-looking component of the inflation process has become more important.

IV.1.4 *The nominal exchange rate and the credit channels*

The evidence presented so far is a starting point to perform additional work on the changes that have occurred in other channels of monetary transmission. In this section we present an exploration of the nominal exchange rate and the credit channels of monetary policy. For this purpose, we estimate a VAR for the period June 1996 to August 2006. We split the sample onto two periods using the dates of Regimes 1 and 2 of the MS-VAR exercise. The first period is from June 1996 to December 2000, and the second period from January 2001 to August 2006.

The set of variables included in this estimation is similar to the one proposed by Morsink and Bayoumi (2001). We perform two estimations: first, we estimate a basic model with a reduced set of endogenous variables; this estimation is performed to compare the results with those presented in Gaytán and González-García (op cit). The main purpose of this comparison is to confirm that their results are not dependent on the set of variables they used. In particular, they only include one monetary variable (the nominal interest rate), while to analyze the effect of an interest rate change that is not originated by a change in money demand, it is necessary to include both the interest rate and a monetary aggregate. The basic model includes the following variables: (i) the output gap; (ii) CPI inflation; (iii) the short term nominal interest rate; (iv) the annualized rate of growth of M1 balances; and (v) the depreciation of the nominal exchange rate.[23] The measure of the stance of monetary policy is, in this case, the short term interest rate.[24, 25]

The results of the basic model confirm that in recent years monetary policy shocks have had a stronger and faster effect on prices. The other results are also similar to those of Gaytán and González-García (op cit), and are not reported for brevity.

For the second estimation, the basic model is then extended to study the credit channel of monetary transmission. Three additional variables are included: (vi) the rate of growth of real bank credit to households; (vii) the rate of growth of real bank credit to firms; and (viii) the rate of growth of the real stock of securities issued by corporations.[26]

Empirical results

The empirical analysis is performed using impulse response functions and variance decompositions. For the impulse response analysis, we present the cumulative responses of the variables included to a 1 percent shock. The accumulated impulse responses are used because, in some cases, we are interested in the effect of the impulses on the level of the other variables (for example, for the pass-through effect, the accumulated impulse response shows the change in the price level to a 1 percent depreciation).

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[23] Since we are interested in determining the change in the pass-through from the exchange rate to prices, we use nominal depreciation. In contrast, Gaytán and González-García's (op cit) use of the real exchange rate is useful to illustrate how the way in which the economy absorbs these shocks has changed.

[24] To identify the shocks, we assume a recursive structure (Choleski decomposition) according to the order in which the variables are presented. These assumptions are frequently used in the study of the monetary policy transmission mechanism (see Christiano et al (2000)).

[25] The variables used are defined as follows: i) the output gap is estimated using the HP filter; ii) CPI inflation is annualized monthly inflation rate; iii) the short term interest rate is the 28-day CETES rate; iv) the rate of growth of M1 is the annualized rate of growth of M1; and, v) the depreciation of the nominal exchange rate is the rate of change of the fix nominal exchange rate.

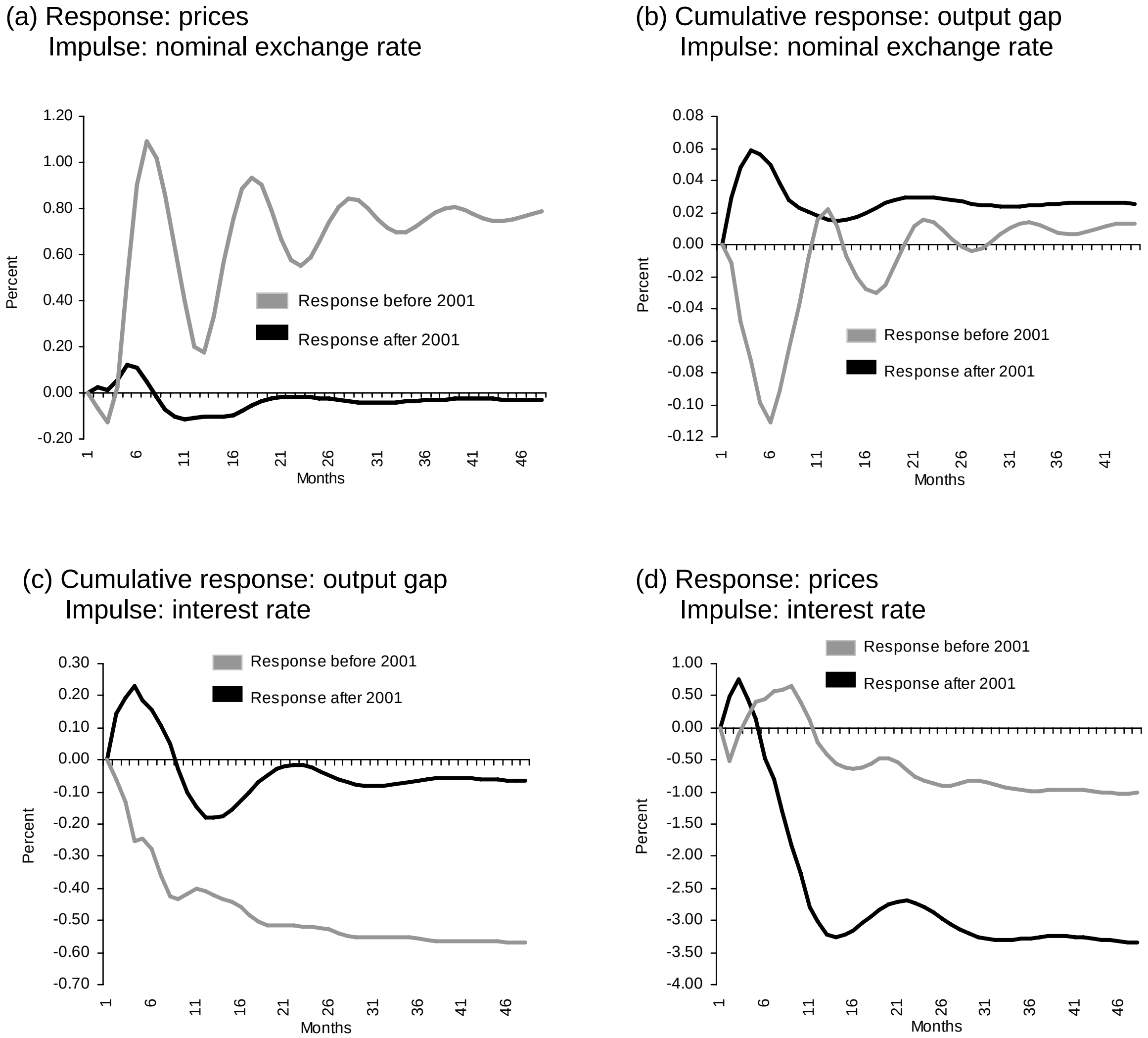
[26] These variables are included before the nominal exchange rate variable, under the assumption that the nominal exchange rate can adjust to the information contained in the rest of the variables. This order is similar to the one used by Morsink and Bayoumi (op cit).

The first exploration under this credit model is to analyze the changes in the pass-through of the nominal exchange rate to prices. Figure 7a presents the response of prices to a nominal exchange rate depreciation of 1 percent. The results confirm an important reduction in the pass-through effect. Prior to 2001, a depreciation of 1 percent generated a long-run increase in prices of around 0.8 percent, a result consistent with the one reported by Garcés (op cit). In the new regime, after 2001, the cumulative effect on prices of a nominal depreciation is close to zero. The direct effect of the nominal depreciation has been greatly reduced; however, there is an indirect effect through output. In the sample 1996–2000, the nominal depreciation had a negative effect on output, possibly reflecting that after the crisis the balance sheets of government, households and firms remained vulnerable to exchange rate fluctuations. After 2001, a nominal depreciation, with a small response of prices, generates a real exchange rate depreciation and output exhibits the usual increase of a small open economy (Figure 7b).

When analyzing the direct effect of interest rate changes on both the output gap and inflation, the following results are obtained: economic activity contracts less sharply during the new regime than prior to 2001 (Figure 7c). On the other hand, in recent years, an interest rate increase generates a faster and stronger direct reduction of inflation than before (Figure 7d). Both results are similar to those reported by Gaytán and González-García (op cit).

Figure 7

Credit channel model response to a 1% impulse



The second exploration consists of analyzing the private sector funding variables so as to study the changes in the credit channel of transmission. Bank financing to firms shows a positive, although transitory, effect on the output gap in recent years (Figure 8a). The response of this type of credit to interest rate shocks is negative under both regimes (Figure 8b).

Corporations' financing through securities has a positive effect on the output gap (Figure 8d). The effect is strong if we consider the relative small size of this type of financing – the stock of securities of the private sector to GDP represents less than 3 percent – and this type of financing is concentrated in a few large firms. This type of financing diminishes as a result of increases in the interest rate under both regimes; however, the reduction under the new regime is faster and stronger (Figure 8c). This result may suggest the existence of a broad credit channel of monetary policy.

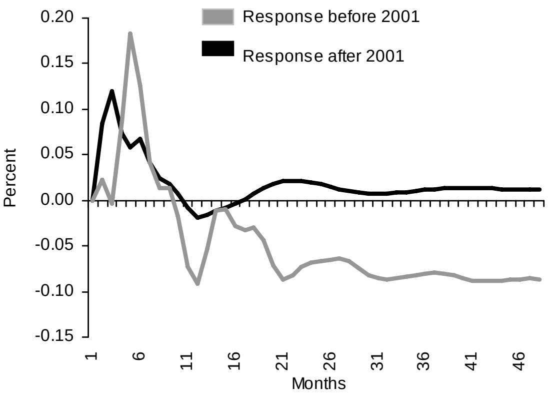
The effect of bank credit to households on economic activity has changed significantly. After 2001, an increase in this credit is associated with an increase in the output gap, while prior to this date the effect is negligible (Figure 8e). Tight credit restrictions that households faced after the crisis and the increased availability of credit to this sector in recent years are the most probable explanation of this result. As for the effect of the interest rate on this type of credit, there is a positive effect on bank credit to households (Figure 8f). This result, which at first seems contradictory, may reflect some important developments in banking in recent years. In particular, on the demand side, the recent loosening of the credit constraints that households faced in combination with its low indebtness levels explain households' low interest rate elasticity of demand for banking credit.Thus, a possible explanation of the positive response of households' credit to an interest rate increase in recent years is the process of financial deepening. The number of households that have had access to credit, particularly to consumption credit, has increased significantly in recent years. Therefore, we include the number of credit cards in the VAR estimation as a proxy variable to control for this process of financial deepening. The dotted line in Figures 8e and 8f show the results of this exercise for the period after 2001. After controlling for household access to credit, the output gap response to an increase in credit is practically unchanged with respect to the previous exercise, but, the response of this type of credit to interest rate increases practically disappears, as prior to 2001. These results suggest that over the last decade the transmission mechanism through household credit is not yet fully operational. Nevertheless, we could expect that as households' access to credit reaches steady levels and households attain their desired level of indebtedness, the credit and the traditional interest rate channels will strengthen.

The variance decomposition comparison between the different regimes confirms the reduced importance of exchange rate shocks in determining all variables, particularly inflation. While prior to 2001, nominal depreciations explained 25.6 percent of the variance of inflation, this share has declined to 3 percent. Regarding private sector financing variables, inflation explains a smaller fraction of their variance after 2001 than in the previous period, especially for household financing, which decreases from 24 percent to only 6.1 percent. In recent years, the output gap has become a more significant variable in explaining changes in bank credit to firms, while the share of fluctuations in household credit explained by this variable is reduced.

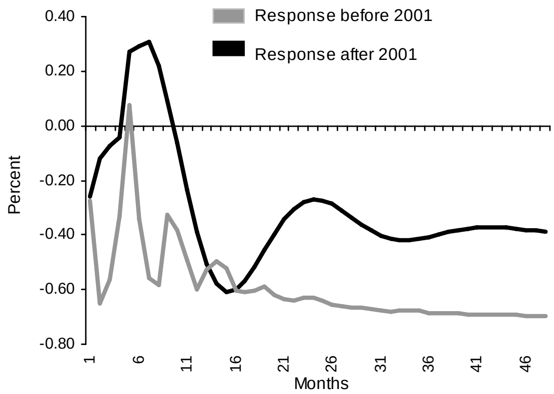
Figure 8

Credit channel model, credit variables response to a 1% impulse

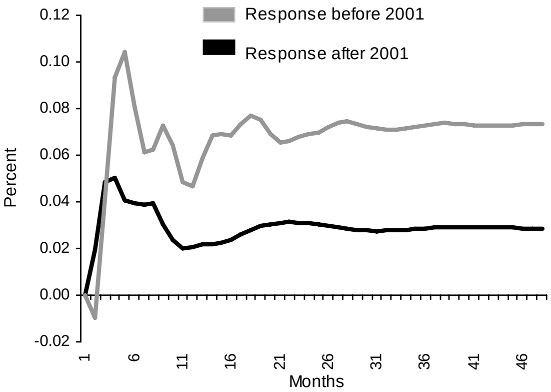
(a) Cumulative response: output gap
Impulse: bank credit to firms



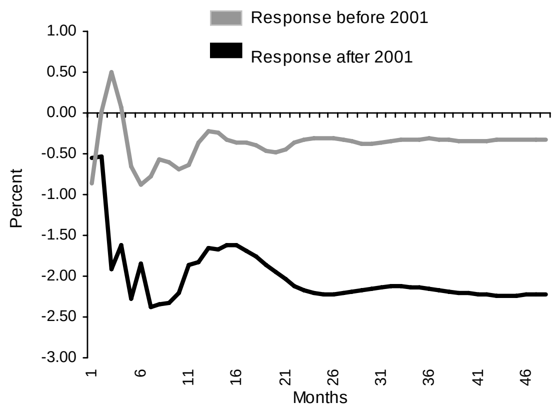
(b) Cumulative response: credit to firms
Impulse: nominal interest rate



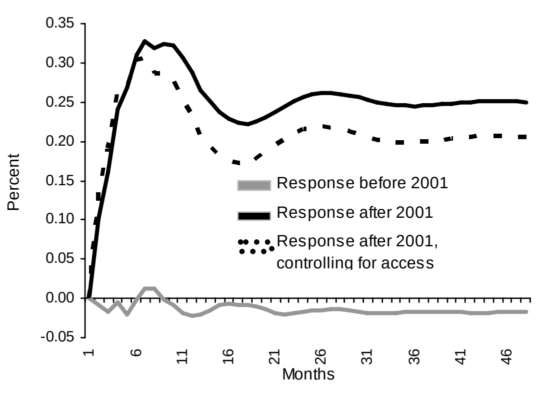
(c) Cumulative response: output gap
Impulse: private securities



(d) Cumulative response: private securities
Impulse: interest rate



(e) Cumulative response: output gap
Impulse: household credit



(f) Cumulative response: household credit
Impulse: interest rate

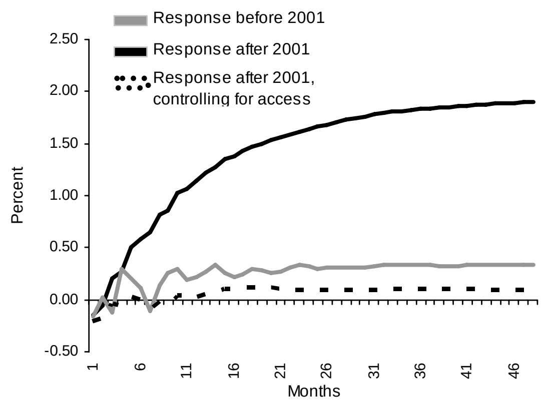


Table 2

Variance decomposition. Forecast horizon: 5 years

	Fore-cast error	Output gap	Infla-tion	Nomi-nal interest rate	Money	Bank credit to house-holds	Bank credit to firms	Secu-rities of the private sector	Nomi-nal exchange rate
Regime 2 (before 2001)									
Output gap	1.4	39.3	12.5	5.4	2.2	0.4	14.0	11.8	14.5
Inflation	11.2	13.0	30.6	2.2	2.3	1.7	18.6	6.0	25.6
Nominal interest rate	3.2	12.2	5.2	35.3	1.6	1.5	21.2	5.9	17.0
Money	7.5	7.0	6.7	5.4	63.6	1.9	3.8	6.9	4.6
Bank credit to households	6.7	9.1	24.0	2.8	4.9	13.4	27.7	6.4	11.7
Bank credit to firms	4.8	4.5	7.4	9.2	6.0	6.9	53.6	4.9	7.5
Securities private sector	9.9	10.5	6.8	7.7	5.9	2.7	13.7	37.3	15.4
Nominal exchange rate	21.2	20.4	6.4	7.5	2.4	0.7	23.2	6.5	32.9
Regime 1 (after 2001)									
Output gap	0.9	65.4	2.9	3.4	7.6	4.9	6.0	2.4	7.4
Inflation	4.8	11.4	68.9	4.7	3.7	2.8	3.1	2.6	3.0
Nominal interest rate	2.6	27.8	4.4	34.7	5.7	14.5	2.7	3.4	6.8
Money	11.4	4.9	8.6	8.9	55.8	4.5	2.6	7.8	6.8
Bank credit to households	1.7	5.3	6.1	4.4	7.5	59.6	6.8	6.6	3.7
Bank credit to firms	2.6	17.2	3.9	2.4	13.3	2.8	56.1	0.9	3.4
Securities private sector	5.2	7.3	4.4	6.2	12.5	12.2	2.9	52.4	2.1
Nominal exchange rate	16.6	5.8	2.0	7.2	3.7	7.6	5.5	6.5	61.7

IV.2 The monetary transmission mechanism and inflation expectations

The results presented in Sections IV.1.2 and IV.1.4 are based on VAR analysis. Although this methodology is adequate in providing a broad picture of the monetary transmission mechanism, it has some shortcomings; in particular, it is ill-suited to identify the role of inflation expectations in the monetary transmission mechanism.[27] In this section we perform an exercise using a simple model that can account for the expectations channel. We use a standard rational expectations small-scale macroeconomic model of the New Keynesian type.

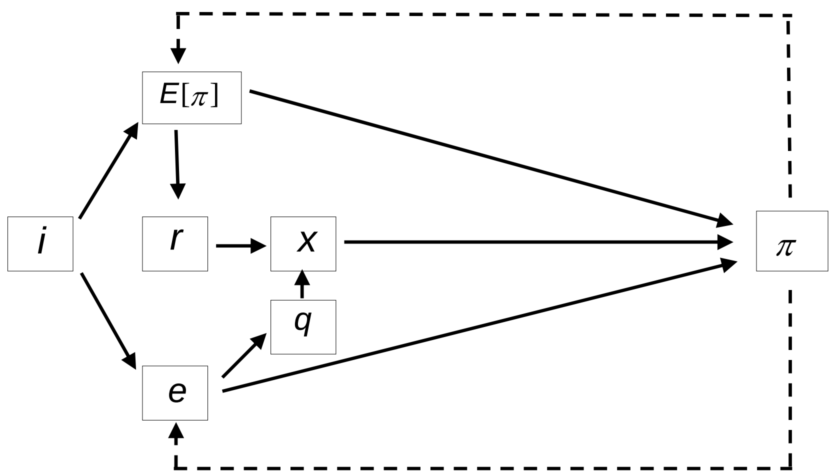
The model is composed of four behavioral equations: (i) a Phillips curve for core inflation; (ii) an IS equation for the output gap; (iii) a real exchange rate equation; and (iv) a Taylor type monetary policy rule for the nominal interest rate. As is common in this type of models, the dynamics are driven by shock innovations on these equations (see Appendix).

The model has a simple structure and belongs to the class of models termed "hybrid", incorporating micro-founded forward- and backward-looking elements. The inclusion of lags and expectations of the variables in the equations is necessary to replicate the dynamics of the observed series. Lagged information can be relevant because of different real and information rigidities.[28] However, as the economy becomes more flexible and monetary policy gains credibility, the importance of the inertial component will tend to decrease.

Figure 9 presents the monetary transmission mechanism implied by this model. The effect of the monetary policy instrument (the nominal interest rate, i) on inflation, π, in the short-run works through three channels: a) inflation expectations, $E[\pi]$, and its direct effect on inflation (Phillips curve); b) the real interest rate, r, (through inflation expectations) and its effect on the output gap, x (IS equation); and, c) the nominal exchange rate, e, that, on the one hand has a direct effect on inflation (Phillips curve), and on the other -given price rigidities- affects the real exchange rate, q, in the short run, which, in turn, affects the output gap (IS equation).

Figure 9

The transmission mechanism of the model



[27] The inclusion of survey information on inflation expectations as an endogenous variable in the VAR may help to mitigate the price puzzle, but it does not account, in a proper way, for an adequate specification of rational expectations since there is no specific rule to assure consistency between survey information and the rational expectations implied by the estimated model.

[28] For example, if consumption habits are important, the output gap will depend on its own lags (McCallum and Nelson (1999)). In addition, when there is imperfect information, agents may set their prices according to a rule of thumb to past inflation (Galí and Gertler (op cit)).

The model presented is used to perform an exercise to ilustrate the changes in the monetary transmission mechanism in Mexico. As summarized in this paper, evidence suggests that the dynamics of inflation and the monetary transmission mechanism experienced important changes around the end of 2000 and the beginning of 2001. Thus, we divide the sample into two sub-samples: the first sub-sample goes from 1996 to 2000, and the second sub-sample from 2001 to 2006. The model and the corresponding parameter estimates for both sub-samples are reported in the Appendix.

The estimations for the two sub-samples show that in recent years there has been a significant increase in the forward-looking components of both the Phillips curve and the IS equation, and a reduction in the backward-looking elements. In the Phillips curve, the coefficient of the forward-looking component of core inflation increased from 0.53 to 0.66; therefore, the effect of inflation expectations in determining inflation has increased in recent years.[29] This result implies that when the commitment of monetary policy to maintain inflation around a specific target is credible, in the presence of inflationary shocks, inflation deviations from this target fade out faster and the persistence of inflation decreases. In the IS equation, the fact that the output gap depends on expectations for its own future value (forward-looking component) implies that it is not only affected by the current values of the real interest rate and the real exchange rate, but also by the expected path of these two variables. Therefore, the increase in the relative importance of the forward-looking component of the IS equation in recent years (the corresponding coefficient increased from 0.17 to 0.57) implies that the effect of a given expected path of real interest rates on aggregate demand is stronger.[30] Thus, this result suggests that in recent years the ability of monetary policy to affect aggregate demand has increased.

Since a cost-push shock to core inflation generates a trade-off for monetary policy between stabilizing inflation and output, it is illustrative to analyze the changes that the economy has undergone in response to this type of shock (Figure 10).[31] A once-and-for-all shock to core inflation increases inflation and reduces the output gap on impact. To contain the effect of the shock on inflation expectations and to lead inflation back to its initial level, the response of monetary policy is to increase the interest rate temporarily. This increment in the interest rate leads to a further reduction in the output gap that contributes to reduce inflation. As the interest rate and inflation return to their initial levels, the effect on the output gap vanishes.

Results in Figure 10 show that after 2001 the increase in the relative importance of the forward-looking components of inflation and output have implied a change in the adjustment of the economy to a cost-push shock. Since the importance of inflation expectations in determining inflation has increased and results show that the response of inflation to the shock is less persistent in the second sub-sample, inflation expectations appear to be better anchored in recent years. Also, given that the effect of monetary policy on aggregate demand is stronger after 2001, the necessary response of the interest rate to contain inflation expectations and to lead inflation back to its initial level is smaller, reducing the cost of stabilizing inflation in terms of the output gap.

In sum, the previous exercise sheds light on the increasing importance of the expectations channel of monetary policy in recent years. There has been a significant change in the

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[29] This change is statistically significant. The 95% confidence interval of the forward-looking component of the Phillips curve is [0.526, 0.528] prior to 2001, and in the second sub-sample it is [0.649,0.679].

[30] This change is statistically significant. The 95% confidence interval changed from [0.122,0.214] in the first sub-sample to [0.556,0.582] after 2001.

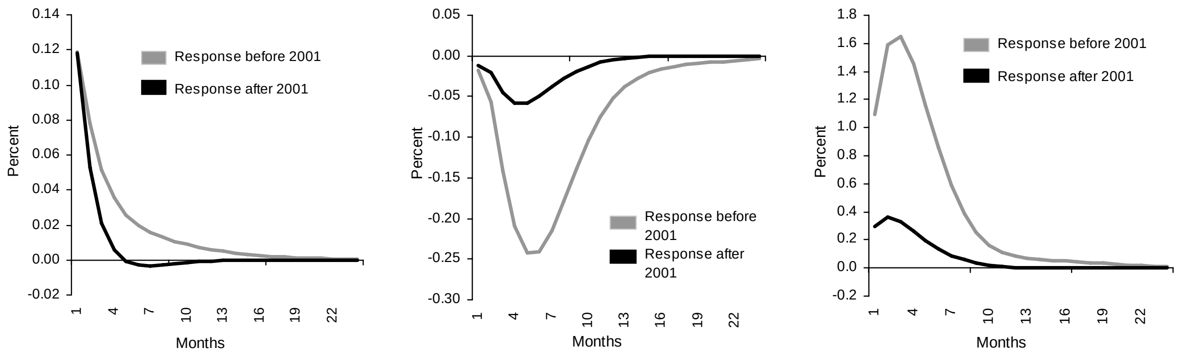
[31] The shock is assumed to have no persistence and is a once-and-for-all innovation with zero mean and constant variance.

forward-looking components of price setting and aggregate demand. These changes have implied that monetary policy has become more effective in reducing inflation pressures.

Figure 10

Small-scale model, response to a one percentage point cost-push shock

(a) Response: core inflation (b) Response: output gap (c) Response: nominal interest rate



V. Final remarks

Over the last decade, the inflation process and the monetary policy transmission mechanism have changed significantly in Mexico. Several factors account for this result. On the one hand, the world economy has followed a disinflation trend; on the other, fiscal discipline and the proper response of monetary policy to inflationary pressures have been crucial elements to understand the changes that have taken place. First, the level and volatility of inflation have decreased, and the inertial component of the inflation process has been considerably reduced. Second, the reduction in persistence has implied that, in recent years, the inflation process seems to have become clearly stationary, which is a necessary condition for a proper functioning of the inflation-targeting monetary policy framework.

In recent years, there is also evidence of changes in the monetary transmission mechanism. Exchange rate fluctuations have become less important in the determination of prices. On the other hand, interest rate movements have had a faster and stronger effect on inflation. These changes, together with increased transparency in the implementation of monetary policy have modified the determinants of inflation expectations and the whole price setting process. As a result, the Mexican economy has witnessed an exceptional long period of macroeconomic stability in recent history.

The restoration of health in the banking system, and the development of financial markets in recent years, may imply that in the future certain channels of monetary transmission will gain relevance. In particular, the narrow and broad credit channels could become more important. There is some preliminary evidence of the functioning of these channels in firms' financing. Nonetheless, the bank-credit channel operating through credit to households is not yet fully operational. This could be a consequence of a recent and unprecedented loosening of credit constraints, together with an important supply of funds to this sector. In that case, as households replenish their stock of durable consumption goods and attain their desired levels of indebtedness, this type of credit will probably become more responsive to changes in interest rates.

The faster and stronger response of inflation to changes in the stance of monetary policy cannot be completely accounted for by the traditional interest rate channel or by the credit channel of monetary transmission. Evidence presented in this paper suggest that the expectations channel of monetary policy seems to be the most probable explanation for this change. In recent years, agents have changed both the information used to form their expectations and the importance of expectations in their price setting and expenditure decisions. All these changes reflect an increased credibility in the commitment of fiscal and monetary policies in pursuing macroeconomic stability and a more flexible economic system, that allows a faster adjustment of the economy to different shocks at a lower cost.

In sum, the Mexican experience shows that the transition from high and volatile to low and stable inflation generates important changes in the way the nominal system, and thus the real economy, work with significant implications for monetary policy and benefits to the economy.

Appendix

The small-scale hybrid model

The specification of the monthly hybrid model of Section IV.2 consists of the following behaviour equations (i to iv) and one identity (v):

Equation:

(i)	Phillips curve	$\pi_t^c = a_1\pi_{t-1}^c + a_2 E_t\left[\pi_{t+1}^c\right] + a_3 x_t + a_4(\Delta e_t + \pi_t^{US}) + \upsilon_t$
(ii)	IS curve	$x_t = b_1 x_{t-1} + b_2 E_t\left[x_{t+1}\right] + b_3 r_{t-1} + b_4 x_t^{US} + b_5 q_t + u_t$
(iii)	Real exchange rate	$q_t = c_0(q_{t-1}) + c_1(E_t\left[q_{t+1}\right] + (r_t^{US} - r_t)) + w_t$
(iv)	Taylor type rule	$i_t = (1-d_3)\left((d_1(\pi_t^A - \pi_t^*) + d_2 x_t\right) + d_3 i_{t-1} + \varepsilon_t$
(v)	CPI inflation definition	$\pi_t \equiv \omega_c \pi_t^c + \omega_{nc}\pi_t^{nc}$

Where: π_t is the monthly CPI inflation rate, $\pi^c{}_t$ is the monthly core inflation, $\pi^{nc}{}_t$ is the monthly non-core inflation, $\pi^A{}_t$ represents annual inflation, $\pi^*{}_t$ is the annual inflation target, x_t the output gap (estimated using a monthly indicator of GDP, IGAE, and an HP filter), e_t the nominal interest rate, q_t the real exchange rate, i_t the nominal interest rate, r_t the real interest rate, and $\pi^{US}{}_t$ and $x^{US}{}_t$ denote the US monthly inflation and the US output gap (estimated using industrial production and an HP filter), respectively. The first four equations include the shock innovations that drive the dynamics of the model: v_t, is a cost-push shock, u_t is a demand shock, w_t a shock to the real exchange rate, and ε_t is a monetary policy shock. These shocks are assumed to be normally distributed with zero mean, constant variance, serially uncorrelated, and orthogonal to each other.

Following the literature on the estimation of this type of models, to avoid the problem of endogeneity of expectations the Generalized Method of Moments (GMM) method is used to estimate the equations.

(i) The estimated Phillips curve for the two sub-samples are as follows:

Table A1

Phillips curve[1]

Sample	π_{t-1}^C	$E_t\left[\pi_{t+1}^C\right]$	x_t	$\Delta e_t + \pi_t^{US}$
1996–2000[2]	0.458	0.527	0.011	0.015
	(0.0006)	(0.0007)	(0.0000)	(0.0001)
2001–2006[3]	0.333	0.664	0.013	0.003
	(0.0076)	(0.0076)	(0.0006)	(0.0076)

[1] Standard deviations reported in parenthesis. [2] The sample used for the estimation is from July 1996 to September 2000. The set of instruments is: a constant; πt-1 to πt-5; Δet-3 to Δet-12; rt-1 to rt-12 and xt-3 to xt-18. [3] The sample used for the estimation is from January 2001 to August 2006. The set of instruments is: a constant; πt-6 to πt-12; Δet-3 to Δet-18; rt-1 to rt-18 and xt-3 to xt-18.

(ii) The estimated IS equation for the two sub-samples are as follows:

Table A2

IS equation[1]

Sample	x_{t-1}	$E_t[x_{t+1}]$	r_{t-1}	x_t^{US}	q_t
1996–2000[2]	0.565	0.168	–0.061	0.139	1.749
	(0.0320)	(0.0237)	(0.0081)	(0.0424)	(0.8887)
2001–2006[3]	0.312	0.569	–0.035	0.219	1.415
	(0.0104)	(0.0066)	(0.0033)	(0.0058)	(0.0773)

[1] Standard deviations reported in parenthesis. In each estimation, a constant term was included to control for the fact that, given the small size of the two sub-samples, the average output gap is different from zero. [2] The sample used for the estimation is from July 1996 to December 2000.The set of instruments is: xt-2 to xt-12; Δqt-1 to Δqt-5; rt-2 to rt-7 and the change in the oil price Δopt-1 to Δopt-5. [3] The sample used for the estimation is from January 2001 to June 2006. The set of instruments is: xt-2 to xt-12; qt-1 to qt-19; rt-2 to rt-12 and the change in the oil price Δopt-1 to Δopt-15.

(iii) The parameters of the real exchange rate equation are calibrated to ensure that in the long run the real exchange rate is consistent with output at its long-term trend (zero output gap):

Table A3

RER equation

Sample	q_{t-1}	$E_t[q_{t+1}]+(r_t^{US} - r_t)$
1996–2000	0.401	0.592
2001–2006	0.315	0.677

(iv) The estimated Taylor type rules for the two sub-samples are as follows:

Table A4

Taylor rule[1]

Sample	$\pi_t^A - \pi_t^*$	x_t	i_{t-1}
1996–2000[2]	5.227	8.707	0.851
	(1.4422)	(2.8921)	(0.0699)
2001–2006[3]	1.086	1.556	0.807
	(0.5504)	(0.8365)	(0.0990)

[1] Standard deviations reported in parenthesis. In each estimation, a constant and a trend variable were included to control for the downward trend followed by the nominal interest rate as a result of the gradual reduction of inflation. [2] The sample used for the estimation is from July 1996 to December 2000. The set of instruments is: a constant; πt-1 to πt-3; qt to qt-3; it-2 to it-4; iUSt; π*t-1; and xt-1 to xt-5. [3] The sample used for the estimation is from January 2001 to August 2006. The set of instruments is: a constant; πt-1 to πt-5; Δet to Δet-5; π*t-2 to π*t-3; xt-1 to xt-4; it-2; iUSt; and xUSt-1 to xUSt-2.

(v) The CPI inflation is defined using the weights of the core and non-core price sub-indices on the CPI:

$$\pi_t \equiv 0.69\,\pi_t^c + 0.31\,\pi_t^{nc}$$

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The monetary policy transmission mechanism under financial dollarisation: the case of Peru 1996–2006

Renzo Rossini and Marco Vega[1]

1. Introduction

This paper surveys the monetary policy transmission mechanism in Peru. The survey covers the most recent empirical papers dealing with the measurement of monetary policy. From the onset we stress that the last ten years have witnessed important changes in monetary policy procedures that led to the adoption of the inflation targeting (IT) framework in 2002.

From the policy perspective, it is important to know the empirics of the monetary policy transmission mechanism, yet the nature of this mechanism is complex. And it is more so in a financially dollarised economy. The degree of financial dollarisation in Peru is still high (around 65 per cent of private credit is denominated in dollars). The high degree of financial dollarisation is key to understanding the transmission mechanism. One important element of the mechanism is the non-linear nature of the balance-sheet effect coming from currency-induced credit risk in the financial system.

The measurement and identification of the deep mechanisms at work in the transmission channel is difficult because monetary policy, as well as the environment surrounding it, has been evolving rapidly. So, uncertainty about the dynamics of the transmission mechanism is an important element the Central Bank of Peru has to deal with. Accordingly, this paper also performs exercises aiming to show the likely effects of central bank policy actions on the nature of the transmission and the way financial dollarisation reduces the monetary policy power to affect inflation. To the practice of monetary policy in a partially dollarised economy, the exercises imply that central bank actions have to be even more pre-emptive with regard to future inflation pressures and more watchful of potential balance-sheet vulnerabilities.

2. Monetary policy evolution in recent years

During the disinflation period (1991–2001), monetary policy in Peru followed a monetary targeting scheme without any commitment to an exchange rate or interest rate level. As mentioned in Rossini (2001), the sizeable degree of asset dollarisation and the high frequency nature of external shocks[2] were key reasons for adopting a managed floating exchange rate regime, whereas the existing high rates of inflation motivated the monetary targeting framework.

The process of disinflation turned out to be gradual (Table 1) not only because central bank credibility recovered slowly but also because of the initial high degree of relative price distortions. Nonetheless, gradualism allowed the real costs associated with the process to be minimised, and by 1997 inflation reached single-digit levels.

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[1] Central Bank of Peru. The opinions herein belong to the authors and do not necessarily reflect those of the Central Bank of Peru.

[2] Namely terms of trade and supply shocks.

Table 1
Annual rates of inflation
In percentage points

Year	End-of-period
1990	7649.7
1991	139.2
1992	56.7
1993	39.5
1994	15.4
1995	10.2
1996	11.8
1997	6.5
1998	6.0
1999	3.7
2000	3.7
2001	–0.1
2002	1.5
2003	2.5
2004	3.5
2005	1.5
2006	1.1

During the disinflation period, the Central Bank of Peru made several changes in its monetary policy design and instruments, creating the conditions for moving to a fully-fledged inflation targeting regime in 2002.

For instance, when inflation rates reached levels lower than 20 per cent, real demand for domestic currency started growing fast, and for the first time, communication problems about money base targeting arose. In that context, beginning in 1994 monetary policy management improved through announcements of end-of-year inflation targets.

Regarding monetary instruments, at the beginning of the nineties there was a lack of both public and private liquid assets in domestic currency, and therefore forex intervention was the main way to control base money growth. To foster an effective interbank market and the needed monetary regulation in domestic currency, the first step was the removal of high reserve requirements on domestic currency deposits (1991–1993) from an average rate of 40 to 9 per cent. This was followed by the issuance of Certificates of Deposit[3] to allow for contractionary monetary operations (1994) and finally repo operations with the banking system to provide temporary liquidity (1997).[4]

Once inflation narrowed to international levels and monetary base growth became more difficult to predict as well as less correlated with inflation, the monetary targeting scheme proved to be no longer satisfactory. Moreover, a new policy challenge appeared in 2001 in the form of deflationary pressures, which had not been recorded in Peru during the last 70 years and posed a serious threat to the Bank's recently gained credibility.

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[3] These are instruments issued by the Central Bank of Peru itself.

[4] When the Government started a programme to develop the domestic public debt market in domestic currency (2001), these securities also became available for repo operations.

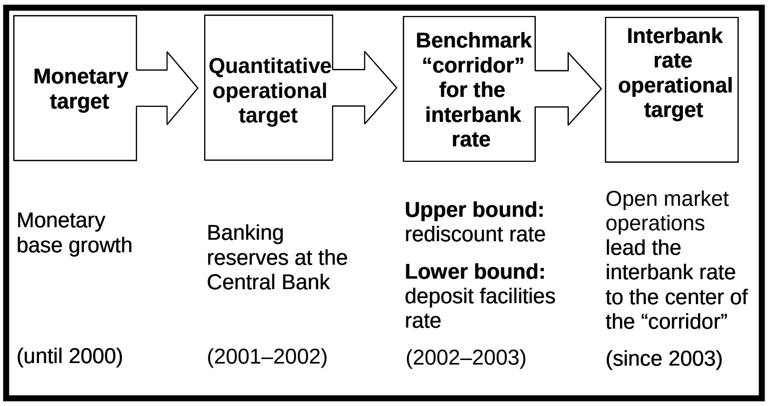
At first, the central bank dealt with such new conditions with a change in the operational target. In 2000, monetary base growth was replaced by a quantitative target: the banking reserves at the central bank. In essence, however, the use of this instrument still relied on the short-run relationship between monetary aggregates and inflation, which explains its abandonment two years later.

In this context, the problem of how to run an expansionary monetary policy without losing credibility in a financially dollarised framework was finally tackled by the central bank with the adoption of inflation targeting in 2002. As described in Armas and Grippa (2006), the characteristics of Peruvian IT are largely similar to those in other countries that have managed to reach and preserve a low inflation rate, consistent with their long-run inflation target level.[5]

With the IT regime, the short-term (interbank) interest rate was introduced as the operational target instead of the monetary aggregate. Figure 1 summarises the evolution of the operational target in recent years.

Figure 1

Evolution of the operational target



The advantages of the current operational target are detailed in Armas and Grippa (2006). These are summarised in four ideas: first, the interbank rate communicates the monetary policy stance clearly; second, this rate is a benchmark for other interest rates denominated in domestic currency;[6] third, the volatility of the interbank interest rate has decreased and the interest rate pass-through has strengthened (Lahura, 2005); and finally, it is flexible enough to allow quick and large increases in the interbank interest rate during extreme situations, to limit currency depreciation and prevent balance-sheet effects from undermining economic activity and the solvency of the financial system.

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5 Inflation targeting in Peru hinges on the central bank commitment to keep inflation on target. From 2002 to 2006, the target was 2.5 per cent with a tolerance margin of +/– 1 per cent. From 2007 onwards, the target is 2.0 per cent with a tolerance margin of +/– 1 percent.

6 The Peruvian currency is the new sol.

3. The existing empirical evidence

A decade ago, De la Rocha (1998) presented a first general overview about the transmission mechanism of monetary policy in Peru. That view relied on three channels: money, credit and the exchange rate. In those years, the influence that the central bank exerted over monetary aggregates was regarded as the most important channel. This was the primary reason for using the monetary base growth as intermediate target even until 2000 (see Figure 1).

De la Rocha (1998) suggests the existence of uncertainty surrounding credit channel effectiveness after the structural changes faced by the Peruvian economy during the nineties. He contrasts factors reducing the effectiveness against others improving it.[7] On the other hand, it seems that the main concern about the exchange rate channel was the balance-sheet effect rather than the direct pass-through to prices. In that context, the role for central bank intervention as a means for taming exchange rate volatility was highlighted.

Empirical research assessing the transmission mechanism of monetary policy in Peru came to light in the second half of the nineties. Early papers highlighted the use of monetary aggregates as the instrument of monetary policy. More recent research, reflecting the change in operating procedures at the central bank, started focusing on the interest rate as the preferred instrument variable.

We divide the current discussion on the transmission mechanisms, studying the interest rate and exchange rate channels, the expectations channel, the credit channel and, given the existing financial dollarisation, we also look into vulnerability issues constraining monetary policy.

3.1 Interest rates and exchange rate channels

Recent VAR evidence on the transmission mechanism is provided in Winkelried (2004), Grippa (2004), Bigio and Salas (2006) and Leiderman (2005). Winkelried (2004) finds rather short and simultaneous responses of both GDP and inflation to an interest rate shock (less than a year). In contrast, Grippa (2004), following a structural identification approach, finds longer monetary policy lags (the peak response of output was in about 18 months after the shock while prices achieve the larger change only three years after).

From the policy perspective, the above two results regarding the transmission lag prove its uncertain nature. In fact, the evolving feature of monetary policy operating procedures over the sample period[8] hampers empirical estimations. The functioning of the transmission mechanism has surely also been changing as the direct influence of the continuous improvement of the monetary policy design, its transparency and communication, not to mention the increasing sophistication of financial markets and financial globalisation. Therefore, VAR models that try to extrapolate past behaviour onto an ever-changing environment have only limited scope. Yet, there are no other sensible alternatives available.

One of the elements of the complexity of the transmission mechanism is the non-linear feature of the transmission. Non-linearities are documented in Bigio and Salas (2006), who find that contractionary monetary policy shocks have a stronger effect on output during recessions than

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7 Higher capital mobility and the development of the domestic capital market are considered as factors reducing the credit channel effectiveness, whereas restoration of confidence in the banking system and higher bank intermediation tend to increase the effectiveness of this channel.

8 Due to the short sub-sample periods, in-depth empirical analysis cannot be performed.

during booms, suggesting the existence of a convex supply curve. In the exercises they perform, monetary policy affects output in about a year and prices in about 16 months.

All in all, as the monetary policy design evolved to suit the developments in the economy, the supporting empirical literature shifted in the same fashion. In the process, the literature finds some evidence that the interest rate channel has become stronger. This is probably the result of the increasing importance of the interest rate as a monetary policy signal and the expanding capital markets within the longer-term maturity spectrum.[9] Moreover, as is typical in small open economies, when the interest rate channel becomes relatively more relevant than the pass-through channel, then the transmission lags turn out to be longer.

However, the above development in the interest rate channel can be potentially dampened by financial dollarisation. As we consider in Section 4, financial dollarisation implies that exchange rate depreciations are contractionary. In this case, the monetary policy power to affect prices via the standard domestic demand channel weakens.[10]

The pass-through from exchange rates to inflation

We now turn our attention to the pass-through from exchange rates to inflation. Many authors suggest the exchange rate pass-through ought to be larger in a dollarised economy than in non-dollarised countries. Importantly, if the pass-through were indeed large, this would heighten the power of monetary policy to affect inflation through the exchange rate channel. However, we shall bear in mind two developments regarding the pass-through in Peru and elsewhere:

(i) There is now a body of research that supports a declining pass-through in developed as well as developing economies.[11]

(ii) The pass-through of exchange rates to domestic prices depends on invoicing practices. Incomplete pass-through characterises developing economies because invoicing of imported goods is made in domestic currency (pricing to market). In Peru, high inflation in the past probably favoured heavy invoicing dollarisation even at the retail level; so when inflation faded, the pass-through also fell. Furthermore, the central bank fostered the introduction of legal measures geared to induce invoicing in domestic currency at the retailer level.[12] As a result, invoicing dollarisation has decreased substantially.

Therefore it is no surprise that empirical papers dealing with estimating exchange rate pass-through to prices have found low pass-through levels. For example, Quispe (2001) finds that a 1 per cent depreciation of the exchange rate produces 0.12 per cent of extra inflation.

More recent empirical explorations by Miller (2004) and Winkelried (2004) come up with similar results: a 1 per cent shock on the exchange rate has an effect on CPI inflation in the

[9] See Armas and Grippa (2006) for a detailed account of the development of the local government bond market in domestic currency. See also Lahura (2005) for estimations of the pass-through of short-term to longer-term interest rates.

[10] Another factor that might explain the general weakening of the domestic demand channel in the world is trade globalisation. This is, for example, the idea put forward in Vega and Winkelried (2005) and Borio and Filardo (2006).

[11] In particular, Edwards (2006) finds that those countries that adopted the IT regime had a stronger reduction in their pass-through coefficients. On the other hand, Frankel et al (2005) find that pass-through reduction in developed countries was even faster than observed in developing countries.

[12] In 2004 a law was enacted to induce price advertising in domestic currency. So, even though dollar advertising was not forbidden, price tagging in soles must also be included.

range of 0.1 to 0.2 per cent within a year.[13] These estimations were recently updated and compared to those of Deutsche Bank (2006), which used a similar method for a group of Latin American countries. The updated pass-through was even lower than 0.1, below the mean pass-through for Latin America but higher than those for Colombia and Chile.

This last result is also compatible with the estimations in Leiderman et al (2006), who perform empirical research using VARS. The paper finds the pass-through in Peru was reduced along with the implementation of the IT framework.

Table 2

Empirical evidence

Direct channels

Papers	Methodology	Sample	Main results
Bringas and Tuesta (1997)	VAR	1991:4–1995:5	– Excess reserves are good indicators of monetary policy. Credit channel is weak.
León (1999)	VAR	1991:6–1998:6	– An innovation to currency in circulation has effects on inflation within 4 to 14 months after the innovation. – No money aggregate is identified with significant effects on output.
Quispe (2000)	VAR	1991:1–1998:6	– Liability dollarisation does not affect the power of monetary policy. – A shock in base money has significant effects on inflation within 8 and 16 months after the shock.
Winkelried (2004)	VECM	1993:1–2003:4	– Results support the existence of interest rate channel as a possible mechanism of action for monetary policy.
Grippa (2004)	VAR	1994:2–2004:2	– The interbank interest rate appears as a reasonable estimation for the appropriate indicator of policy stance.
Bigio and Salas (2006)	Non-linear VAR	1994:1–2004:7	– Interest rate shocks have asymmetric effects: during boom periods, interest rate increases have more effects than interest rate decreases.
Leiderman (2006)	VAR	1993:1–2005:7	– Higher pass-through in Peru than in Chile.

3.2 The expectations channel

There has not been empirical research measuring the expectations channel so far. This has been due to the lack of long-term inflation expectations data. The longest extant sample relies on mean private forecast surveys produced by Consensus Economics, which delivers

[13] Winkelried (2003) finds a non-linear effect whereby the same shock to the exchange rate during a boom period will hit inflation in about 30 per cent.

monthly average responses about the year-on-year inflation expected for current and next calendar years. Using these data and tracking the realised inflation within a year, a time series of one-year-ahead inflation expectations can be calculated. In this subsection, this document presents some preliminary estimation that supports how the expectations channel might have become stronger.

Figure 2

One-year-ahead inflation expectations and inflation targets

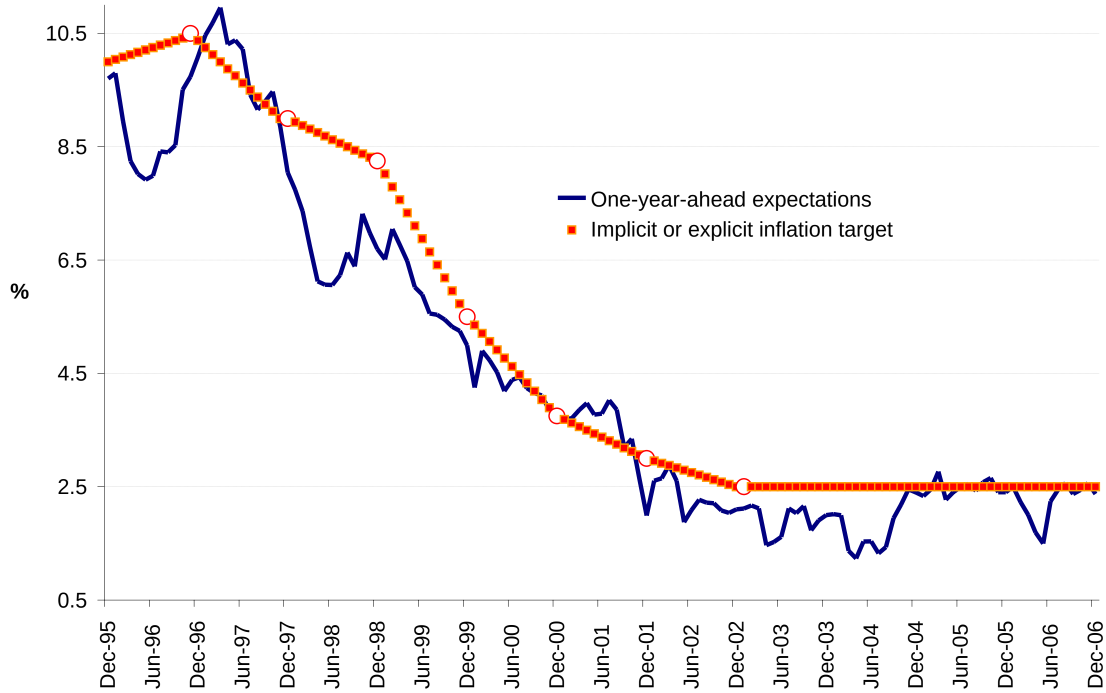


Figure 2 depicts the inflation expectations series. These inflationary expectations can be compared with the inflation target to see how close or far apart they are from each other. It is important to note that until 2001 and since 1994, the central bank announced a desired inflation range for each year.[14] The circles in every December denote the middle values of those ranges. The values for the other months are obtained by simple interpolation, as seen in Figure 2. The target of 2.5 per cent is considered from December 2002 onwards.

From expectation models, it is plausible to consider that the expectation series above vary in time due to changing information and to how private forecasters process information. Forecasters tend to use the announced target as information to form longer-term expectations while they tend to use current information (eg the recently observed inflation evolution) to form shorter-term expectations.

One simple test for improved inflation expectations anchoring is to run a regression of the form

$$\pi^{e}_{t,t+12} = \alpha_t \pi^{target}_{t+12} + (1-\alpha_t)\, \pi_{t-1} \qquad (1)$$

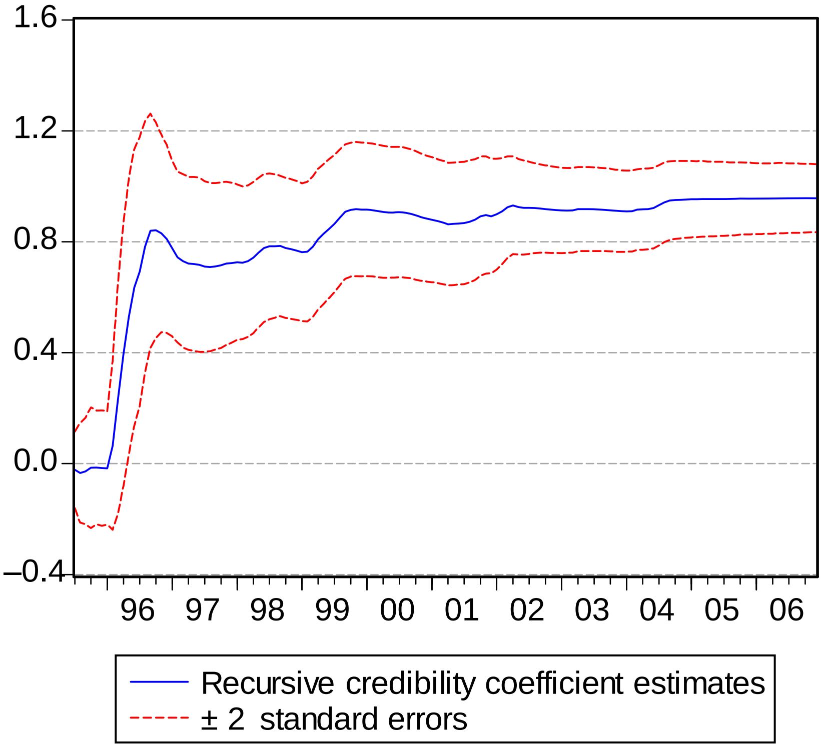
[14] Rossini (2001) tracks the range values together with their announcement dates and documentation.

where $\pi^{e}_{t,t+12}$ is the 12-month-ahead expectation of inflation taken at time t, π^{target}_{t+12} is the inflation target committed to be achieved 12 months ahead, π_{t-1} is the inflation observed one period before expectations are formed and α_t is the weight attached to the target when inflation expectations are formed. This coefficient can be interpreted as the credibility of the central bank on its commitment to achieve the target in the future.

The evolution of the credibility coefficient was estimated through recursive regressions. The results are depicted in Figure 3.

Figure 3

Credibility coefficients using recursive OLS regressions



During this period, the credibility parameter grows from values close to 0.8 at the end of the nineties to values that are closer to 1.0 in the inflation targeting period. This result points to the increasing anchoring of expectations by the central bank. This in turn favours the expectations channel. The importance of this finding is that, through this channel, changes in nominal interest rates induced by the central bank deliver nearly proportional changes in real interest rates (given that inflation expectations at medium to longer horizons are anchored by the target). Thus monetary policy becomes more powerful.

3.3 The credit channel

The evidence about the strength of this channel is weak for Peru. There have been two opposing forces behind this channel. First, higher capital mobility and domestic capital market developments have increased the available substitutes for bank credit such us financing through debt or equity in the capital markets. This has reduced the effectiveness of the credit channel. On the contrary, with increasing confidence in the banking system, higher bank intermediation has improved the effectiveness of this channel, as it replaces informal financing mechanisms.

The most recent empirical evidence on the importance of the credit channel relies on panel data at the firm level. Table 3 summarises the evidence; the bottom line is that the credit channel has not been relevant for monetary policy.[15] Even though the growth of private sector credit contributed to the expansionary phase observed in the period 1994–97, this occurred because large banks had sizeable credit lines with foreign banks. The posterior credit contraction (after the Asian crisis) is explained, first, by a decline of lending capacity (external lines were cut) and later, by banks' unwillingness to provide credit.[16]

Table 3

Empirical evidence

Credit channels

Studies	Methodology	Results
Bringas and Tuesta (1997)	VAR	– Liquidity effect prevails. Higher influence over monetary liabilities than credit levels.
Quispe (2001)	VAR	– Central bank has limited power to reduce the credit supply through financing reduction in domestic currency of banks.
Barajas and Steiner (2001)	Supply and demand model	– Evidence of credit rationing in Peru, caused by a lower disposition to provide it.
Berróspide and Dorich (2002)	Panel data	– Differentiated effects by bank type. Evidence of credit restriction only in larger banks.
Loo-Kung and Shiva (2003)	Panel data	– On average, monetary policy is not able to affect the overall supply of bank lending.
		– Evidence of lending channel in local currency in small banks.
		– Differentiated effects by bank size. Monetary policy has less power over larger banks.

3.4 Vulnerable balance sheets and their effect on monetary policy

One essential issue in a financially dollarised economy is the aggregate vulnerability of balance sheets resulting from sharp exchange rate depreciations[17] attributable, for example, to a sudden stop of capital inflows. This imposes a trade-off for policy makers between exchange rate flexibility and financial stability. In the short run policy makers should be cautious and cannot afford to neglect exchange rates movements. However, in the long run, they should recognize that in order to de-dollarise the economy, it is necessary to allow exchange rate flexibility.

[15] Moreover, within the past few years new alternative sources of finance have been developed, particularly bonds and commercial paper, thus reducing the direct credit channel effect.

[16] For the case of Peru, Barajas and Steiner (2001) find that the credit contraction observed during the crisis years was due mainly to the reduction of credit supply resulting from credit rationing. This occurred despite the fact that lending capacity recovered and demand for credit was strong.

[17] In extreme cases of financial fragility, sizeable unexpected exchange rate depreciations against the dollar increase the burden of dollar-denominated debts, weakening balance sheets and increasing the risks of financial distress.

The practice of monetary policy in emerging markets has indeed been shaped by the dilemma imposed by financial fragility. This is, for example, outlined in Amato and Gerlach (2002), which points out that on the path towards fully-fledged IT, many countries kept exchange rate targets and only slowly abandoned them. In fact, abandonment of exchange rate targets has usually not been undertaken until measures to mitigate financial vulnerability have been put in place.

The IT framework in Peru has included these elements of risk control within its special monetary policy design to foster financial stability.[18] However, like any risk mitigation approach, the Peruvian framework has been put in place without knowing the full extent of the balance-sheet effect, let alone its existence.

Empirical research has tackled the issue through two approaches: using micro panel data at the firm level and estimating aggregate macroeconomic data. The overall conclusions we can derive from the studies are twofold. First, the evidence on whether exchange rate depreciations are contractionary or expansionary is not conclusive. Second, exchange rate effects over the economy are likely to be non-linear and asymmetric (Table 4).

Table 4

Empirical evidence

Balance-sheet effects

Studies	Methodology	Results
Carranza et al (2003)	Panel	– Overall contractionary effects.
Jimenez (2005)	Panel	– Firms' indebtedness with banks is sensitive to exchange rate shocks. Smaller banks are more vulnerable.
Azabache (2006)	Panel	– Non-linear effects on loan portfolio of banks.
Castillo and Dorich (2005)	Panel	– Weak balance-sheet effect at the firm level, but important at the macro level.
Bigio and Salas (2006)	VAR	– Evidence of asymmetric contractionary real depreciation on output.
Leiderman (2006)	VAR	– Evidence of Granger causality from real bilateral exchange rate to nonperforming loans.

4. Dealing with uncertainty about exchange rate effects

The Central Bank of Peru adopted inflation targeting as a monetary policy framework in early 2002, thus becoming the only highly financially dollarised economy to become an ITer. As such, the design and implementation of IT therefore needs to pay special attention to the possible balance sheet consequences of currency mismatches and the potential run on dollar deposits in the banking system. The risks associated with sudden and sharp currency

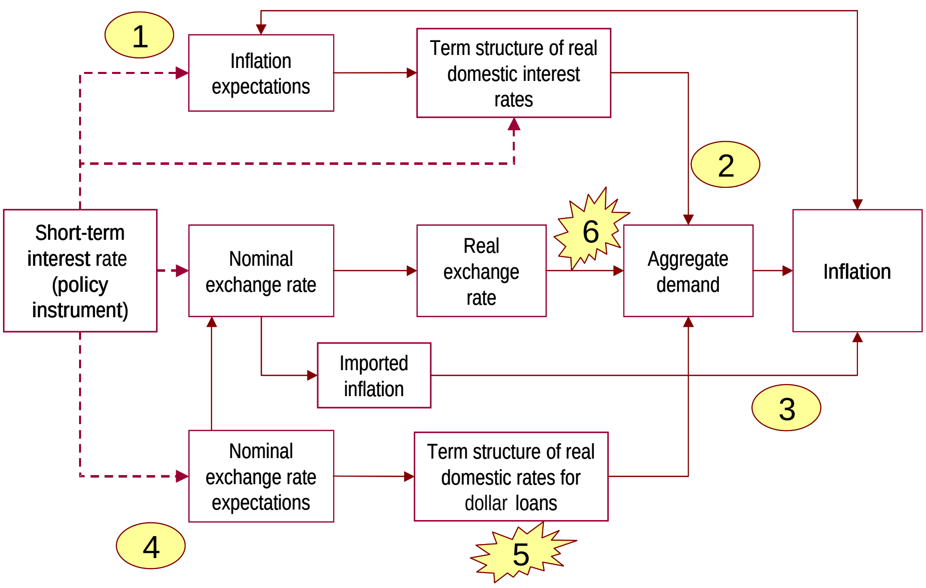
[18] In Armas and Grippa (2005), the risk control framework includes a series of measures besides the managed-floating approach to inflation targeting.

depreciations are not negligible. Therefore, the central bank takes a prudential approach to control these risks.[19]

The core quarterly forecasting model (QFM) relies on a simple structure that tries to capture the main findings about the transmission mechanism laid in the empirical survey of the previous section. Namely, it models the interest rate as well as the exchange rate and expectation channels.

Figure 4

The monetary policy transmission mechanism implied in the QFM structure



The mechanism depicted in Figure 4 resembles the standard monetary policy transmission theory in small open economies. In particular, we have stressed channels (1), (2), (3) and (4): the inflation expectations channel, the interest rate channel through aggregate demand, the pass-through from exchange rates to inflation, and exchange rate expectations channel, respectively. These channels behave in the same fashion as any other small open economy model, though financial dollarisation might have a bearing on the specific empirical sensitivities of endogenous variables within each of these channels.

Importantly, a financially dollarised economy imposes extra channels through which monetary policy can affect aggregate demand and inflation. Of course, financial vulnerabilities coming from sudden stops and exchange rate market distortions also spread through these channels with the potential to affect macroeconomic outcomes. These "vulnerability mechanisms" are labelled as (5) and (6) in the picture. Channel (5) represents the way long-run exchange rate expectations affect the real interest rate on dollar loanable funds to domestic borrowers. Furthermore, the cost of dollar loans for domestic borrowers is determined by the long-term foreign real interest rate plus the real depreciation rate. Lastly, channel (6) is the net real exchange rate impact on activity originated from balance-sheet as well as net export effects.

[19] See Armas and Grippa (2005) for a detailed account of the risk control approach under IT.

Empirical sensitivities at the aggregate level within these three channels are harder to identify. The empirical approaches at the firm level surveyed in this paper provide some rationale for the importance of exchange rate concerns in endogenous monetary policy reactions. However, the overall prudential approach taken by the central bank might have dampened latent and potential adverse effects in the recent past. Therefore, reduced form econometric exercises remain uncertain. So, what is urgent in the central bank research agenda is the structural estimation of deep parameters and the study of robust analysis to overcome the uncertainties regarding exchange rate effects.

In what follows we perform simple exercises taking into account the potential uncertainties that are embedded in the QFM. To do this, Table 5 presents the main equation blocks of the model[20] describing the mechanism depicted in Figure 4.

Table 5

Equations in the Quarterly Forecasting Model (QFM) for the Peruvian economy

Aggregate demand

$$y_t^{gap} = a_y y_{t-1}^{gap} - a_r r_{4,t-1}^{gap} - a_{rS} r_{4,t-1}^{S,gap} - a_{qb} \Delta q_{t-1}^{US,gap} + a_q q_{t-1}^{M,gap} + \xi_{y,t} \qquad (1.1)$$

$$i_{4,t} = \tfrac{1}{4} E_t (i_t + i_{t+1} + i_{t+2} + i_{t+3}) + \varepsilon_{i4,t} \qquad (1.2)$$

$$r_{4,t} = i_{4,t} - E_t[\pi_{4,t+4}^{core}] \qquad (1.3)$$

$$i_{4,t}^* = \tfrac{1}{4} E_t (i_t^* + i_{t+1}^* + i_{t+2}^* + i_{t+3}^*) + \varepsilon_{i4^*,t} \qquad (1.4)$$

$$r_{4,t}^S = i_{4,t}^* + (E_t[e_{t+4}] - e_t) - E_t[p_{4,t+4}^{core}] \qquad (1.5)$$

Inflation (supply)

$$\pi_t = g\pi_t^{non\_core} + (1-g)\pi_t^{core} \qquad (2.1)$$

$$\pi_t^{core} = b_m \pi_{t-1}^m + (1-b_m)\{b_\pi \pi_{t-1}^{core} + (1-b_\pi)\pi_{t+1}^e\} + b_y y_{t-1}^{gap} + \varepsilon_{\pi,t} \qquad (2.2)$$

$$p_t^m = r p_{t-1}^m + (1-r)[a_m p_{t-1}^{noncore\_fuel} + (1-a_m)(e_t - e_{t-1} + p_t^*)] + e_{m,t} \qquad (2.3)$$

Short-run exchange rate

$$\left(e_{t+1}^e - e_t\right) = i_t - i_t^* - prem_t - \varepsilon_{e,t} \qquad (3.1)$$

$$e_{t+1}^e = c_s e_{t-1} + (1-c_s)E_t[e_{t+1}] \qquad (3.2)$$

Monetary policy

$$i_t = f_i i_{t-1} + (1-f_i)\{i_t^{neutral} + f_\pi(E_t[\pi_{4,t+h}^{core}] - \pi_{ss}) + f_y[c_y y_t^{gap} + (1-c_y)y_{t-1}^{gap}]\} + \varepsilon_{i,t} \qquad (4.1)$$

At first sight, the model is a standard small open economy model in the New Keynesian tradition. The first block contains the output gap as a function of one-year real interest rates and real exchange rates plus exogenous factors embedded in $\zeta_{y,t}$.

[20] A thorough exposition of the model can be found in Central Bank of Peru (2005).

Note that besides the domestic one-year real interest rate, the corresponding real dollar interest rate also plays a role in this equation. As long as the economy remains dollarised, a fraction of non-tradable producing agents will take dollar loans. Due to market segmentation, agents (without market power) cannot arbitrage when differences in expected costs among currencies arise. The relevant real rate of these loans is determined by equation (1.5), which measures the cost for agents with incomes in soles but liabilities in dollars. Here long-run exchange rate expectations have a direct impact on these real rates.

We can also note the presence of the bilateral exchange rate depreciation (through the term a_{qb}) together with the effective real exchange rate (through the term a_q). If a_{qb} were higher than a_q then, at the aggregate level, the balance-sheet effect channel would overshadow the net-export channel, as Carranza et al (2004) suggest.

The inflation block is also close to standard modelling practice. It considers the imported inflation effect (π_m) and the lagged output gap (y^{gap}) as well as inertial, expectations and exogenous supply factors. However, one issue that can arise is the strength of the pass-through in a dollarised economy. Given the estimations presented in Miller (2003), Winkelried (2003) and Leiderman (2006), the pass-through (the combined effects of parameters b_m and α_m) in the model is rather small.

The short-run exchange rate block is worthy of attention. It is normally expected that a rise in interest rates would have an appreciatory impact on the nominal spot exchange rate. This behaviour can be modelled by an uncovered interest parity relationship. However, most standard models assume the next-period exchange rate expectations are rational, which means the spot rate is indeed determined by the entire profile of interest rate differentials expected in the future. This fact makes the spot exchange rate a jumpy variable, which is compatible with a pure-floating exchange rate regime. However, exchange rate interventions by the central bank limit the volatility of the spot rate as viewed at the relevant quarterly frequencies. One way to introduce the impact of interventions is to introduce adaptive or inertial exchange rate expectations, as we do in equation (3.2). The more acute the intervention behaviour is, the less volatile the exchange rate becomes, so the inertial parameter c_s functions as a proxy of the degree of exchange rate interventions.[21]

Last, the monetary policy rule block is standard as well. The behaviour of the central bank is determined by an inflation-forecast targeting rule common in most central bank models.

Given this model structure, we perform two exercises dealing with uncertainty about the exchange rate effects. In our first exercise, we condition the model to extreme values of the c_s parameter; thus we in fact model how the behaviour of the transmission mechanism would change due to shift from lower to higher exchange rate intervention activities. In the second exercise we control for possible balance-sheet effects by trying different values for the real exchange parameters in the demand equation.

4.1 The role of foreign exchange market interventions

The central bank intervenes in the foreign exchange market to smooth undue fluctuations. Without intervention, any bubble-like behaviour would not be sustainable anyhow, and the market would correct deviations from equilibrium. However, the transition to equilibrium could nevertheless endanger financial markets in a dollarised economy. Along these lines, Morón and Winkelried (2005) suggest that it is optimal to dampen exchange rate fluctuations in a dollarised economy like Peru.

[21] The higher c_s is, the more inertial (and less volatile) the exchange rate is. Bofinger and Wollmershäuser (2003) explore another approach to model intervention. In their model, interventions affect the exchange rate premium so as to lean against the wind whenever good or bad news threatens to move the premium.

However, intervention policy faces a trade-off. On the one hand, excessive intervention could sustain dollarisation in the long run, as people do not internalise the risks of dollarisation, providing safe returns to dollar deposits and low costs to dollar debts. But on the other hand, episodes of excessive volatility (associated, for example, with a large and abrupt depreciation) would have a negative effect in the short run, affecting economic activity due to balance sheet vulnerabilities.

Thus, one direct and observable outcome of central bank intervention is the low variability of exchange rates. We use the QFM to simulate alternative degrees of intervention by moving the parameter c_s from 0 (no intervention) to a value equal to 1 (very strong intervention that makes exchange rates very smooth).

Figure 5

Responses to a 100 basis point rise in the interest rate when the exchange rate expectations parameters change

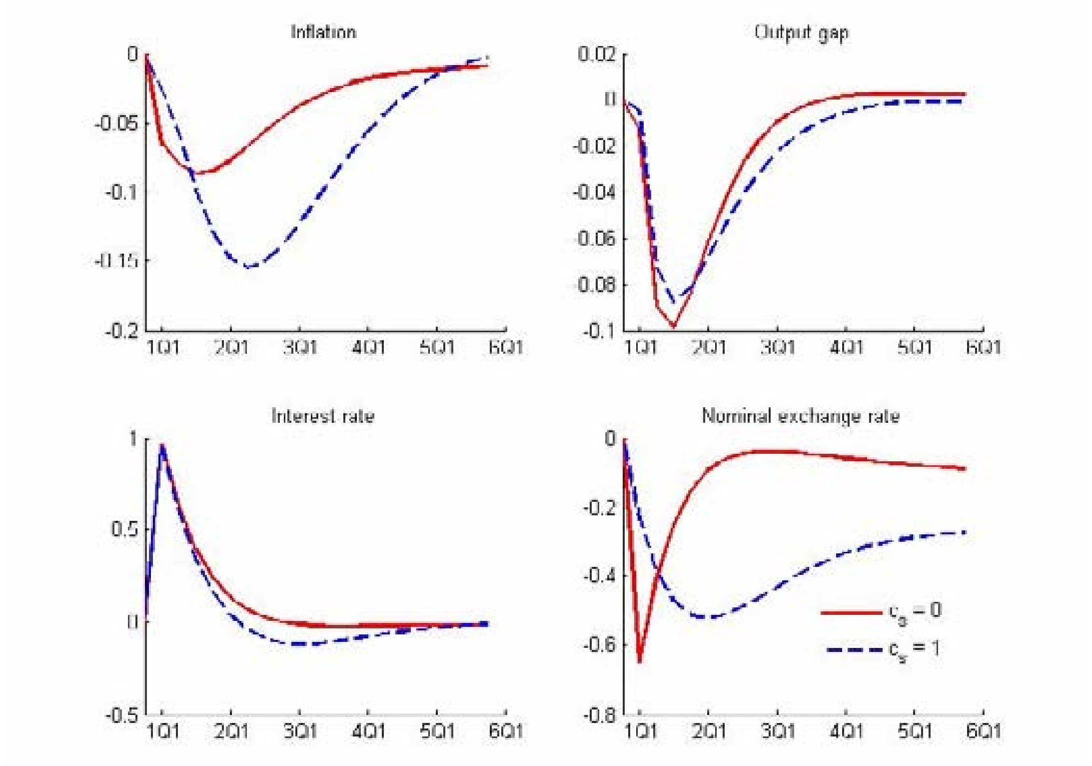


Figure 5 shows the response of the four main variables in the model. The solid line represents the high-exchange-rate volatility model whereas the discontinuous line stands for the low-exchange-rate volatility model. A monetary policy shock that implies a higher interest rate makes the domestic currency denominated bonds more attractive, causing a nominal exchange rate appreciation. The model implies that if the exchange rate were allowed to float more (by means of less intervention), the inflationary effect of exchange rate appreciation would be quicker but smaller. In contrast, more intervention implies a long lasting and stronger pass-through effect on inflation. Leiderman et al (2006) propose the hypothesis regarding a higher pass-through in dollarised economies. To fine-tune the hypothesis, given the simulation result, it may well be the case that higher pass-through results from central bank intervention activities rather than dollarisation per se.[22]

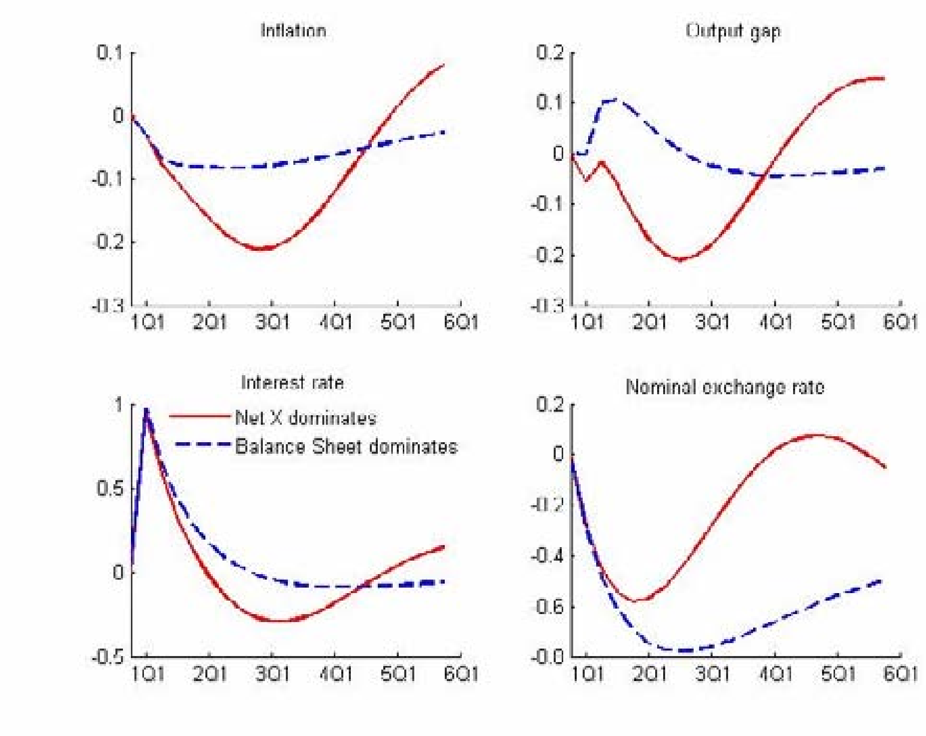
Regarding economic activity, the interest rate rise seems to have a stronger effect under the high-exchange-rate volatility model. This effect is the direct result of the net-exports effect embedded in the model. In reality, it may well be the case that the positive net-exports effect dominates only for small exchange rate movements, whereas the balance-sheet effect dominates whenever larger exchange rate shocks hit the economy. This potential non-linear effect is not modelled here.

4.2 The balance-sheet effect

How does the presence of the balance-sheet effect impinge on monetary policy's power to affect inflation? In Figure 6 we depict responses to an interest rate move to reduce the inflation rate. The exercises show again two possible cases. In the first case, the net-export effect dominates (the parameter a_q in equation (1.1) is set to 0.20, while the parameter a_{bq} is 0.14). The results are depicted in the solid line. In the second case, the parameter a_q is lowered to 0.05, which means that the balance-sheet effect dominates.

Figure 6

Responses to a 100 basis point rise in the interest rate under possible parameterisation of balance-sheet and net export effect on aggregate demand



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22 Successful interventions to smooth out volatility precisely deliver better information about where the exchange rate is heading. This information may serve price setters to pass-through more of the exchange rate's slow movements over the cycle.

In a standard open economy model, we would observe an appreciation of the currency and a fall in the output gap due to the real exchange appreciation, both effects thus reinforcing each other in equilibrium. In the modelling framework presented here, the above effects not necessarily reinforce each other. They may even offset each other and thereby weaken the monetary policy transmission channel.

As expected, under the balance-sheet model (discontinuous line) monetary policy's power is reduced due to the expansionary effect produced by the exchange rate appreciation. We observe that the output gap remains above zero for about a year after the contractionary interest rate move. So, taking into account the nominal exchange rate appreciation and the expansionary result in output, inflation still falls, but only timidly and in a long-lasting way.

5. Conclusions

We have performed an empirical survey with the following main findings:

- There is mixed evidence about the monetary policy transmission lags in Peru. There is, however, a hint of longer lags due to the use of the interest rate as the operating target.
- The pass-through channel from exchange rates to inflation is rather small, about 10 per cent within a year. These results are in line with other findings for Peru and elsewhere.
- The evidence about the credit channel is less convincing, but recent rapid de-dollarisation should help to reinforce it in the future.
- There is uncertainty about the balance-sheet effect because the evidence is not conclusive. If the effect indeed exists, it is likely to be non-linear and asymmetric. Macroeconomic time series analysis of this effect is hindered by the lack of enough controls.
- Lower financial dollarisation will reinforce the interest rate channel of monetary policy.
- A simple econometric test with expectation surveys suggests that the expectations channel has strengthened during these last years.

Financial dollarisation has two overall effects on monetary policy. First, it calls for an appropriate design of IT to control the inherent risks surrounding a dollarised environment. Second, it makes monetary policy less effective whenever the balance-sheet effect is strong.

Importantly, the transmission mechanism is endogenous to the particular monetary policy design put in place; for example, the degree of foreign exchange rate intervention changes the timing and strength of the pass-through mechanism. Namely, a lower degree of intervention makes the pass-through quicker but lower.

On the other hand, when the balance-sheet effect dominates over the net-export effect in the aggregate demand determination, a contractionary monetary policy expands output in the first year, and only after that time, the net-export effect appears. Regarding inflation determination, the resulting higher demand tends to offset the downward pressure coming from the exchange rate appreciation, delivering a small inflationary effect.

The interest rate channel seems to be effective in Peru because dollarisation is not of the currency substitution type. Central Bank of Peru estimates have shown that an increase in interest rates tends to feed through the banking overnight interest rate to the longer-term market interest rates and finally have an impact on aggregate demand and inflation.

Additionally, a reduction in financial dollarisation would reinforce this channel as well as the credit transmission mechanism.

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Transmission mechanism of monetary policy in the Philippines

Diwa C Guinigundo[1]

I. Introduction

The transmission mechanism of monetary policy allows monetary policy to affect real economic activity and inflation through various channels. This mechanism likewise describes the associated lags through which monetary policy actions impact the economy. Recent surveys in the literature have identified and focused on several channels of transmission, particularly through market interest rates, the foreign exchange rate, the volume and allocation of credit, portfolio effects induced by asset price changes, and induced changes in agents' expectations.[2] These channels are interdependent and interrelated as the effects of monetary policy actions could flow through various paths and influence the level of aggregate demand and supply in the economy and ultimately output and inflation.

There are two important aspects to consider in evaluating the transmission of monetary policy. The first is the transmission from the instruments directly under the central bank's control (eg, short-term interest rates or reserve requirements) to variables that most directly affect conditions in the non-financial sector (loan rates, deposit rates, asset prices and the exchange rate). The second is the link between financial conditions and the spending decisions of both households and firms.

Financial globalization in recent years has affected the monetary transmission mechanism, either by changing the overall impact of policy or by altering the transmission channels. The liberalization of capital accounts alongside technological advances and the emergence of increasingly sophisticated financial products have posed new macroeconomic challenges for central banks in industrial and emerging market economies alike with regard to monetary policy implementation. Increased offshore borrowing and the internationalization of the local currency effectively reduces firms' exposure to domestic credit-market conditions and acts to limit the impact of monetary policy on aggregate demand. Meanwhile, the structural changes associated with the globalization process increase not only the uncertainty with respect to the monetary transmission mechanism, but also the transmission mechanism itself, which changes systematically as globalization leads to open capital markets. In light of this development, understanding the transmission mechanism of monetary policy has become one of the pressing issues for policymakers and researchers in recent years.

The liberalization of the Philippine financial system during the early 1990s paved the way for the introduction of financial instruments that had a significant impact on the conduct of monetary policy. This development resulted in the weakening of the traditional link (as posited in a monetary aggregate targeting framework) between money on the one hand and output and inflation on the other. Due to the difficulty in attaining monetary targets because of the growing instability in this relationship, the Bangko Sentral ng Pilipinas (BSP) shifted to inflation targeting as the framework for monetary policy in 2002 to put more emphasis on price stability and less weight on intermediate monetary targets.

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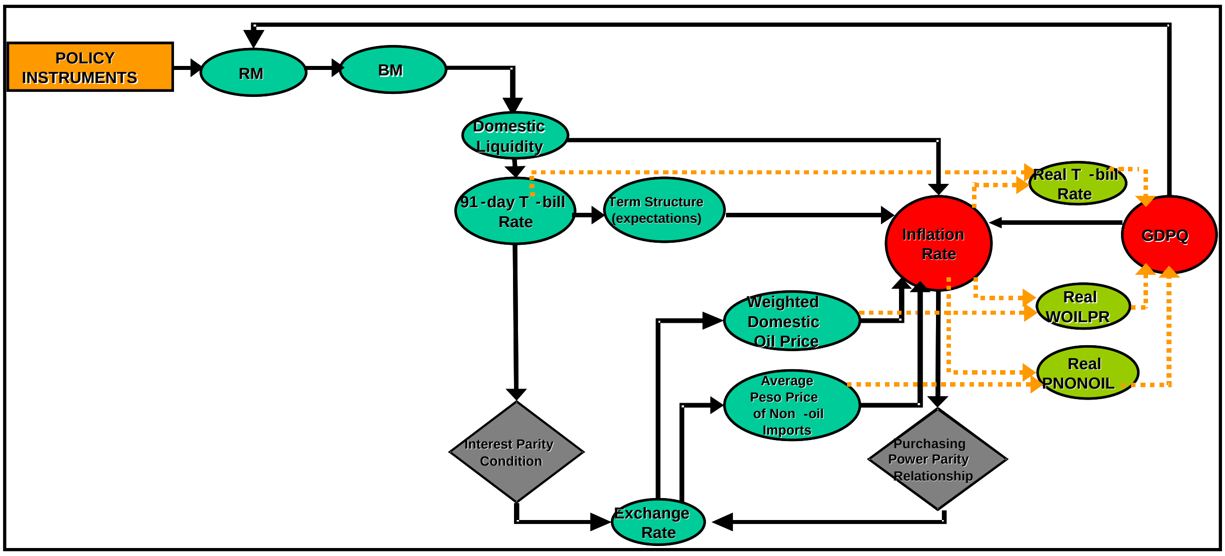
[1] Deputy Governor for Monetary Stability Sector, Bangko Sentral ng Pilipinas.

[2] See, for example, the Monetary Policy Committee, Bank of England, "The Transmission Mechanism of Monetary Policy".

One of the BSP monthly models for forecasting inflation may be useful in tracing the transmission of monetary policy from changes in the policy instruments to consequent changes in output and inflation. Changes in the BSP's policy instruments contribute to changes in inflation through the reserve money and base money which then determine the level of domestic liquidity. The level of domestic liquidity directly affects inflation. The level of domestic liquidity also affects the 91-day Treasury bill (T-bill) rate, which in turn alters the term structure of interest rates (differential between 182- and 91-day T-bill, as proxy for inflation expectations), which then impacts directly on inflation. Through the interest rate parity condition, the change in the 91-day T-bill rate also drives changes in the exchange rate. The exchange rate, in turn, affects the prices of domestic oil products (through the projected world oil price) and non-oil imports, both of which have a direct positive impact on inflation. Meanwhile, inflation has a feedback on exchange rate through the purchasing power parity (PPP) relationship. Changes in the exchange rate drive future changes in the prices of oil and non-oil imports. The model also shows the impact of real T-bill rates and real import prices. Thus, the model allows for multiple-round impacts of exchange rate movements on inflation.



Note: The dotted lines in the diagram trace the link of other endogenous variables in the model to output. The 91-day T-bill rate, weighted domestic oil price and the price of non-oil imports, each adjusted for the inflation rate, determine the real T-bill rate, real domestic oil price and real price of non-oil imports, respectively. These in turn influence the level of output. Meanwhile, the level of output has a feedback to the monetary sector through its impact on reserve money.

This paper focuses on the relative strengths of the various transmission channels in the Philippines. With the shift to inflation targeting, it was observed that the expectations channel has increasingly become a very important and in fact a more effective channel of monetary policy relative to other channels.

II. Channels of transmission

Interest rate

A central bank's interest in the transmission mechanism of monetary policy arises from the fact that it takes time for monetary policy to exert its maximum impact on inflation. A central bank should be able to carefully calibrate its policy interest rate today so as to achieve its inflation target in the future to a level that is broadly consistent with the economy's growth objective. If the price stability objective is achieved, the central bank will then ultimately have contributed to the increase in output.

In the Philippines, the policy interest rates consist of the BSP's overnight reverse repurchase (RRP) or borrowing rate and overnight repurchase (RP) or lending rate. The policy rates are set by the Monetary Board, which is the policymaking body of the BSP. By affecting the level of liquidity, the change in the level of the BSP's policy rates influences the benchmark 91-day Treasury bill rate, banks' lending rates, deposit rates and the whole spectrum of market interest rates. In particular, the short-term market interest rates track closely the movements in the BSP's policy rates. Hence, if there is an adjustment in the BSP's policy rates, the immediate consequence of such an action would be a parallel change in the short-term rates. However, the key issue is that while short-term rates tend to follow the adjustments in the policy rates, they may not change by the same magnitude as the changes in the policy rates.

The BSP has undertaken studies to assess the impact of BSP policy rates on market interest rates. For instance, results of econometric exercises by Dakila and Claveria (2006) showed that the BSP retains its capability to influence market interest rates through the adjustment of the policy rate.[3] The study showed that apart from the past trend in the T-bill rate itself, the policy rate is the most significant determinant of the T-bill rate over the very near term (within three months). Beyond this period, exchange rate changes begin to dominate the policy rate in influencing the T-bill rate. However, the pass-through from the policy rate to the T-bill rate is quite limited.[4, 5]

The same study also examined the effect of the shift to inflation targeting on the correlation between the RRP rate and the 91-day T-bill rate. It was observed that the correlation was fairly high prior to the shift to inflation targeting and weakened thereafter. The weakening is consistent with inflation targeting as a forward-looking framework of monetary policy. Under this framework, the policy rate is set in consideration of how the inflation forecast compares with the target. The robust positive relationship prior to inflation targeting may be an indication that the policy rate may be more reactive to prevailing financial developments compared to the current framework.[6] Causality tests likewise show that the channel of impact from policy rates to T-bill rates may be indirect through secondary market rates.

Credit

The credit channel remains important for monetary transmission in the Philippines mainly because of the continued dominance of banks in the financial system.[7] Bank lending remains

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3 In their study, an impulse response analysis of the reverse repurchase (RRP) rate and the 91-day T-bill rate from a vector autoregression (VAR) of the RRP rate, month-on-month change in the exchange rate, 91-day T-bill rate, real money supply and deviation of gross domestic product (GDP) from trend showed that a one-time shock in the RRP rate by one percentage point leads to a maximum increase in the 91-day T-bill rate of 0.70 percentage point in the second month and dissipates thereafter.

4 Simulations in the BSP Multi-Equation Model (BSP-MEM) likewise indicate that the impact of the policy rate on the T-bill rate is minimal. In particular, sensitivity analyses derived from the model show that a one percentage point increase in the RRP rate leads to a 0.10 percentage point increase in the T-bill rate after one month and to a 0.12 percentage point rise in the bellwether over an average period of twelve months.

5 It can be observed that T-bill rates actually deviated from policy rates roughly during the implementation of the Revised Value-Added Tax (RVAT) Law. This law, which was an important component of the fiscal reform package, contributed to the improvement of investor sentiment on the fiscal outlook and led to a general decline in T-bill rates.

6 For the period following inflation targeting, the correlation between the policy rate and the primary and secondary T-bill rates in fact turned negative.

7 As of December 2006, banks accounted for around 80.7 percent of the total assets of the financial system.

an important source of financing for the corporate sector as equity and corporate bond markets remain relatively underdeveloped.

However, the financial market liberalization that started in the Philippines in the early 1990s weakened the ability of bank lending to reflect the stance of monetary policy. The surge in alternatives to bank loans has somewhat diminished the link between the real economy and the bank lending channel, thereby reducing the importance of credit as a channel for monetary transmission. The opening up of financial markets resulted in the surge of financing through non-banks that offer lower funding alternatives than those provided by commercial banks. Moreover, while non-performing loans (NPLs) of banks have declined, their magnitude remains higher than the pre-1997 Asian crisis levels, leading to continued cautious lending, and a steady shift in preference of corporate firms from bank lending to internal financing. Moreover, recent policy initiatives which are intended to increase demand and trading of securities are likely to further weaken the bank credit channel. These policy changes include: (1) the introduction of unit investment trust funds (UITFs);[8] (2) establishment of the Fixed Income Exchange (FIE);[9] and (3) passage of the Securitization Act of 2004.[10]

In the banking system, more and more deposits have been freed from legal reserve requirements over the years through lower statutory and liquidity reserves, further weakening the link between monetary policy and banks' ability to lend. Recent trends in bank lending show that banks are lending more to the consumer segment of the market than to corporate borrowers. Notwithstanding this development, the increase in consumer lending has not mitigated the weakening of the credit channel as the increase in demand for credit cards has remained largely unaffected by the changes in the BSP's key policy rates.

Over the past decade, and especially after the Asian crisis, the BSP instituted policy changes aimed at ensuring the stability of the financial system. This package of financial reforms includes a staggered increase in minimum capital requirements over a three-year period until end-2000. The phased program of capital increases was aimed at further strengthening the capacity of banks to survive adverse shocks and encourage bank mergers.

In addition to the changes in the prescribed minimum levels, the BSP adopted the BIS-type, risk weight-based capital adequacy framework requiring banks to set aside capital equivalent to 10 percent of risk-weighted assets. The BSP is now in the final preparatory stages of the implementation and adoption of Basel II by 2007 that will compel banks to further strengthen their capital position.

Simultaneous with the improvement in the prudential regulatory framework, the BSP realigned its supervisory system. Improvements in supervisory techniques and approaches include: (1) the adoption of a consolidated risk-based approach to supervision and examination of banks; (2) the adoption of a ladder approach in the imposition of corrective and punitive measures on erring banks; and (3) the adoption, as a general principle, of the timely exit of problem banks.

These policy changes in the regulatory environment served to ensure that banks are operated in a safe and sound manner. These, however, could have indirectly contributed to

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[8] Unit investment trust funds (UITFs), also called common trust funds (CTFs), are open-ended pooled trust funds denominated in pesos or any acceptable currency which are operated and administered by a trust entity and made available by participation.

[9] The FIE had been established to provide an electronic platform for secondary market trading of fixed-income instruments and other debt instruments such as government securities, commercial paper and bonds issued by companies and asset-backed securities.

[10] The Securitization Act of 2004 (Republic Act no 9267) was signed into law by the President on 19 March 2004. It establishes the legal, tax and regulatory framework for asset securitization.

the cautious lending stance of banks in granting new or additional credit, thereby affecting the bank lending channel.

Exchange rate

The Philippines' exchange rate policy, which supports a freely floating exchange rate system whereby the BSP leaves the determination of the exchange rate to market forces, with some scope for occasional BSP action to dampen sharp fluctuations in the exchange rate, is considered consistent with the inflation targeting (IT) framework for monetary policy. Indeed, the credibility of the IT framework is influenced in large part by the commitment to a flexible exchange rate regime. Under its IT framework, the BSP closely monitors developments in the foreign exchange market and, when necessary, uses adjustments in policy instruments (eg, policy interest rates, reserve requirements) in cases where extreme movements in the peso threaten the inflation target. The BSP's response to exchange rate volatility is consistent with price stabilization since fluctuations in the exchange rate tend to feed directly into domestic prices of imported goods and services, and indirectly through to the prices of goods and services that use imported inputs. The increase in prices of both the imported and import-intensive goods in turn feed into demand for adjustments in wages and transport fares. Through this channel, exchange rate movements affect both actual inflation and inflation expectations.

In the Philippines, the length of time within which exchange rate changes work their way through the pattern of spending and ultimately through inflation (exchange rate pass-through) has been estimated at around a year. The impact is immediate – felt on the first month – but the maximum impact is felt about nine months after the exchange rate shock, whereupon the pass-through declines. Sensitivity analyses from the BSP's inflation forecasting models show that a ₱1.00 appreciation/depreciation results in a 0.01 percentage point decline/increase in inflation after one month and reduces/increases the average annual inflation by 0.043 percentage point. Based on the preliminary 2000 input-output (IO) table, it was estimated that a 1 percent appreciation/depreciation of the peso would reduce/increase inflation by about 0.14 percentage point. The exchange rate pass-through on inflation computed from the IO table is higher than the sensitivity derived from the inflation forecasting models since the former already incorporates the total price effect of the peso appreciation over time. On a personal consumption expenditure-weighted basis, transportation and electricity and gas prices contributed the most to the reduction in inflation (see Annex 1).

The current low level of exchange rate pass-through may be linked to cyclical conditions, notably the negative output gap (as indicated by the level of unemployment and moderate capacity utilization in manufacturing) and the manageable inflation environment, as well as to structural conditions, notably the presence of competition from low-priced imported goods and the relatively muted demand for higher wages.

The BSP addresses exchange rate pressures mainly through its headline policy rates. At times, when excess liquidity leads to speculative activities in the foreign exchange market, other monetary tools are utilized, including adjustments in both regular and liquidity reserve requirements.[11]

[11] The BSP also at times adopts a tiering scheme on banks' aggregate placements with the BSP under the borrowing and lending and special deposit accounts (SDA) windows to discourage banks from parking their funds with the BSP. In times of market pressure, the BSP may suspend the tiering scheme to siphon off excess liquidity from the financial system that may find its way into speculative activities in the foreign exchange market.

Asset prices

It is widely accepted that under an inflation targeting framework, monetary policy should focus on the movements of prices of goods and services, not on asset prices. Under this framework, monetary policy could react to a rapid rise in asset prices only in so far as they affect inflation and inflationary expectations through the wealth effect. However, it is important for the monetary authorities to be concerned with asset price bubbles since they influence investment and consumption behavior and function as leading indicators of economic activity that contain useful information about future movements of inflation and output.

In the Philippines, marked fluctuations in asset prices were observed in the years leading up to and following the Asian crisis. The early to mid-1990s were characterized by a general rise in asset prices, followed by a rapid collapse during the Asian crisis. The Philippine experience indicates that a combination of surging capital inflows, rapid credit growth, and accommodative monetary policy can lead to a rise in asset prices:

- The liberalization of nearly all capital account and foreign exchange transactions in 1992 resulted in an influx of foreign capital. Greater openness, as well as the peso's stability and low US interest rates, encouraged foreign borrowing by financial institutions.
- Capital inflows, as well as increasingly market-determined interest rates and credit policies, boosted lending, particularly to the real estate sector.
- Lending and credit conditions were also helped by a generally accommodative monetary policy stance in the mid-1990s.
- Property and stock prices surged with massive capital inflows and rapid credit growth, and fell sharply as the Asian financial crisis broke out.

The fluctuations in asset prices influenced real aggregates, such as household consumption and investments as well as inflation, which broadly moved in tandem with asset price changes. In the post-Asian crisis period, however, private consumption has continued to grow strongly despite the decline in equity and real estate prices. This may be due to the observation that overseas worker remittances are also behind consumption smoothing.

In the Philippines, the asset price channel is closely linked to the bank lending channel, since the financial system remains dominated by banks. The collapse of asset prices during the Asian financial crisis contributed to the rise in non-performing loans (NPLs) and real and other properties acquired (ROPAs) of banks in subsequent years. The deterioration in asset quality of banks, among other factors, dampened credit activity. At present, banks generally have limited direct exposure to real estate and stocks. Commercial bank loans to the real estate sector are below the cap of 20 percent of total loans (11.8 percent as of September 2006). Trading account securities in shares of stock and equity investments in allied/non-allied undertakings are about 2.7 percent of total assets of commercial banks as of June 2006.

The Philippine experience in the 1990s, during which the rapid growth in asset prices was accompanied by accommodative monetary policy, suggests that asset price fluctuations can affect monetary transmission through the credit channel, to the extent that they affect bank asset quality and lending behavior. This is particularly true in the case of property assets. Monetary authorities should therefore pay attention to movements in asset prices, particularly during periods of accommodative monetary policy.

A test of the existence of an asset price channel in the Philippines indicates that asset prices can predict price movements a full year or a full two years ahead (see Tables 1 and 2). Notwithstanding that they are an actual component of the consumer price index (CPI), rentals (proxying for housing prices) can independently be significant as a predictor of future price movements, since in the current economic situation it is primarily through rentals that property owners can monetize the equity in their homes and other real properties.

Equity and bond prices tend to have a limited impact on household wealth and consumption since the retail segment of domestic and equity and bond markets remains relatively underdeveloped and household ownership of equity shares and bonds is far from widespread. Household accumulation of financial assets is instead likely to be concentrated more in savings deposits and insurance.

The BSP's response during the Asian crisis was to increase policy interest rates to mitigate the deterioration in the economic environment rather than address the need to control artificially high asset prices. Recognizing the adverse effects of abnormally high asset prices on the real sector and the banking system, monetary authorities as early as 1995 included the monitoring of asset price changes in the monetary policy framework. The BSP also adopted prudential measures to cap banks' lending to the real estate sector.

It should be noted that BSP concern on asset prices becomes more critical in the face of supply shocks. If the BSP were to counteract supply pressures on output by reducing interest rates, asset price inflation could be abetted in the process.

Table 1

Dependent Variable: INFLATION (4)
Method: Least Squares
Sample (adjusted): 1993:1 2005:4
Included observations: 52 after adjusting endpoints
Convergence achieved after 55 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.520513	1.912129	3.933057	0.0003
MA1_INFLATION	–1.266250	0.288627	–4.387152	0.0001
MA2_GDP_GR	0.479032	0.239252	2.002207	0.0519
MA1_M3_GR	–0.162029	0.068849	–2.353394	0.0235
MA2_M3_GR	–0.137793	0.072834	–1.891868	0.0656
MA1_ER_GR	–0.100497	0.039970	–2.514301	0.0159
MA2_ER_GR	–0.076971	0.039094	–1.968849	0.0558
MA1_RENTALS_GR	1.324633	0.253801	5.219186	0.0000
MA1_PHISIX_GR	0.043184	0.020741	2.082042	0.0436
MA2_PHISIX_GR	0.044013	0.016878	2.607653	0.0127
AR(1)	0.893429	0.052253	17.09813	0.0000

R-squared	0.889543	Mean dependent var.	6.358284
Adjusted R-squared	0.862602	S.D. dependent var.	2.326756
S.E. of regression	0.862463	Akaike info criterion	2.727357
Sum squared resid.	30.49757	Schwarz criterion	3.140120
Log likelihood	–59.91129	F-statistic	33.01849
Durbin-Watson stat.	1.570991	Prob (F-statistic)	0.000000
Inverted AR Roots	.89		

Table 2

Dependent Variable: INFLATION (8)
Method: Least Squares
Sample (adjusted): 1992:1 2004:4
Included observations: 52 after adjusting endpoints
Convergence achieved after 20 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.712071	1.388144	1.233353	0.2243
MA1_INFLATION	0.466908	0.250600	1.863158	0.0694
MA2_M3_GR	0.281476	0.059454	4.734332	0.0000
MA1_TBILL91	–1.212012	0.256904	–4.717757	0.0000
MA2_TBILL91	0.576176	0.169799	3.393284	0.0015
MA1_ER_GR	0.164503	0.043323	3.797135	0.0005
MA2_ER_GR	–0.040703	0.026783	–1.519744	0.1361
MA1_PHISIX_GR	0.060211	0.015914	3.783439	0.0005
MA2_TERM_STRUCTURE	2.517530	0.867789	2.901084	0.0059
AR(1)	0.522730	0.135192	3.866584	0.0004

R-squared	0.854165	Mean dependent var.	6.358284
Adjusted R-squared	0.822915	S.D. dependent var.	2.326756
S.E. of regression	0.979133	Akaike info criterion	2.966742
Sum squared resid.	40.26544	Schwarz criterion	3.341981
Log likelihood	–67.13530	F-statistic	27.33304
Durbin-Watson stat.	1.433439	Prob (F-statistic)	0.000000

Inverted AR Roots	.52

Definition of variables:

Inflation (n)	= quarterly CPI inflation at n quarter leads
GDP_GR	= GDP growth
M3_GR	= M3 growth
ER_GR	= year-on-year change in the exchange rate
RENTALS_GR	= year-on-year change of rentals component of the CPI
PHISIX_GR	= year-on-year change of Phisix
TBILL91	= 91-day T-bill rate
TERM_STRUCTURE	= 182-day T-bill rate minus 91-day T-bill rate
MAn_X	= denotes the moving average of the variable X over the n-year period

Expectations

Meanwhile, the enhanced transparency associated with the shift to inflation targeting has served to increase policymakers' awareness of the importance of the expectations channel in the conduct of monetary policy. Greater attention has been paid as a result to gauging public inflation expectations.

An empirical test of the expectations channel, given sparse data, may be done by testing whether the expectations hypothesis of the term structure of interest rates holds for the Philippines. By definition, the expectations hypothesis of the term structure of interest rates states that the returns for a lender facing uncertainty over the long-term horizon can be computed by considering the expected returns of shorter-term periods covered by the long horizon and constructing a weighted average plus a term premium to compensate him for assuming the greater risk extended by longer-term lending. Empirically testing the expectations hypothesis therefore involves regressing the long-term interest rate on the average of the short-term interest rates of the consecutive time to maturities it covers and on the term premium. The hypothesis is said to hold if the coefficient of the average short-term rate is equal to one and if the term premium can be shown to be constant (ie, not time-varying). The role of the expectations hypothesis is crucial in the sense that it provides the link between market rates of interest-bearing financial instruments on which economic activity depends and the policy rate. It does this by extending the effect of the policy rate on short-term interest rates to the longer-term interest rates on which a lot of business and household decisions are based.

Regressing the 182-day T-bill rate on the average of the two 91-day Treasury bill rates, covering its time to maturity and relegating the term premium to the residual term, it is observed that the assumption that the term premium is constant does not hold, but the premise that the coefficient of the regressor is equal to one does hold. Our initial examination of the result shows that the existence of the expectations channel is qualified (see Table 3).

Table 3

Dependent Variable: TBILL182
Method: Least Squares
Sample (adjusted): 1988:4 2006:2
Included observations: 71 after adjusting endpoints
Convergence achieved after 90 iterations
Backcast: 1988:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.044198	0.612645	1.704411	0.0929
(TBILL91+TBILL91(2))/2	1.009628	0.046003	21.94702	0.0000
AR(3)	0.012578	0.127499	0.098648	0.9217
MA(1)	0.887787	0.060110	14.76930	0.0000

R-squared	0.958884	Mean dependent var.	13.28451
Adjusted R-squared	0.957043	S.D. dependent var.	5.568910
S.E. of regression	1.154211	Akaike info criterion	3.179399
Sum squared resid.	89.25757	Schwarz criterion	3.306874
Log likelihood	–108.8687	F-statistic	520.8506
Durbin-Watson stat.	1.847261	Prob (F-statistic)	0.000000

Inverted AR Roots	.23	–.12–.20i	–.12+.20i
Inverted MA Roots	–.89		

In the past few years, monetary authorities' assessment of the required magnitude of policy rate changes has been shaped in large part by continuing evidence of minimal demand-pull inflationary pressures, given moderate resource utilization in the economy. Nevertheless, with the escalation of cost-push pressures associated with the recent oil price shock, authorities have considered, during various discussions on the monetary policy stance, responding with marginal changes in the policy interest rates as a means of influencing/managing inflation expectations and signaling the BSP's commitment to its inflation objective.

The communication strategy and credibility of the BSP are also important factors that influence the formation of inflation expectations. In particular, a full dose of monetary policy action may not be necessary if the public is convinced that the BSP will act in accordance with its policy pronouncements.

III. Concluding remarks

The Philippine experience shows that increased financial globalization and the liberalization of the Philippine financial markets have affected the various transmission channels of monetary policy. These changes have undermined the traditional relationships between monetary aggregates and goal variables (inflation and output) which rendered monetary policymaking a more challenging task. Because of these developments, the BSP decided to shift to inflation targeting as the framework for monetary policy to address the need for a more forward-looking approach in the conduct of monetary policy.

With the shift to inflation targeting, it was observed that the expectations channel has taken a more important role in the transmission of monetary policy in the Philippines. The enhanced transparency associated with inflation targeting has increased policymakers' awareness of the importance of gauging public inflation expectations in the conduct of monetary policy. While the expectations channel has strengthened during the inflation targeting period, the effect of inflation targeting on the interest rate channel, specifically the correlation between the policy rate and the benchmark 91-day T-bill rate, has weakened. This evidence is consistent with inflation targeting as a forward-looking framework of monetary policy. The robust positive relationship prior to inflation targeting may be an indication that the policy rate then may be more reactive to prevailing financial developments compared to what is done under the current framework.

In the Philippines, the credit availability channel and the asset price channel remain closely linked due to the dominant role of the banking system in the Philippine financial system. Financial market liberalization, coupled with the large NPL overhang, which is a remnant of the Asian financial crisis, has weakened the credit availability channel and, to a certain extent, the asset price channel of monetary policy. Meanwhile, the BSP's flexible exchange rate policy has helped to limit the exchange rate pass-through from nominal exchange rates to inflation. Together with the firm commitment to maintain the inflation target, exchange rate changes are likely to be viewed by firms as temporary, and this has worked to weaken the exchange rate channel of monetary policy transmission. In the Philippine case, the low level of exchange rate pass-through may be linked to cyclical and structural conditions, notably the manageable inflation environment and the presence of competition from low-priced imported goods and the relatively benign labor market condition.

Annex 1

Impact of 1% peso appreciation on Consumer Price Inflation

Based on preliminary 2000 input-output table

	Impact on inflation;[1] in percentage points	PCE weight[2]	Impact on inflation (weighted); in percentage point
01 Paddy	-0.0424	0.0000	0.0000
02 Other grains	-0.0508	0.0008	0.0000
03 Other food crops	-0.0971	0.0214	-0.0021
04 Non-food crops	-0.1308	0.0006	-0.0001
05 Livestock and poultry	-0.1084	0.0205	-0.0022
06 Forestry	-0.1133	0.0000	0.0000
07 Fishery	-0.1040	0.0400	-0.0042
08 Crude petroleum and natural gas	-0.0906	0.0000	0.0000
09 Iron Ore	0.0000	0.0000	0.0000
10 Other metallic Ore	-0.0965	0.0000	0.0000
11 Non-metallic ore and quarrying	-0.1831	0.0003	-0.0001
12 Milled grain and flour	-0.0620	0.1164	-0.0072
13 Fish products	-0.0842	0.0171	-0.0014
14 Slaughtering and meat products	-0.1239	0.0767	-0.0095
15 Other food products	-0.1337	0.1474	-0.0197
16 Beverage	-0.1445	0.0285	-0.0041
17 Tobacco	-0.1346	0.0128	-0.0017
18 Spinning	-0.4426	0.0002	-0.0001
19 Weaving and dyeing	-0.4859	0.0002	-0.0001
20 Knitting	-0.5462	0.0003	-0.0002
21 Wearing apparel	-0.3908	0.0066	-0.0026
22 Other made-up textile products	-0.4498	0.0011	-0.0005
23 Leather and leather products	-0.3218	0.0001	0.0000
24 Timber	-0.1469	0.0001	0.0000
25 Wooden furniture	-0.2579	0.0039	-0.0010
26 Other wooden products	-0.3010	0.0006	-0.0002
27 Pulp and paper	-0.4123	0.0005	-0.0002
28 Printing and publishing	-0.3315	0.0021	-0.0007
29 Synthetic resins and fiber	-0.3382	0.0000	0.0000
30 Basic industrial chemicals	-0.4718	0.0000	0.0000
31 Chemical fertilizers and pesticidies	-0.3976	0.0003	-0.0001
32 Drugs and medicine	-0.4253	0.0041	-0.0017
33 Chemical final products	-0.4049	0.0125	-0.0051
34 Refined petroleum and its products	-0.5776	0.0160	-0.0093
35 Plastic products	-0.5149	0.0004	-0.0002
36 Tires and tubes	-0.5554	0.0001	-0.0001
37 Other rubber products	-0.4781	0.0014	-0.0007
38 Cement and cement products	-0.3552	0.0003	-0.0001
39 Glass and glass products	-0.3718	0.0000	0.0000
40 Other non-metallic mineral products	-0.3141	0.0004	-0.0001
41 Iron and steel	-0.5120	0.0000	0.0000

For footnotes, see the end of the table.

Impact of 1% peso appreciation on Consumer Price Inflation (cont)

Based on preliminary 2000 input-output table

		Impact on inflation;[1] in percentage points	PCE weight[2]	Impact on inflation (weighted); in percentage point
42	Non-ferrous metal	-0.3782	0.0000	0.0000
43	Metal products	-0.4913	0.0002	-0.0001
44	Boilers, engines and turbines	-0.4017	0.0000	0.0000
45	General machinery	-0.4304	0.0000	0.0000
46	Metal working machinery	-0.3674	0.0000	0.0000
47	Specialized machinery	-0.4364	0.0000	0.0000
48	Heavy electrical equipment	-0.5056	0.0000	0.0000
49	Television sets, radios, audios & comm eqpt	-0.6004	0.0006	-0.0004
50	Electronic computing equipment	-0.6597	0.0001	0.0000
51	Semiconductors and integrated	-0.6533	0.0000	0.0000
52	Other electronics & electronics products	-0.6051	0.0000	0.0000
53	Household electrical equipment	-0.4650	0.0021	-0.0010
54	Lighting fixtures, batteries, wiring & others	-0.4602	0.0003	-0.0001
55	Motor vehicles	-0.4333	0.0018	-0.0008
56	Motorcycles	-0.4700	0.0001	-0.0001
57	Shipbuilding	-0.3108	0.0000	0.0000
58	Other transport equipment	-0.4436	0.0000	0.0000
59	Precision machines	-0.4392	0.0004	-0.0002
60	Other manufacturing products	-0.3631	0.0014	-0.0005
61	**Electricity and gas**	**-0.3571**	**0.0318**	**-0.0114**
62	Water supply	-0.2649	0.0036	-0.0009
63	Building construction	-0.2011	0.0000	0.0000
64	Other construction	-0.2072	0.0020	-0.0004
65	Wholesale and retail trade	-0.0685	0.0861	-0.0059
66	**Transportation**	**-0.2810**	**0.0493**	**-0.0138**
67	Post and telecommunication	-0.0596	0.0136	-0.0008
68	Finance and insurance	-0.0573	0.0172	-0.0010
69	Real estate & ownership of dwellings	-0.0380	0.1221	-0.0046
70	Education and research	-0.0699	0.0516	-0.0036
71	Medical and health service	-0.2641	0.0358	-0.0095
72	Restaurants	-0.1521	0.0349	-0.0053
73	Hotel	-0.1413	0.0021	-0.0003
74	Other services	-0.1030	0.0090	-0.0009
75	Public administration	-0.0614	0.0000	0.0000
	TOTAL		**1.0000**	**-0.1370**

[1] Impact of 1% peso appreciation on the commodity's price inflation, in percentage points; e.g., 1% appreciation lowers the price of hotel services by 0.14 percentage point. [2] Weight of the commodity in Personal Consumption Expenditures (I-O 2000, Final Demand); in decimal points.

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The monetary transmission mechanism in Poland

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I. Introduction

The monetary transmission mechanism (MTM) describes how changes in the short-term interest rate introduced by monetary policy affect aggregate output and inflation. As there are a number of ways through which monetary policy actions may have an impact on output and inflation, routine approaches usually concern only selected parts of this complex transmission mechanism (cf Mishkin (1995)). Some more comprehensive studies, however, attempt to put these channels into a unified model framework.[3]

The composition of this paper reflects both approaches: a comprehensive model approach, as well as some separate studies. In the second section we present and discuss the monetary transmission channels which form the most important parts of this mechanism in Poland as they are reflected in the core forecasting model of the National Bank of Poland (NBP) – the ECMOD. The third section presents separate studies investigating separate channels not explicitly incorporated in the ECMOD model, eg the credit and expectations channels. The fourth section discusses the role of monetary aggregates in monetary transmission and in the conduct of monetary policy in Poland. The last section recapitulates and highlights the major problems connected with the monetary transmission channels.

II. Monetary transmission channels in the ECMOD

The ECMOD is a quarterly macroeconomic model of the Polish economy (Fic et al (2005)). It has been in operation as the core forecasting model of the NBP since May 2005. As in the case of most macroeconomic models used at central banks, the ECMOD's theoretical foundations derive both from classical and from Keynesian theories. In the short term, economic growth is mainly determined by demand factors, rigidities and inertia, while in the long run it is the supply side that shapes the behaviour of the economy. In such a setup there is scope for monetary policy to influence the demand side of the economy in order to smooth out fluctuations in output and inflation in the medium run. However, in the long run, monetary policy actions exert no influence on the economy.

The ECMOD has been developed to generate forecasts of key macroeconomic variables, including the projections of inflation, GDP, its components, and other categories relevant for

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[3] Contrary to some new concepts regarding the MTM (eg the one proposed in Svensson (2006), which suggests that "the monetary-policy transmission mechanism should be seen as a mapping from an instrument-rate path to target-variable paths, not as a mapping from an instrument-rate level to a level of the target variables at some particular horizon"), in the present analysis we stick to the more standard view of the MTM as an explanation of a lagged reaction in output and inflation to short-term interest rate changes.

the conduct of monetary policy. The model serves as a simulation tool enabling quantification of the effects of monetary policy and exogenous shocks resulting from changes in foreign demand, oil prices, etc. Monetary transmission in the ECMOD focuses on the two most important channels transmitting monetary impulses into the economy: the interest rate and exchange rate channels. To construct a complete picture of the MTM more easily, before proceeding to the description of the two channels, we will now present the final stage of the transmission process, ie the determination of inflation.

Direct determinants of inflation

In the ECMOD model, the main consumer inflation concept is represented by the core CPI inflation index. The inflation equation is based on the concept of cost-push inflation, according to which prices depend on the costs of production factors, ie unit labour costs and import prices. The price level is also influenced by demand factors quantified using the output gap. Where demand outstrips supply, sellers are able to demand higher margins, which results in price growth. Otherwise, demand lower than supply necessitates a reduction in margins. Inflation is additionally affected by inflation expectations, which, however, are assumed to have adaptive properties. For this reason, they are represented in the model by the lagged inflation.

Interest rate channel

Within the ECMOD framework, the short-term interest rate is an exogenous variable. In this way, the model can simulate the influence of the interest rate on changes in the behaviour of endogenous variables such as output and inflation. A rise in nominal interest rates translates into an increase in the real rate of interest and the user cost of capital. Higher real interest rates dampen private consumption, and a higher user cost of capital hinders investment activity.

A drop in the consumption growth rate builds on the inter-temporal substitution and liquidity constraint of households. According to the hypothesis of inter-temporal consumption substitution, higher real interest rates encourage the postponement of current consumption.

Investment results from the discrepancy between the desired level of capital stock (fixed at the level of equality of the marginal product and the user cost of capital), and the current capital stock. For this reason, a higher level of the user cost of capital triggers a cutback in investment demand. In other words, enterprises reduce their wish for capital input and, in effect, investments, in response to the rising user cost of capital (higher real interest rates).

A reduction in both output categories mentioned above leads to a fall in aggregate demand. Facing falling demand, enterprises cut both wages and employment in order to re-establish the balance between their costs and prices, on the one hand, and to sustain a technologically optimal labour input given the new level of output, on the other. In addition, wage changes in the model are tied to the unemployment gap. As cuts in employment tend to increase the unemployment rate, the employee’s wage expectations are squeezed. Hence, the reduction of wages is accomplished by a reduction in the demand for labour and lower expected wages of workers. Moreover, wage growth also depends on inflation directly – a fall in inflation eases wage pressures. The estimated parameters of the ECMOD imply that in response to a monetary tightening the wage bill decreases faster than the GDP. Consequently, this leads to a reduction in unit labour costs. The decline in unit labour costs constitutes the most important deflationary impulse, as the concept of inflation modelling applied in the ECMOD relies on the cost-push approach.

GDP deceleration negatively affects investment demand, which translates into lower potential GDP growth. However, a faster decrease in actual GDP than in potential GDP results in widening the output gap, while a declining output gap exerts additional negative pressure on inflation. The direct linkage between the growth rate of consumer prices and the output gap is, however, relatively weak.

It should be mentioned that the re-estimation of the model in early 2006 revealed that the impact of the output gap on net inflation had decreased further. According to the research results of Chmielewski and Kot (2006), who estimated the net inflation equation from the ECMOD on a series of rolling samples of data, the output gap coefficient has been gradually losing statistical significance since 2003. They interpret this result as meaning that the equation should be supplemented by international factors. Next, the authors found that the output gap is still significant in the equation when net inflation is adjusted for a change in price indexes of "tradable" goods. In other words, they separated globalisation-affected inflation from domestically driven inflation and verified that the latter is responsive to monetary policy changes. This result corresponds to the findings of Borio and Filardo (2006), indicating the rising importance of the global output gap in relation to the domestic output gap in the Phillips curve for a group of 16 industrialised economies.

Clearly, the ECMOD introduces some short-cuts in the modelling of the interest rate transmission channel. The model does not demarcate between household and corporate investment demand. Furthermore, the model makes use of 3M WIBOR, and no deposit or loan rates are explicitly modelled. Neither does the model distinguish between interest rates for the household and corporate sectors, on which some comments can be found in Crespo-Cuaresma et al (2006). The authors showed that the long-run pass-through from the policy rate to the short-term deposit and lending rates is generally high, ranging from 63% to 91%. There are no significant differences between the pass-through for household and corporate deposits (around 90% for both categories), while the pass-through for household lending rates is slightly lower than that for corporate lending rates (circa 60% vs 70%). Their results further indicate that the pass-through of the policy rate into lending and deposit rates may have fallen in recent years. Still, these results allow the assumption that the above-mentioned simplifications applied in the ECMOD do not critically influence its results.

Exchange rate channel

In the ECMOD framework the exchange rate channel represents the integral part of the influence that monetary policy exerts on inflation through shifts in the short-term interest rate.[4] The exchange rate in the ECMOD is endogenous and corresponds to the floating exchange rate regime currently in force in Poland. The long-term path of the real exchange rate is determined by the fundamentals, encompassing differences of potential output between Poland and its main trading partners. It is assumed that the convergence of GDP levels at home and abroad is accompanied by the convergence of the price levels. In this context, the long-term exchange rate path can be considered as a relative version of the purchasing power parity theory. According to this theory, the potential growth rate in Poland, which exceeds the one observed in economies of the main Polish trading partners, results in the appreciation of the long-term path of the real exchange rate. Deviations of the real exchange rate from its long-term path depend on three factors: the level of net foreign assets, the real interest rate disparity and the risk premium. An increase in net foreign assets

[4] There are various studies singling out the influence of the exchange rate on inflation and examining the pass-through effect in Poland. They do not, however, deliver any coherent results. For example, Coricelli et al (2006), applying a structural VECM model on the 1993–2002 sample, estimate that a long-run pass-through of the exchange rate to consumer prices is 80%. Darvas (2001), applying a single-equation approach, estimates on the basis of the 1993–2000 sample that the long-run pass-through of the exchange rate to consumer prices is around 20%. The IMF (2004), applying the structural VAR approach, estimates that the pass-through of the effective exchange rate to consumer prices in a 12-month period amounts to 22% (for the 1996–2003 sample), 58% (for the 1996–1999 sample), and 20% (for the 2000–2003 sample).

results in exchange rate appreciation. Such a mechanism prevents excessive accumulation of receivables and liabilities with respect to foreign entities. The other factor which leads to the deviation of the exchange rate from its long-term path is the real interest rate disparity – its increase results in the appreciation of the zloty exchange rate, while its decrease translates into depreciation of the zloty. Finally, deviations of the real exchange rate from its long-run path given by fundamentals depend on the risk premium approximated by the general government deficit.

Import and export prices are determined following the price-taker/price-maker approach. Exporters and importers set export and import prices taking into account both the prices on their domestic market (meaning that they make prices on goods they export (import)) and prices on markets of their trading partners (meaning that they take prices existing on markets to (from) which they export (import) as given). In other words, import and export prices are weighted averages of prices in Poland and prices abroad expressed in Polish currency.

A tightening of monetary policy leads to an appreciation of the domestic currency due to a change in the interest rate disparity. The appreciation of the exchange rate leads to a drop in the growth rate of both export and import prices. As the behaviour of the long-run consumer price index is driven by production costs (unit labour costs and import prices), a reduction in import prices translates into a decrease in consumer prices. Moreover, a monetary policy tightening leads to the widening of the trade gap as export profitability falls and imports become more competitive as compared to domestic production. A lower trade balance reduces GDP, causing a fall in the demand for labour and a subsequent increase in the unemployment rate. Further developments are in line with those described in the interest rate channel.

According to the current specification of the ECMOD, a hike in short-term interest rates of 100 basis points sustained for 4 quarters (operating through both the interest rate and the exchange rate channel) results in a reduction in GDP growth of 0.3 percentage points. after 4 quarters and a reduction in inflation of 0.2 percentage points. after 8 quarters. However, the specified strength of the response to the interest rate shock might vary, as the relative importance of the transmission channels might change. The ECMOD model is being developed constantly to capture structural changes affecting the Polish economy. Structural factors such as EU accession, the deepening of the international division of labour and the increasing openness of the Polish economy might have exerted a strong impact on the behaviour of economic agents, which cannot be fully reflected in the model estimated on the basis of past data series.

III. Some other research results on monetary transmission channels in Poland

This section presents some separate research results on monetary transmission channels in Poland which might be important for the conduct of monetary policy. They have not been included in the core forecasting model framework for various reasons. First of all, their relevance for the conduct of monetary policy as compared to the interest rate channel (including the exchange rate impact) is presumably weaker. Secondly, in some cases the possibility of incorporating the channels in the forecasting process is heavily constrained by data availability. Thirdly, some research, as well as anecdotal evidence, seems not to yield any clear results. Finally, a model which could contain all channels of monetary transmission would be far too complicated, and the sole forecasting process could lose in terms of transparency and would be too difficult to operate smoothly.

Credit channel

The necessary condition for the credit channel to operate is the significant role of banks as a source of capital for the corporate sector. If some borrowers do not have easy access to the capital market, their investment expenditure will depend on bank credit. Monetary tightening results in a reduction of loan supply due to worsening demand prospects and to deterioration in the creditworthiness of households and firms, which in turn affects the consumption and investment of the private sector and output growth. Some banks can be in a better position than others to offset monetary policy tightening. Owing to the asymmetric information problem, small banks may find it more difficult to raise non-deposit funds to keep loans at the desired level. The same is true for poorly capitalised banks.

In Poland banks dominate the financial market, so a necessary condition for the credit channel to operate is fulfilled. Empirical studies on the bank-level data produce ambiguous results. For the period 1997–2001 Pawłowska (Wróbel and Pawłowska (2002)) shows that the credit channel in Poland operates and that small as well as less capitalised banks tend to reduce credit supply after a monetary tightening. Chmielewski (2005) also provides some evidence that less capitalised banks are more prone to react to a monetary tightening. However, the most recent evidence (Grabek (2006)) performed on an extended sample does not confirm these results. All in all, taking into account these findings, it is hard to assess the importance of the credit channel in monetary transmission in Poland.

Inflation expectations channel

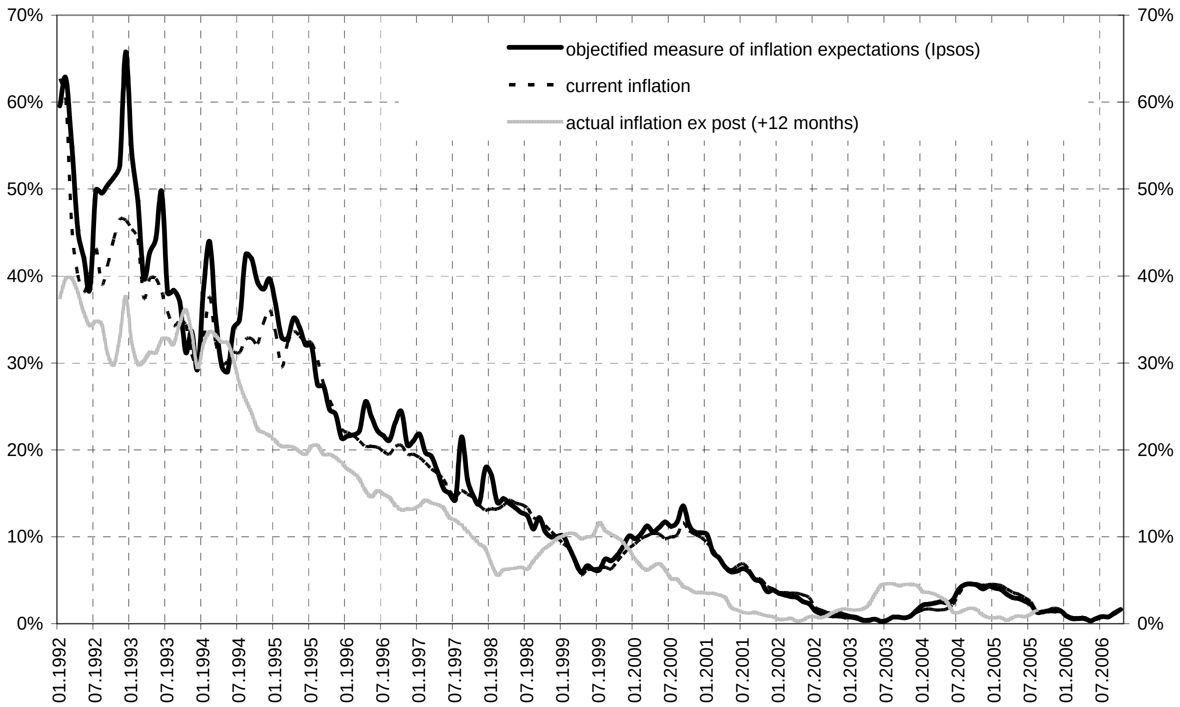
Inflation expectations play a pivotal role in various channels of the monetary policy transmission mechanism, as they influence real interest rates, the exchange rate, aggregate demand, wages and prices. In theory it is commonly assumed that expectations are rational, ie that they fulfil unbiasedness and macroeconomic efficiency conditions. However, numerous empirical studies suggest that inflation expectations are characterised by different propensities to look forward and backward. The more forward-looking they are, the more efficient the central bank is in influencing inflation and inflation reduction is less costly in terms of output.

Figure 1 presents the expected rate of inflation in 1992–2006, compared to the current rate of inflation (known at the moment the surveys were carried out) and actual inflation ex post (with reference to which the expectations were formed). It can be easily seen that they are usually close to the current rate of price change. However, in 1992–1997 there were periods when inflation expectations were even higher and much more volatile than current inflation, which might have resulted from a coincidence of economic, political and social events. Since April 2001 (except for the period November 2003–August 2004, when respondents' opinions were heavily influenced by the EU accession shock) consumer inflation expectations have been lower than the current inflation rate.

Various studies on the process of formation of Polish consumers' inflation expectations indicate that they might not fulfil requirements of the rational expectations hypothesis, since unbiasedness and macroeconomic conditions are not met (eg Łyziak (2005); Kokoszczyński et al (2006)). This assessment suggests that Polish consumers commit systematic forecasting errors and do not incorporate all relevant information available at the time that their expectations are formed. Some other empirical findings (Łyziak (2003)) suggest that consumers' inflation expectations are characterised by a significant degree of backward-looking and remain in the long-run relationship with the current rate inflation. In the short run, the reaction of inflation expectations to changes in current inflation is asymmetric, ie it is stronger in the case of rising inflation and weaker in the case of falling inflation.

Figure 1

Polish consumers' inflation expectations, current inflation rate and actual inflation ex post from 1992 to 2006



Source: NBP calculations based on Ipsos and Polish Central Statistical Office (GUS) data.

The assumption of the backward-looking character of Polish consumers' inflation expectations would mean that the NBP's monetary policy had an indirect impact on consumer inflation expectations mainly through changes in the current rate of inflation. Therefore, even if inflation expectations did well in explaining price dynamics, as suggested by estimates of the New Keynesian Phillips curve presented in Kokoszczyński et al (2006), the NBP monetary policy seemed to have a limited impact on them directly, and this would impose constraints on the effectiveness of the monetary transmission mechanism.

However, the results obtained might be critically dependent on the econometric methods applied. Aside from the results of econometric studies available so far, some anecdotal evidence could indicate that at least in some situations Polish households react quite rationally and in a forward-looking manner. Moreover, a study examining the rationality of the inflation expectations of Polish entrepreneurs, though a novel approach taking into account the entire distribution of these expectations, shows that corporate expectations in Poland are indeed rational (Czogała et al (2005)).

In addition, it should be stressed that the central bank can influence the formation of economic agents' expectations not only through interest rate changes, but also by its transparency and external communication. This mechanism has been acknowledged by the monetary authorities in Poland and some measures have been taken to increase transparency and improve communication techniques (for a review of changes in the NBP's transparency and communication, see, for instance, Czogała et al (2005)). It is not yet possible to assess unanimously the effects of these steps on the formation of expectations due to short data series.

Monetary channel

There are two main issues to be mentioned in the context of a desirable development of the monetary analysis at the NBP. The first one refers to the relationship between money and asset prices. The second one concerns the link between money and inflation. Both issues reflect the use of monetary aggregates in the strategy of the ECB, the growing role of money in analysing inflation and financial stability, as emphasised by some other central banks, and an increasing general interest in the topic of monetary analysis.

The first issue concerns the role of monetary data in signalling tensions in the asset markets. This involves important challenges for the conduct of monetary policy, including the central question just around the corner – should central banks take "extra action" measures and react to excessive asset price growth in advance, or "mop up after" (see Blinder and Reis (2005), Kohn (2006)). The debate on this topic is one of the hottest in central banking nowadays and firm conclusions have not been reached so far. For instance, White (2006) advocates that under pure inflation targeting, central banks may tend to ignore imbalances building up on the asset markets. A sudden adjustment of such imbalances could pose serious risks to economic growth and send the economy into a period of bad or even ugly deflation. To avoid this, central banks could act in advance, and the timing of such "extra action" can be based – among other things – on the growth of money, which can be a good indicator of asset-market imbalances. Also, Christiano et al (2006) point out that monetary policy that not only targets inflation, but also "leans against the wind" by tightening its stance when credit growth is strong, has the potential to reduce the costs of boom-bust cycles in the asset markets.

The Monetary Policy Council acknowledged the above issues in its Monetary Policy Guidelines for 2007, where it states that in the pursuit of monetary policy it is necessary for central banks to make allowances for asset prices, since their rapid growth during an unstable boom may be accompanied by a rising risk of their violent and considerable slump. This, in turn, poses a threat to the stability of the financial system and the real economy. The MPC states further that, in assessing the risk of emergence of disruptions in the asset market and the inflation outlook, it may be useful in the longer run to account for the paths of monetary aggregates (MPC (2006). As for now, work is in progress at the NBP on constructing reliable measures of real estate prices that could help trace the imbalances in this market in Poland.

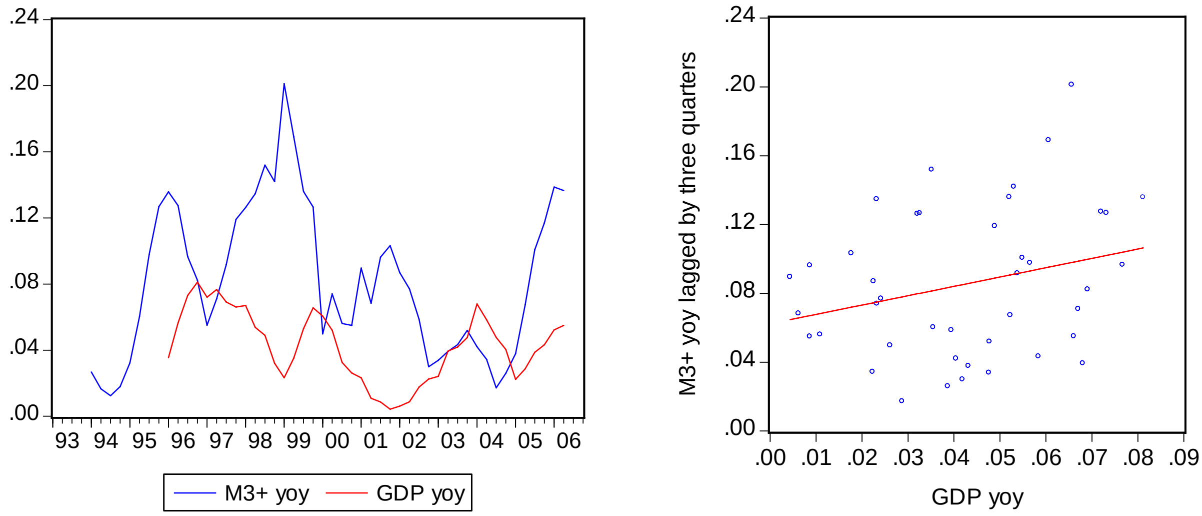
The second issue concerns the role of monetary data in signalling future inflation. The important argument in this context is offered by the ECB's two-pillar framework, which seems to be supported by recent evidence on the link between low-frequency components of monetary series and inflation fluctuations (Gerlach (2003), Gerlach (2004), Neumann (2003), Bruggeman et al (2005)). In this approach the monetary pillar can be perceived as a way to predict changes in steady-state inflation, while output gap or cost factors are highly correlated with short- and medium-term inflation fluctuations. Against this background it seems desirable to construct a money-enhanced Phillips curve-like equation, describing the developments of inflation as a function of standard MTM factors like output gap or the exchange rate along with monetary measures, eg monetary aggregates filtered with spectral analysis tools. Recently it has been pointed out on theoretical grounds that the money-enhanced Phillips curve specification does not provide any additional information as compared to the typical "new Keynesian" Phillips curve model and that money is redundant there (Woodford (2006)). From the empirical point of view, however, it might still be considered as one of the important inputs to the monetary policy decision-making process, especially in view of the ECB's experience, which indicates that allowing for money provides more accurate inflation forecasts (Fisher et al (2006)). The latter might be reflected in increasing interest outside the euro area in the problem of monetary analysis as a potential input into monetary policy.

In addition, there is an issue of potential inclusion of money in the utility function in the general equilibrium approach. If money comes into the utility function as a non-separable argument, then money may matter for inflation and the real economy. It should, however, be mentioned that several studies do not support the non-separability hypothesis (Swofford and Whitney (1987); Andres, Lopez-Salido and Valles (2006)).

Some of the studies reported above, as well as encouraging results for the euro area, suggest that monetary aggregates might bear relevant information about long-run price developments. Preliminary results for the Polish economy are encouraging and seem to support the view that there exists a money-inflation link. For instance, some preliminary estimations of the Phillips-curve augmented with money gap measures indicate the statistical significance of the money gap and a delayed impact of money on price changes. At the same time, the GDP gap has proved not to have a bearing on the development of consumer prices, which might be consistent with the findings on the growing role of external factors in explaining domestic inflation in Poland (eg Allard (2006)). In addition, a tentative analysis of correlations between changes in money and GDP seems to point to possible relationships holding between the two, with monetary aggregates acting as a leading proxy for GDP (see Figure 2). In any case, what is apparent in the view of the research studies cited, is that more thorough research on the money-inflation relation, with plausible use of frequency filters, might be required before some final conclusions can be reached. A short data series for Poland may, however, constitute a serious obstacle to reaching robust results.

Figure 2

Broad money M3+ (real) and GDP (both in yoy terms).
Left panel: developments over time;
right panel: scatter of GDP and M3+ lagged by three quarters



Source: Own calculations based on NBP data.

Apart from the potential studies on links between money and inflation, further in-depth analysis of the credit aggregates would seem to be very useful as a supporting tool of economic analysis. A purely qualitative assessment of credit dynamics might be particularly helpful in the assessment of the current state of the economy and, consequently, potential pressures on prices. For example, in 2004 there was a very fast acceleration of economic activity with GDP growth reaching 5.3%, as compared to 3.5% in 2003. Individual consumption and accelerated and fixed capital investments turned positive after a long period of stagnation. However, this was not accompanied by any significant rise in lending to households. Moreover, the rate of growth in lending to enterprises remained negative. This could be a signal that the rise in domestic demand might have been fuelled mainly by the one-off demand shock connected with the EU accession. In fact, it turned out that the fast acceleration of economic growth in 2004 was not sustainable, as economic activity slowed significantly in 2005 and GDP growth decreased to 3.5%. In contrast, the acceleration of GDP growth observed in 2006 was accompanied by a significant rise in lending to both households and enterprises. This might be a sign of consolidation of the high domestic demand growth and a build-up in inflation pressures due to a closing output gap.

IV. Conclusion

The interest rate and exchange rate channels are recognised as the most important monetary transmission mechanisms in Poland. For this reason both channels are embedded in the core forecasting model of the NBP, ie the ECMOD. However, they should be monitored closely, as the ongoing structural changes in the Polish economy might change their relative importance. For example, in the wave of integration, global factors such as a slowdown or revival of the global economy seem increasingly to have a bearing on the development of prices or the domestic market. This should be taken into account in future versions of the ECMOD.

A high degree of uncertainty concerns some other channels of monetary policy transmission that are not explicitly included in the ECMOD: the credit channel and the expectations channel. It is hard to assess the importance of the credit channel in monetary transmission in Poland by relying on some empirical studies. According to some other research results, consumer expectations seem to a large degree to be backward-looking, whereas some anecdotal evidence might suggest the contrary.

Some of the monetary transmission channels remain unexplored, mainly because of a lack of appropriate data or sufficiently long data series. The poor data problem concerns mainly the assets channel and, in particular, real estate prices. Apart from the need for studies of the links between broad money and inflation, some more in-depth analysis of credit aggregates might prove very useful as a supporting tool for the economic analysis used in the conduct of monetary policy.

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Monetary policy transmission mechanism in Saudi Arabia

Muhammad Al-Jasser and Ahmed Banafe

1. Introduction

In most emerging economies, the exchange rate still plays a greater role in the monetary transmission mechanism than interest rates. This is partly because domestic banking systems are less developed, and partly because a full range of monetary instruments is not available. The exchange rate is part of the transmission mechanism in two ways. First, it affects aggregate demand through net exports; and second, it affects inflation directly through the pass-through effect, although the pass-through is having less of an impact in a globalised economy, where competition is keeping prices well contained.

In recent years, monetary policy in Saudi Arabia has been influenced by abundant liquidity due to high oil prices, and by the growth in consumer and business lending by domestic banks. One major challenge has been how to respond to asset price inflation. A second challenge has been to develop Government bond markets to provide a wider range of assets to domestic banks so that the transmission mechanism from repo rates to the longer end of the bond and credit markets can be enhanced. Finally, Islamic financing has been growing in importance.

2. Structure of the policy framework

Saudi Arabia's monetary policy framework is firmly wedded to its fixed exchange rate policy. Saudi Arabia uses the exchange rate as a nominal anchor for stabilizing exchange rate expectations and keeping inflation low. This maintains public confidence in the policy framework and encourages capital inflows for domestic investment. The rationale for pegging the Riyal to the Dollar is the pattern of Saudi Arabia's external receipts and payments, which are predominantly in US Dollars. Saudi Arabia derives most of its revenue from oil exports, which vary widely and cannot be adjusted by changes in the exchange rate as they depend critically upon world energy demand. Therefore, the Government stabilizes the economy by operating a counter-cyclical fiscal policy in which expenditures are kept steady when receipts are volatile. Hence, the stability of the Riyal against the Dollar is relevant in the context of overall economic policy.

The operational target of the Saudi Arabian Monetary Authority (SAMA) is to manage system liquidity through the repo window, and its intermediate target is stability of the Riyal against the Dollar, which is the anchor and intervention currency.

3. Monetary policy rules and instruments

Monetary policy comprises policy targets (eg medium-term price stability or exchange rate stability); strategy (what interest rate level is required to achieve the target); the operational framework, which determines how to reach the required interest rate level by using the available instruments (eg key interest rates such as repo, supply of reserves); and the monetary policy transmission mechanism, which is the process through which monetary policy decisions affect the economy in general and the policy target in particular. Inflation-targeting rules, the exchange rate, monetary aggregates and the level of bank reserves are often used as part of the strategy process because they limit the discretion of the central bank, strengthen its credibility and anchor private sector expectations. Changes in rules are more important than any single change in policy instruments. Interest in monetary rules has increased over the past decade as many central banks sought to organize their policy deliberations around specific targets. In contrast, a feedback rule (such as Taylor's rule) does not give complete guidance on deviations between actual and target values of objective variables because of interpretation problems on relevant targets (ie the desired inflation, output, and equilibrium funds rates).

In Saudi Arabia, the exchange rate is targeted for conducting monetary policy. Although reserve requirements have been a powerful instrument of monetary policy in the past, SAMA has made no changes to reserve requirements since 1980. With the advent of Central Bank Bills in 1984, SAMA moved to using repo rates for managing day-to-day system liquidity and signaling the desired overnight rate to the market. Government Development Bonds inaugurated the government debt market in 1988, and the Central Bank Bills were replaced by Treasury Bills in 1992. Currently, the repo and reverse repo rates are the most effective indirect instruments used by SAMA for conducting monetary policy. Recent budget surpluses have allowed the payback of longer-dated Government debt, but SAMA makes sure that enough Treasury Bills remain in issue to allow repo operations to continue unhampered. In times of severe speculation against the Riyal through the forward market, SAMA augments its repo rate policy with intervention in the forward market to contain wild gyrations in foreign exchange (Fx) swap points and interest rates.

4. Monetary policy transmission

Emerging markets generally face a higher degree of uncertainty with regard to capital flows than is the case for industrial countries. Under a fixed exchange rate regime (or a fixed but adjustable peg) as in Saudi Arabia, capital inflows put downward pressure on domestic interest rates and increase investment relative to domestic saving. If inflation rises as a result of abundant liquidity, external competitiveness will deteriorate. Under a floating exchange rate regime, capital inflows lead the exchange rate to appreciate, resulting in a loss of competitiveness.

SAMA seeks to ensure that monetary and exchange rate policies are mutually consistent. Given the Riyal peg to the Dollar, short-term Riyal interest rates should in theory be almost identical with their Dollar equivalents. With almost perfect asset substitutability between Riyal and Dollar instruments, a small change in Riyal interest rates results in a large change in domestic liquidity. In times of speculation against the Riyal, SAMA initially lets the interest rate differential widen to make speculation more expensive. Fx intervention is a discretionary policy under extreme market conditions, and this option has proved to be effective in mitigating speculation-linked volatility in the forward market, which happens to be a preferred channel for speculation and interest rate play. On two occasions (ie 1993 and 1998), SAMA intervened in the forward market as interest rate support faltered in containing excessive volatility in Fx swap rates resulting from speculation against the Riyal.

When oil revenues are high, as is currently the case, the result is an injection of liquidity into the monetary system. This puts downward pressure on domestic interest rates and paves the way for asset price inflation. In recent times this effect has been exacerbated by private investors keeping extra funds in the domestic banking system instead of diversifying their portfolios through investment abroad. A further development has been in the banking system. Home ownership and mortgages have grown in importance, and the banks have increased their emphasis on making consumer loans. This exacerbated the inflation in share prices, as many participants were using borrowed funds. In a fixed exchange rate system, it was more appropriate to target this problem with administrative measures instead of a rise in interest rates through the repo rate channel. SAMA therefore curbed the abundant liquidity by setting prudential requirements for bank credit to the private sector as well as margin lending relative to total credit.

Monetary policy mainly influences short-term interest rates, which are used for pricing deposits and loans. Interest rate changes tend to induce portfolio shifts among assets that may, in turn, affect their relative prices. The interest rate channel affects asset prices. The recent liquidity boom in Saudi Arabia was the result of high oil revenues and a shift in investor preference towards domestic assets. These factors led to very low interest rates. An atmosphere of excitement about gains in the stock market took hold, with irrational expectations about the market trend. The result was a temporary “wealth effect”, which was reflected in consumption and investment. In this context, should monetary policy react to asset prices? This issue is still debated among researchers and academics. SAMA’s policy is to remain extremely cautious on targeting asset prices. This is because assessing asset price valuations is a very challenging exercise. Indeed, tightening guidelines on bank credit and margin lending was not an attempt to influence asset prices directly. In the aftermath of a precipitous decline in the stock market, SAMA responded by smoothing the interest rate renormalization process to prevent a further decline in confidence.

There has been a noticeable increase in the number of Islamic financing transactions. To date these have mostly been in Dollars. They provide considerably cheaper financing terms than conventional equivalents because they attract an additional class of investors. However, to the extent that they are priced against conventional loans, they are affected by the interest rate environment, and so far they have not provided any policy challenge.

In a fixed rate exchange system with almost perfect asset substitutability, monetary policy cannot be autonomous, and in the case of Saudi Arabia, oil revenues and their impact on fiscal policy play a predominant role in setting the monetary scene. SAMA’s policy has continued to be one of generally passive accommodation of system liquidity, and non-interference with the free workings of the market. During the past decade, when the ratio of Government debt to GDP first rose and then fell sharply, SAMA’s role as a central bank and debt manager has been critical, emphasizing the dictum that monetary policy should avoid being seen as subsidizing deficit financing.

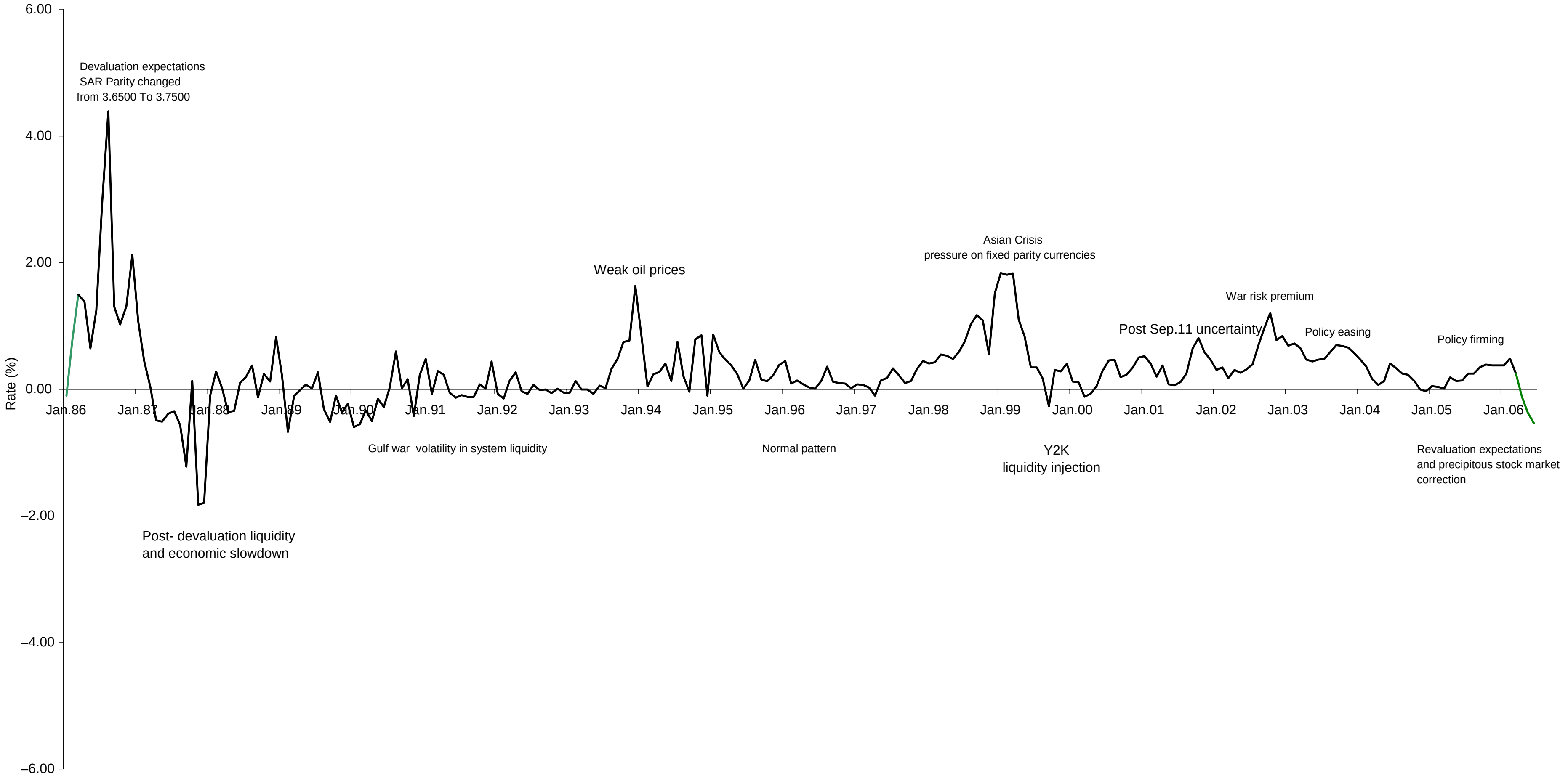
5. Summary conclusion

SAMA’s monetary policy framework is firmly wedded to its fixed exchange rate policy. Given the predominance of the US Dollar in Saudi Arabia’s Fx receipts and payments, the stability of the Riyal against the Dollar is relevant in the context of overall economic policy. While SAMA retains reserve requirements as a policy instrument, it uses the repo and reverse repo rates for conducting monetary policy. Short-term interest rates react to the signals sent by SAMA through the repo rate. The interest rate channel is at times augmented by administrative measures, such as setting prudential guidelines for bank credit. Fx intervention is a discretionary policy under extreme market conditions for mitigating excessive volatility in Fx swap rates. SAMA seeks to ensure that monetary and exchange rate policies are mutually consistent.

As for asset price inflation, SAMA’s policy is to remain extremely cautious on targeting asset prices. This is because assessing asset price valuations is a very challenging exercise. In the aftermath of a precipitous decline in the stock market, SAMA responded by smoothing the interest rate renormalization process to prevent a further decline in confidence.

SAMA’s monetary policy remains independent of its role as a debt manager for the government. Monetary conditions are set in response to overall macroeconomic considerations.

Spread between 3 month SAR and USD interbank rates



The anchoring of inflation expectations in Singapore

Khor Hoe Ee[1] and Saktiandi Supaat[2]

Introduction

The credibility of a central bank is probably one of the most important factors determining whether the pursuit of an anti-inflation policy is associated with significant output and employment losses. When a central bank lacks credibility, the public will not believe that the central bank will do what it says it is going to do. As a result, inflation expectations in the private sector will exceed the central bank's inflation target. These expectations will feed into the wage and price decisions of households and firms, causing businesses and workers to demand higher prices for their goods and services. The resulting increase in general prices complicates the environment for monetary policy, making the central bank's job more difficult.

The central bank therefore needs to take the public's expectation of inflation into account when determining the stance of monetary policy, in order to achieve its objective. Moreover, central banks need to assess the credibility of their monetary policy on an ongoing basis. A key to this ongoing assessment is knowing the inflation expectations of the general public and their consistency with the price stability objective of the central bank. In this respect, measures of expected inflation play an important role in any such exercise, given that the inflation expectations of firms and households over various horizons influence their wage and price decisions, thereby affecting the inflation process.

While low inflation is an objective of monetary policy, it is equally important that the low inflation is not achieved artificially through administrative means at the cost of relative price distortions.

Hence this short note has two parts. The first part analyses the behaviour of inflation expectations of the Singapore economy by market analysts as derived from qualitative survey data and the extent to which they are well anchored. The second part reviews the detailed data underlying the consumer price index to examine the degree of flexibility of relative prices in Singapore.

Inflationary expectations from qualitative responses

One way to gauge inflation expectations would be to use survey data. We use the monthly Asia Pacific Consensus Economics survey, which interviews over 180 prominent Asia-Pacific financial and economic forecasters for their estimates of a range of variables. The monthly Asia-Pacific Consensus survey provides us with one-year-ahead expected inflation numbers. The survey also provides, on an annual basis, five-year-ahead forecasts of CPI inflation. These CPI forecasts will provide a basis for our analysis.

Understanding the process underlying the formation of inflation expectations could greatly enhance the design and conduct of monetary policy. For example, it could enable us to understand what types of institutional arrangements and communication policies help the

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central bank retain credibility for meeting its price stability objective, especially when large and persistent relative price changes ripple through the inflation data.

To that end, unlocking some of the mysteries about inflation expectations may help central banks decide whether and how to incorporate a numerical inflation objective into the monetary policy process. Some central banks have used these numerical objectives as a tool to help anchor inflation expectations. Economists refer to a numerical inflation objective as a "commitment device". But whether or not there is an explicit numerical objective, anchoring inflation expectations requires a central bank to keep inflation low and stable, to reinforce its commitment to price stability, and to clearly communicate its policies in pursuit of that commitment.

Figure 1 below provides a schematic diagram of the interaction between inflation expectations and the conduct of monetary policy. The loop on the right shows that inflation expectations are affected by the credibility of the central bank, which is in turn dependent on the commitment and track record of the central bank and the effectiveness of its monetary policy. The loop on the left reflects initiatives by MAS in recent years to enhance its communication and increase its transparency and accountability. It shows how the credibility of the central bank is enhanced through greater accountability while improved communication helps to anchor inflation expectations.

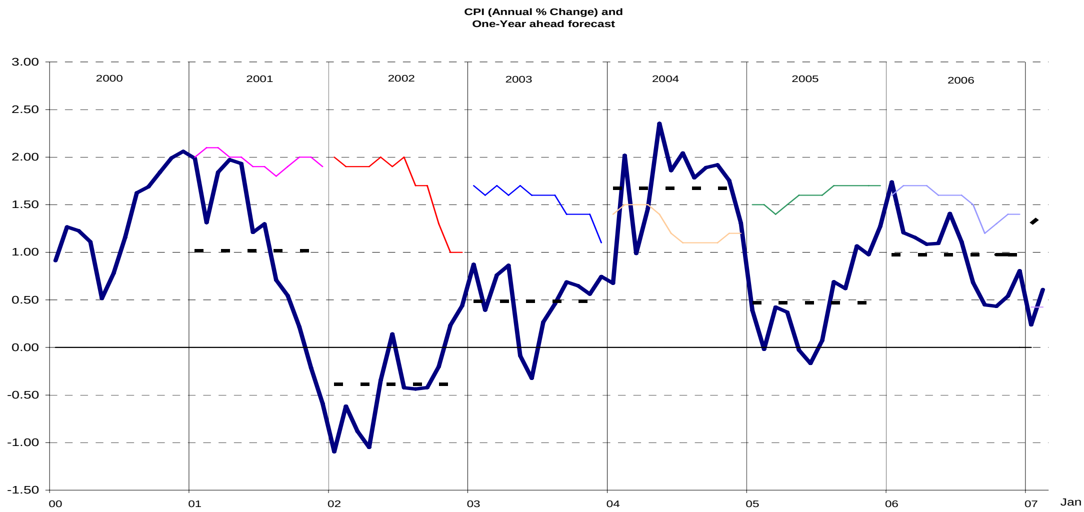
Figure 1

Anchoring expectations and effective monetary policy

Indeed, if we plot the one-year and long-term inflation forecasts extracted from the survey data (see Charts 1 and 2), there is a strong indication that inflation expectations tend to hover between 1% and 2%. Chart 2 plots the five-year CPI inflation forecasts from 1999 to 2006. It shows that the profile of inflation forecasts has flattened in recent years to around 1.5%, providing some evidence that inflation expectations have become better anchored as a result of the recent initiatives to enhance communication, transparency and accountability.

Chart 1

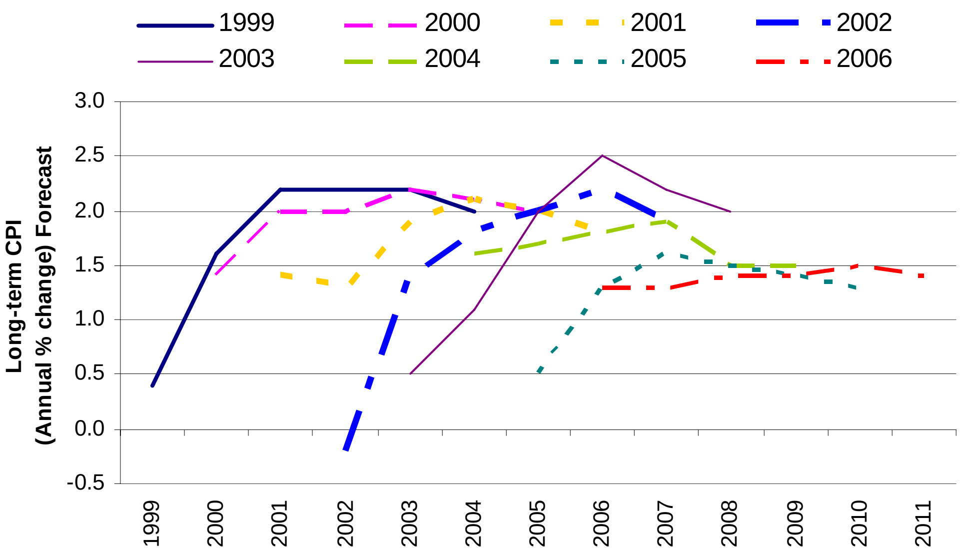
One year ahead CPI inflation forecast



Thin lines show the one year ahead forecasts of CPI Inflation from the year before. Dotted lines represent the average CPI inflation rate for the whole year. The thick solid line is the actual CPI inflation.

Chart 2

Long term (five-year) CPI inflation forecasts



Flexibility in relative prices

We next assess the degree of flexibility in Singapore's relative prices. In particular, we show that relative prices are highly flexible, implying that there have been few distortions behind the low inflation expectations in Singapore.

It is important to distinguish between inflation and a relative price increase. People often see price increases in some of the items they buy and associate that with higher inflation. However, inflation is a condition that affects all prices, not just a subset of prices of particular goods and services. Changes in relative prices – that is, the prices of individual items relative to the average of all prices – are quite different from inflation. Changes in relative prices reflect changes in the supply and demand conditions in specific markets. Sometimes a particular item experiences such a large and persistent relative price change that it temporarily ripples through the inflation data. The obvious example is the increase in oil prices. The sharp increase in energy prices in the last few years has greatly increased the costs faced by businesses and households in many countries. It is important to allow individual prices to move up and down relative to one another so as to ensure that inflation is not unduly biased in one direction. Such changes in relative prices are essential to ensure that economic resources are allocated efficiently within the economy.

We assess the pattern of price changes in Singapore by drawing on micro-level CPI data. The data set used is the monthly CPI data at the five-digit level provided by the Department of Statistics. The coverage is from January 1998 to August 2006. Excluding accommodation-related items and new items introduced during the CPI rebasing in 2004, a total of 136 price series or about 86% of the CPI basket are analysed. From this rich data set, several stylized facts support the view that relative price changes are quite flexible in Singapore.

The first set of results relates to the frequency of consumer price changes in Singapore. The "frequency approach" employed by Aucremanne and Dhyne (2004) was adapted for this exercise. This methodology proxies flexibility in prices by the frequency of price changes (F), which is defined as the number of observations of price changes divided by the total number of observations. The formulae to determine the frequency of price changes for product i and the aggregated frequency of price changes for a product group j are as follows:

$$F_i = \frac{\sum_{t=2}^{T} DUM_{i,t}}{T-1} \text{ and}$$

where: *DUMi is a dummy variable which takes the value of "1" if the price of product i has changed in time period t and "0" otherwise*

T is the time span of the sample

nj is the number of products observed in product group j

Following Bils and Klenow (2004), the implied average price duration (D) for each product, defined as an uninterrupted period during which the price index remains unchanged, is inversely related to the frequency of price changes, ie D = 1/F. This assumes that price changes occur at discrete time intervals.

Chart 3 shows the distribution of price duration of the 136 price series in the CPI basket. A significant portion of the CPI basket is characterised by fairly frequent price changes, with almost 60% of the basket exhibiting a short price duration of one to two months, and close to 80% experiencing price adjustments at least once in six months. Overall, the average price duration for all items is 1.7 months, while the weighted average price duration is 3.6 months.

Next, we also found that price decreases are just as common as price increases, and the average magnitude of price decreases is only slightly smaller than that of price increases. Table 1 shows that there are varying frequencies of price changes across different product groups during the period from January 1998 to August 2006.

Chart 3

Distribution of price duration

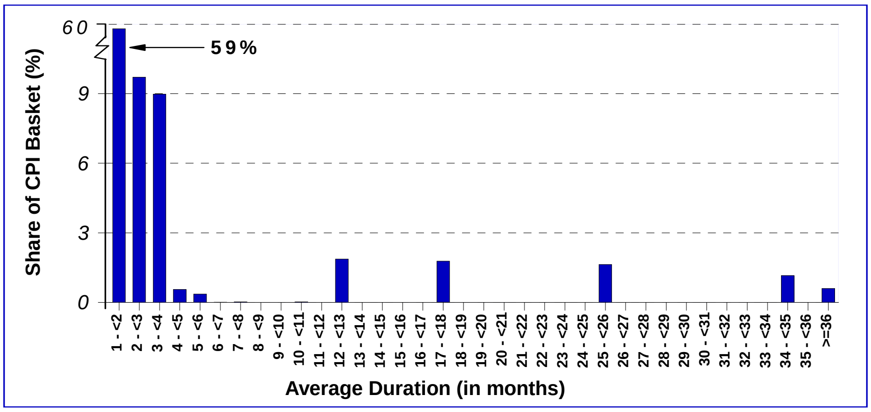


Table 1

Frequency of price changes and price duration

CPI Groups/subgroups	Weights in CPI basket	Frequency (%)	Duration (months)	Weighted duration (months)
Non-cooked food	1029	94.9	1.1	1.1
Cooked food	1300	81.2	1.2	1.1
Recreation & others	1659	69.7	1.4	2.3
Clothing & footwear	357	66.3	1.5	2.3
Health care	469	61.0	1.6	2.1
Transport	1671	51.0	2.0	6.9
Communications	504	37.9	2.6	2.6
Education & stationery	819	36.8	2.7	9.0
Housing (excluding accommodation)	766	22.5	4.4	4.7
All items	8574	58.0	1.7	3.6
Goods vs services				
Goods	4833	84.1	1.2	1.3
Services	3741	38.9	2.6	5.7

Note: CPI groups are ranked in descending order of frequency of price changes.

There appears to be little downward rigidity in prices in Singapore, as the frequency of price increases is only slightly greater than the frequency of price decreases, as indicated by the ratio of 1.1 (Table 2). In an inflationary environment, the magnitude of price increases can be expected to exceed price decreases on average. This asymmetry is observed in Singapore, with the average monthly price increases and price decreases at 1.2% and –1.1% respectively.

Table 2

Average and median size of monthly price changes (%)

CPI Group	Median size of price increases	Median size of price decreases	Average size of price increases	Average size of price decreases	Ratio of magnitude of price increases to decreases	Ratio of frequency of price increases to decreases
Non-cooked food	0.5	–0.4	1.1	–1.0	1.1	1.1
Cooked food	0.1	0.0	0.2	–0.2	1.2	3.2
Clothing & footwear	1.5	–1.8	2.6	–2.4	1.1	1.0
Housing (excluding accommodation)	0.4	–0.3	1.7	–1.0	1.6	0.9
Transport	0.7	–0.5	1.1	–1.2	0.9	1.0
Communications	1.1	–1.2	2.1	–2.1	1.0	0.5
Education	0.4	–0.6	0.8	–0.9	0.9	1.7
Health care	0.3	–0.2	0.5	–0.4	1.3	2.0
Recreation & others	0.4	–0.4	0.9	–0.8	1.2	1.1
All items	0.5	–0.5	1.2	–1.1	1.1	1.1
Goods vs services						
Goods	0.8	–0.7	1.3	–1.2	1.1	1.0
Services	0.8	–0.4	1.4	–0.8	1.7	1.7

Across product groups, the degree of asymmetry between the frequency of price changes and the magnitude of price changes differs markedly, as shown in Table 2. Clothing and footwear experienced the largest magnitude of price changes, due to the effects of seasonal sales. In comparison, price changes for cooked food are often minor, despite the higher occurrence of price increases. The ratio of the magnitude of price increases to price decreases is the highest for the housing category, due to the recent surge in global oil prices which pushed up prices of oil-related items, such as electricity and gas tariffs. As expected, in categories with a larger component of consumer services, such as health care and recreation, prices tend to be biased upwards. Prices in the education category are, however, dragged down by declining prices of computers.

With regard to the ratio of the frequency of price increases to price decreases, it is highest for cooked food at 3.2 and lowest for communications at 0.5. The former probably reflects the effects of rising wages on total operating costs while the latter reflects the effects of liberalisation of the telecommunications industry and technological progress, which has lowered prices of telecommunications services and equipment over the sample period.

These results provide strong evidence that relative prices in Singapore are flexible, implying that there are likely to be few distortions in relative prices within the economy.

Conclusion

In this note, we show that inflation expectations in Singapore have become quite well anchored at around 1.5%, reflecting the strong credibility of MAS in maintaining price stability and the effects of enhanced transparency and accountability in recent years. We also provide evidence that relative prices in the economy are highly flexible, implying that the low inflation expectations were achieved with few distortions in resource allocation.

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Changes in the monetary transmission mechanism in Thailand

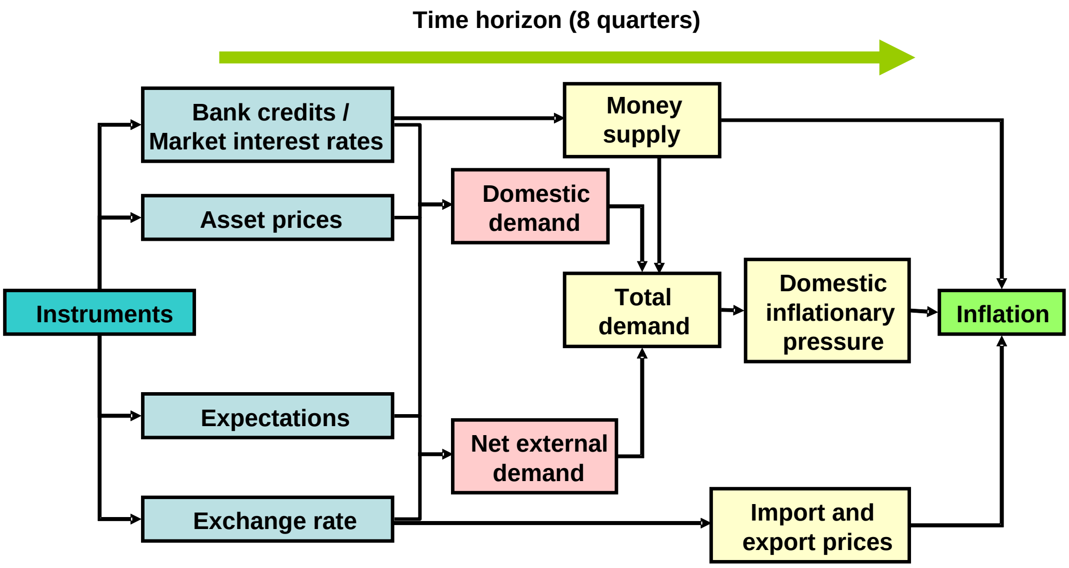
Monetary Policy Department
Bank of Thailand

1. Introduction

The Bank of Thailand (BOT) implements monetary policy through its influence on the selected key policy rate. The Monetary Policy Committee (MPC) has the responsibility for setting the appropriate rate that it believes will keep inflation within the target range. Once set, the rate change will affect monetary conditions through several channels of the transmission mechanism, including market interest rates, credits, asset prices, expectations and the exchange rate (Figure 1). The effect is gradual but expanding through changes in domestic demand and net exports, eventually hitting production and inflation.

Figure 1

Transmission mechanism of monetary policy



Disyatat and Vongsinsirikul (2002)[1] found that, for the period 1993–2001, the interest rate channel played the dominant role in Thailand and accounted for almost half of the total transmission to the real sector, while the credit channel, exchange rate channel and asset prices channel each contributed to the pass-through of monetary policy by around

1 This study uses VAR analysis on quarterly data over the period 1993–2001, including the policy rate, GDP and proxy variables for each channel. In measuring a channel's impact from an interest rate impulse, the paper compares the impact with that particular channel closed (by exogenizing the representative channel variable) to the impact with that channel opened (by endogenizing that representative channel variable). The difference represents the impact of the channel of interest. Key results from the exercise are presented in Appendix A.

17 percent. It should be noted, however, that the pass-through via the credit channel declined after the financial crisis in 1997, due to the weakened banking sector. In other words, the estimated results from the period covering the years immediately following the crisis were likely to find a less significant pass-through via the credit channel compared to normal circumstances.

This paper aims to highlight significant changes in Thailand's transmission mechanism after the financial crisis of 1997 and during the recent monetary policy tightening cycle from mid-2004 onward. The interest rate and credit channels are discussed together, followed by the exchange rate channel and the asset prices channel. Conclusion remarks are presented in the last part.

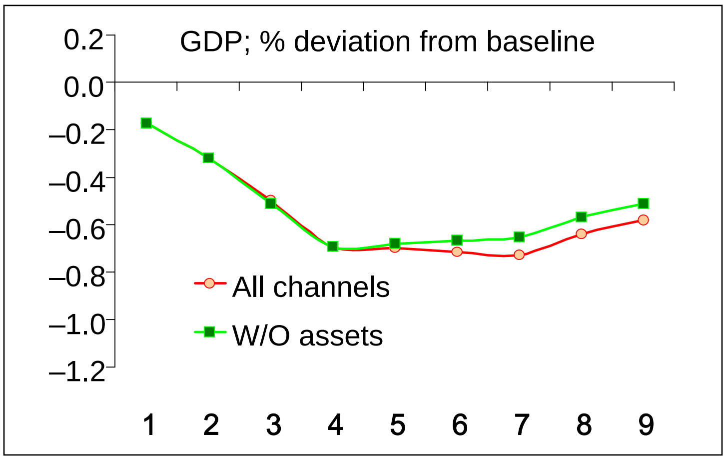
2. Channels of monetary policy transmission

2.1 Interest rate and credit channels

Traditionally, interest rate and credit channels – whereby the central bank's monetary decision influences economic activities through market, especially bank, interest rates and bank lending – are the dominant monetary policy transmission channels in Thailand. As confirmed by the estimated magnitude of monetary policy transmission using the Bank of Thailand Macroeconometric Model (BOTMM) and 1994–2002 data, the interest rate channel alone accounted for more than half of the total transmission from monetary policy to economic activities (Figure 2). Moreover, Disyatat and Vongsinsirikul (2002) wrote, "in addition to the traditional interest rate channel, the results … point to a transmission mechanism in which banks play an important role. The exchange rate and asset price channels have been less significant by comparison". The conclusion is not surprising given the economy's heavy reliance on the banking sector.

Figure 2

Monetary policy transmission – interest rate channel using BOTMM Jan 03 and the 1994Q1–2002Q3 sample period

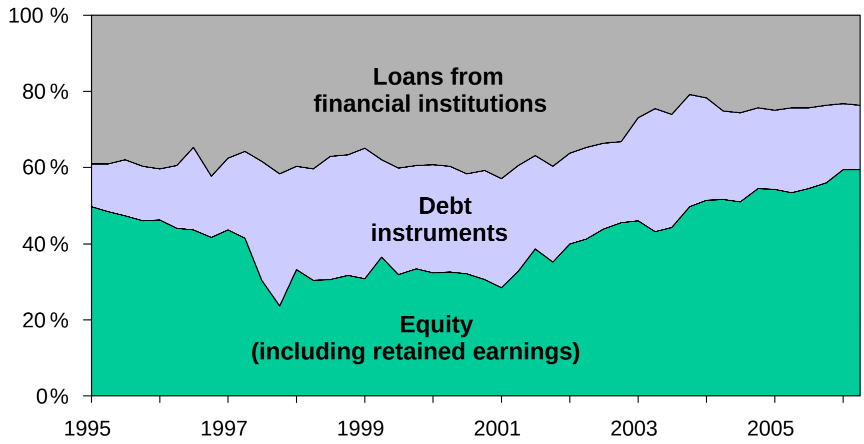


Source: Sriphayak and Vongsinsirikul (2006).

As shown in Figure 3, in 1995 as much as 40 percent of listed firms' financing was in the form of loans from financial institutions, and most likely the proportion was far higher for smaller firms, which had limited access to the equity and debt markets. Meanwhile, monetary policy transmission via bond holdings was muted by the limited supply of government bonds in the market, as the government was running budget surpluses between 1988 and 1996. Incidentally, total bonds outstanding accounted for less than 10 percent of GDP in 1995. In addition, the asset prices channel was restricted by limited participation of households in the equity market.

Figure 3

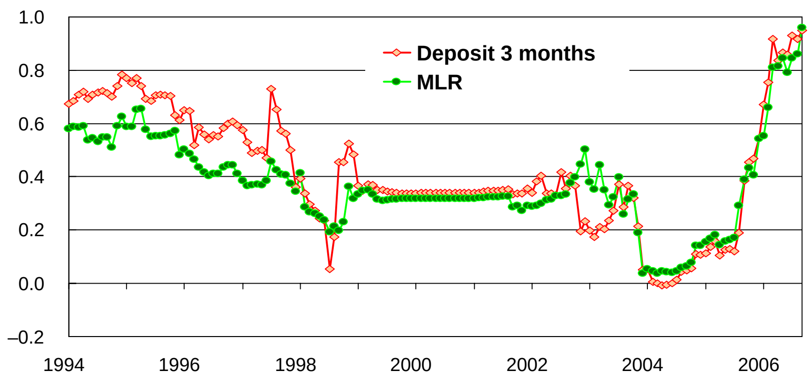
Sources of corporate financing



Source: Stock Exchange of Thailand and BOT staff calculations.

Figure 4

Pass-through[1] from 14-day repo to retail rates



[1] Using the **dynamic multiplier method**, ie, regressing Δ Deposit3m (or MLR) on Δ RP14d (contemporaneous and lagged) and lagged Δ Deposit3m (or MLR) with a rolling window of 50 observations.

Source: BOT staff calculations.

The financial crisis of 1997 brought about significant changes to the economy, including how monetary policy was transmitted. As shown in Figure 4, the pass-through from the 14-day repo rate[2] to retail rates of commercial banks went down in the period following the financial crisis, with the stickiness of policy pass-through being most evident around 2004 and early 2005, when the policy rate had already been hiked by 125 basis points and large banks had not raised retail rates at all in response. Policy pass-through picked up quite strongly starting in late 2005, and by 2006 had even surpassed the degree of pass-through in the pre-crisis period.

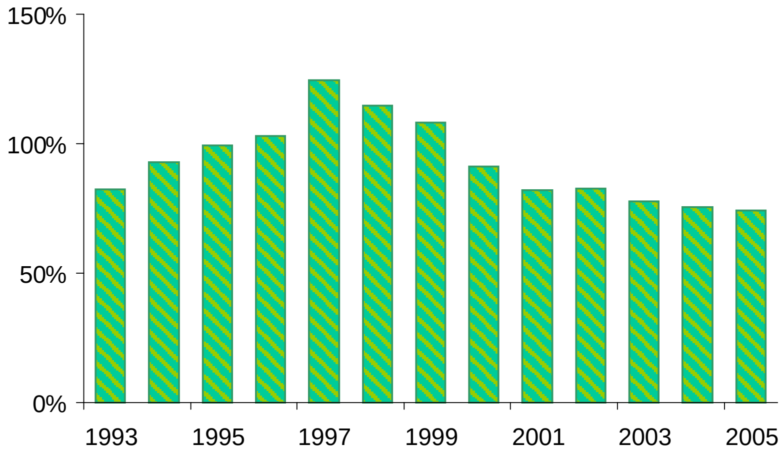
This section of the paper aims to explain the factors which accounted for the significant decline in the pass-through and its subsequent pick-up as mentioned above.

Structural changes of the economy after the financial crisis

Important changes took place in the Thai economy following the 1997 financial crisis. Very clear at the time was the increase in the degree of risk aversion in both the corporate and banking sectors. For example, with the exchange rate experiencing unprecedented volatility, the corporate sector became far more cautious with regard to foreign borrowing. Banks' exposure to high-risk sectors, such as real estate, took a serious toll on their financial health, leading to far stricter lending practices in the post-crisis period. While the decline in economic activities was a key factor behind the shrinking of bank loans, increased risk aversion in the economy joined in and also pushed down the ratio of bank loans to GDP (Figure 5).

Figure 5

Bank loans to GDP



Source: Bank of Thailand.

Another evident change was the increase in the supply of debt instruments (Figure 6). While government bonds were issued to finance the budget deficit as tax revenues contracted along with economic activities and government spending was eventually used to stimulate the economy, corporate bonds rose as quality firms circumvented the banking sector in search of financing.

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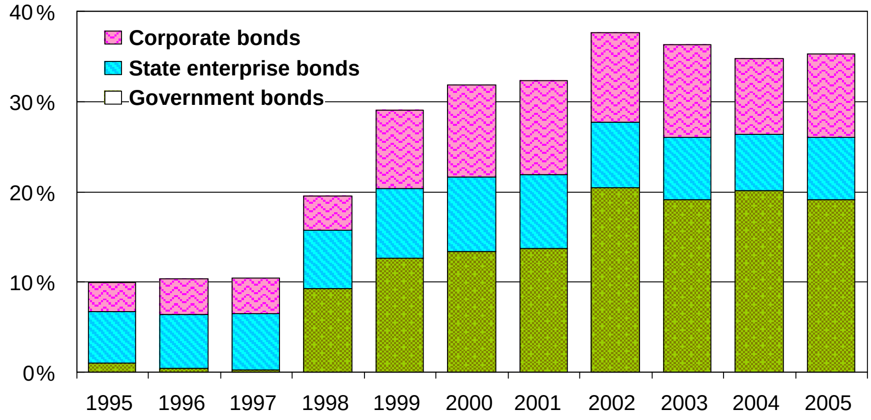
[2] The 14-day repo rate became the policy rate in May 2000, when the BOT first adopted inflation targeting as its monetary policy framework. Prior to that, the central bank was under a fixed exchange rate regime up until June 1997 and used monetary targeting between July 1997 and April 2000. Although the 14-day repo rate was not used formally to send the policy signal, it moved in line with other money market rates and responded quickly to the central bank's policy actions, which was aimed at maintaining either the exchange rate parity or some level of monetary growth.

Figure 6

Ratio of bonds outstanding to GDP

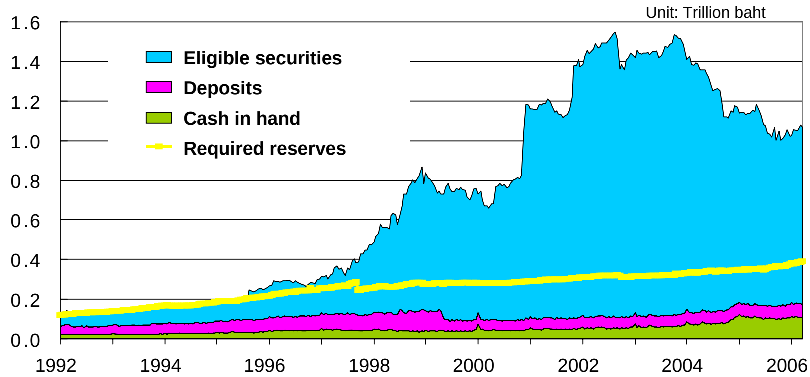


Source: BOT and National Economic and Social Development Board (NESDB).

Together, the heightened risk aversion and greater availability of debt instruments led to a very different structure of banks' balance sheet compared to the pre-crisis years. In particular, banks' asset composition switched from loans to the real sector toward liquid assets, ie securities holding, and with that their holdings of liquid assets ballooned far beyond prudential and liquidity requirements to levels not seen before (Figure 7). Banks also switched from being net borrowers in the pre-crisis period to being net lenders in the post-crisis period, with the BOT doing most of the borrowing on behalf of the Financial Institutions Development Fund (FIDF), which had incurred heavy losses in the attempt to restore stability to the financial system in 1997.

Figure 7

Banks' liquid asset holdings



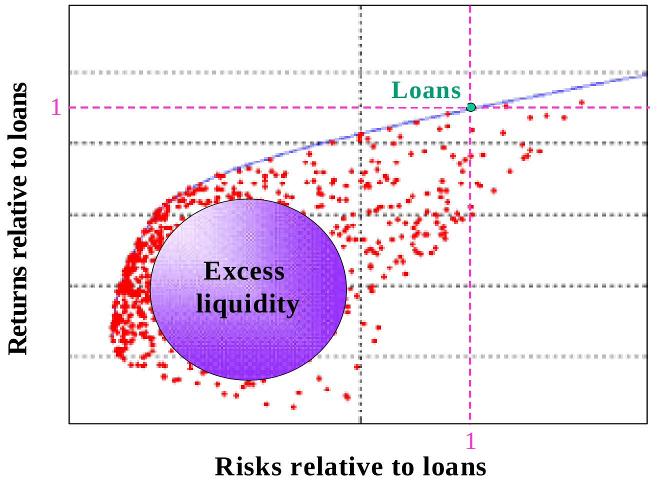
Source: Bank of Thailand.

"Excess liquidity" and impaired transmission through the banking sector

The BOT uses the term "excess liquidity" to try to capture the idea that banks would have preferred to use part of the massive assets held in liquid form for other purposes, such as for lending at higher returns, but for some reason, for example soft loan demand, could not do so and thus are forced to maintain higher-than-desired levels of liquid assets. In that case, money market and bond investments, which are typically associated with lower risks and accordingly lower returns compared to loans, would be considered excess liquidity if their risk-adjusted returns are less attractive to banks than that of loans. Graphically, liquid assets which are "excess" would be in the interior of the risk-returns frontier, as illustrated in Figure 8. The further an asset is from the frontier, the more "excess" it would be.

Figure 8

Risk-returns frontier of different bank assets



The presence of excess liquidity would then interfere with monetary policy transmission because the marginal increase in the policy interest rate would not tempt banks to raise their retail rates. In particular, banks would not want to hike deposit rates to mobilize more funds, for loan extension (the desired asset class) has not been constrained by the lack of funds and thus doing so would only raise their excess liquidity holding, making them hold even more of the undesirable asset class. What the marginal increase in the policy interest rate would do, however, is to raise the risk-adjusted returns of money market and bond investments slightly,[3] nudging them closer to the frontier in Figure 8 and thereby bringing excess liquidity down a little.

Where excess liquidity is sizeable, the policy interest rate may have to be brought up significantly before the risk-adjusted returns of money market and bond investments reach the frontier. Once there, an additional increase in the policy interest rate would trigger a move in banks' retail rates because banks are now willing to hold liquid assets. They would raise deposit rates to mobilize funds and use those funds to expand their money market and bond investments – not necessarily loans – in the asset portfolio. They may also raise retail lending rates to maintain their interest spread and profits. At that point, monetary policy transmission would resume.

The above story illustrates the mechanism whereby policy transmission works through the asset side of banks' balance sheet. This route may not be typical under normal circumstances, where banks usually are net borrowers in the money market and hence an increase in the policy interest would raise their funding cost more or less quickly, encouraging them to seek alternative sources of funds such as deposit mobilization through more attractive deposit rate offers (Figure 9). However, the "excess liquidity" concept has been useful in explaining what happened in Thailand in late 2004 and early 2005, when the interest rate pass-through took significantly longer than before.

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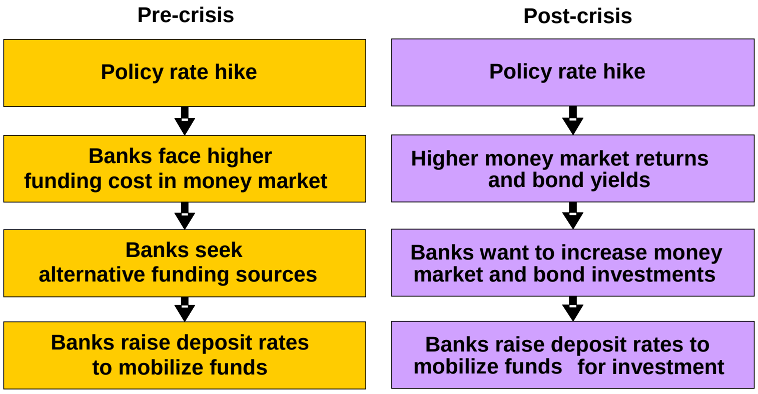
[3] Money market rates and short-term bond yields track the policy interest rate closely in Thailand.

Figure 9

Interest rate pass-through and banks' balance sheet



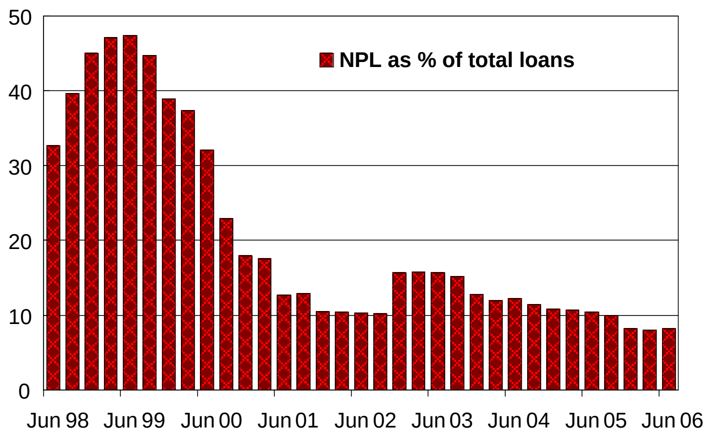
"Excess liquidity" in Thailand

Prior to the financial crisis in 1997, the concept of excess liquidity did not apply to banks in Thailand. At the time, the banking sector held liquid assets at a level close to the reserves requirement, as shown earlier in Figure 7, and banks were net borrowers in the money market.

During the financial crisis, monetary policy was first tightened to help stabilize the exchange rate and, once stability was achieved, was eventually eased to facilitate the economic recovery. The 14-day repo rate was reduced from above 10 percent in mid-1998 to just 1.5 percent by mid-2000. Meanwhile, the money market and bond investment positions of banks – especially large banks – rose significantly. Despite the fairly low money market returns in line with the modest policy rate, the story of excess liquidity impeding the interest rate pass-through was not evident because extending loans was still very unattractive as NPLs stayed above 20 percent of total loans (Figure 10). In other words, the risk-adjusted returns of money market and bond investments were probably not unattractive compared to loans at the time.

Figure 10

NPL ratio

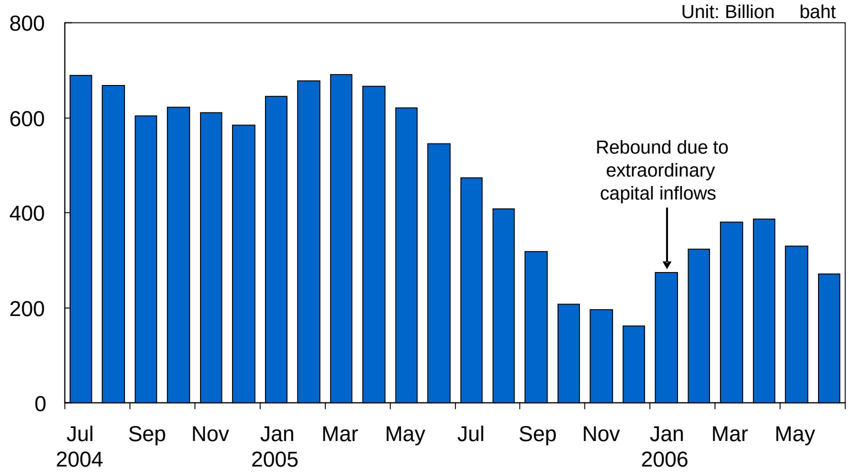


Source: Bank of Thailand.

However, as NPLs gradually declined to below 12 percent in early 2004, the risk-adjusted returns from lending to the real sector rose and, conversely, the relative risk-adjusted returns from holding liquid assets like money market investments and bonds fell. By mid-2004, excess liquidity associated with such liquid asset holdings in banks' portfolios was estimated to be close to 700 billion baht (Figure 11). And it was not until that amount was reduced by approximately half in the third quarter of 2005 that the interest rate pass-through began to pick up noticeably. It should be cautioned, however, that the estimated figures might not be numerically precise due to some assumptions on the risk-adjusted returns of each asset class in the calculation of excess liquidity. Nevertheless, the general direction of the estimated figures is consistent with the estimated degree of interest rate pass-through as presented in Figure 4.

Figure 11

Estimated excess liquidity



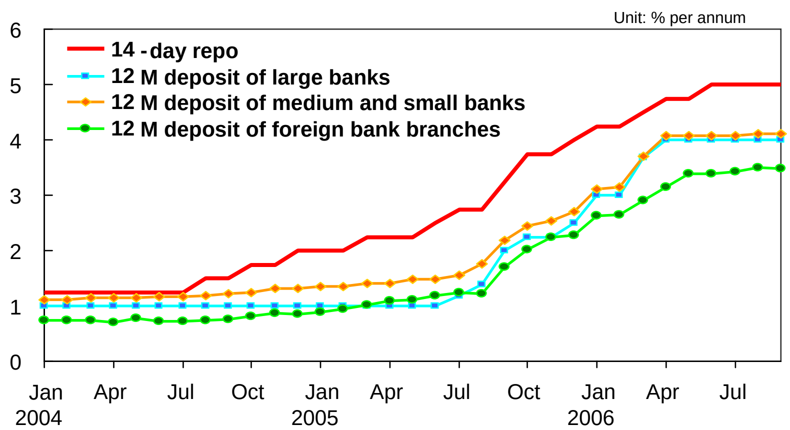
Source: BOT staff estimates.

Large banks, small banks

Another piece of evidence to support the validity of the excess liquidity story is the difference in the time lag of interest rate pass-through between large and small banks. Although the banking sector as a whole had considerable excess liquidity in hand, that liquidity was not distributed evenly among banks. While large banks were loaded with excess liquidity, smaller banks and foreign bank branches were still net borrowers in the money market. The increases in the policy rate put pressure on their funding costs, causing them to raise their deposit rates in order to mobilize funds sooner than large banks, by about one quarter (Figure 12).

Figure 12

Policy and retail interest rates

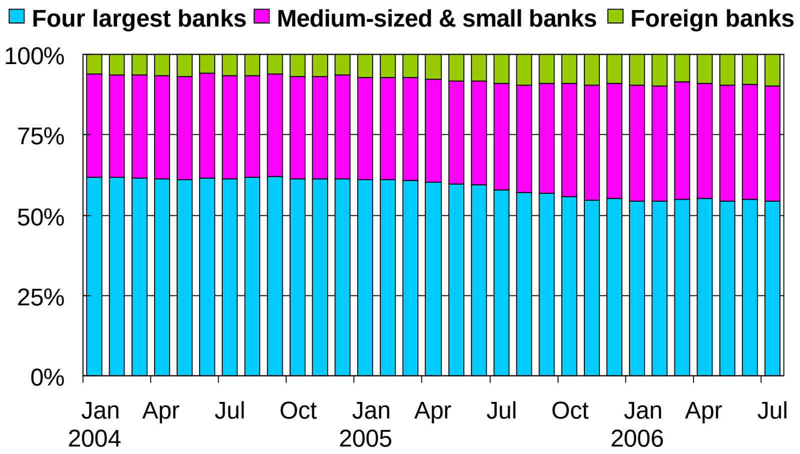


Source: Bank of Thailand.

The earlier increase in the deposit rates of medium-sized and small banks caused deposits to move away from large toward smaller banks. Facing an erosion of market share (Figure 13) and keener competition, as indicated by the decline in the Herfindahl index (Figure 14), large banks on the one hand felt the pressure to preserve their market share. On the other hand, the policy interest rate had meanwhile risen considerably and the risk-adjusted returns on money market investments as well as bond holdings started to become attractive. Therefore, even though loan growth did not accelerate significantly, large banks became interested in mobilizing deposits to expand their liquid asset holdings. As the two factors combined, large banks started to compete aggressively for funds, and the interest rate pass-through picked up very quickly from the latter half of 2005 onward.

Figure 13

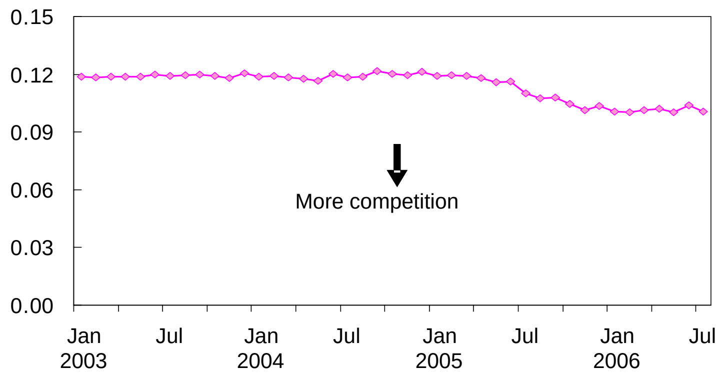
Share in the deposit market



Source: Bank of Thailand.

Figure 14

Herfindahl index for deposit market



Source: BOT staff calculations.

Interest rate pass-through via other routes

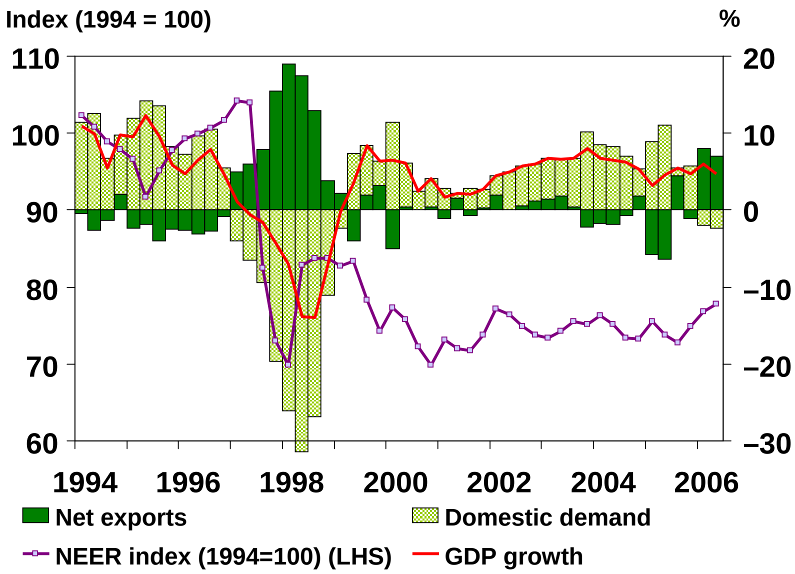
Aside from the weaker monetary policy transmission via the banking sector, other routes of interest rate pass-through strengthened in the post-crisis period. Greater participation in the bond market by households and firms, as evidenced by the higher shares of households' holdings of debt securities to GDP and increased direct borrowing by firms (Figures 3 and 6), allowed changes in the policy rate to influence households' wealth and firms' cost of funding directly. However, given that the shares of such households and firms were still small, the increase in pass-through via these routes was unlikely to offset the decline in pass-through via the banking sector in the post-crisis period up to mid-2005.

2.2 Exchange rate channel

The exchange rate has played a prominent role in Thailand's monetary policy implementation as it can have a significant impact on inflation and the real economy through external competitiveness and foreign investors' sentiment, as is typical in a small economy open to both trade and capital flows. Although domestic demand has been the major contributor to GDP growth, prior to as well as after the financial crisis in 1997, net exports often provides a cushion for GDP growth when domestic demand temporarily softens, as seen in the first half of 2006 (Figure 15).

Figure 15

NEER and contributions to GDP growth from net exports and domestic demand



Source: Bank of Thailand.

This section aims to shed light on monetary policy transmission via the exchange rate channel in Thailand. The analysis is divided into two parts: firstly, the pass-through from the policy interest rate to the exchange rate, and secondly, the pass-through from the exchange rate to the real economy.

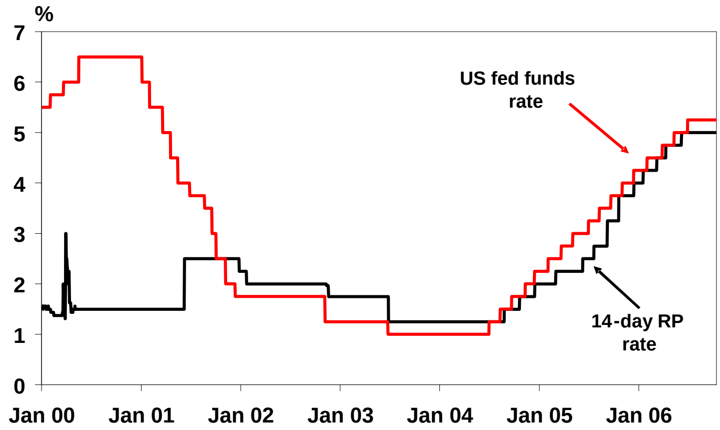
Pass-through from the policy interest rate to the exchange rate

According to the conventional view, when a central bank changes its policy rate, returns on domestic investments relative to foreign investments also change. Such interest rate differential drives capital flows and thus the relative exchange rate. As a result, a central bank often keeps the interest rate differential stable to help maintain capital account stability and keep the bilateral exchange rate from being too volatile for the economy.

During Thailand's most recent tightening cycle, against the backdrop of higher inflation risks from persistently high oil prices and satisfactory economic expansion, the 14-day repo rate rose from the trough of 1.25 percent per annum as of end-July 2004 to 5 percent as of end-October 2006, as shown in Figure 16. At the same time, the US fed funds rate was raised from its historical low of 1 percent per annum as of end-May 2004 to 5.25 as of end-October 2006. Consequently, at end-2006 Q3, the interest rate differential between the two countries was 25 basis points.

Figure 16

14-day repo rate and US fed funds fate

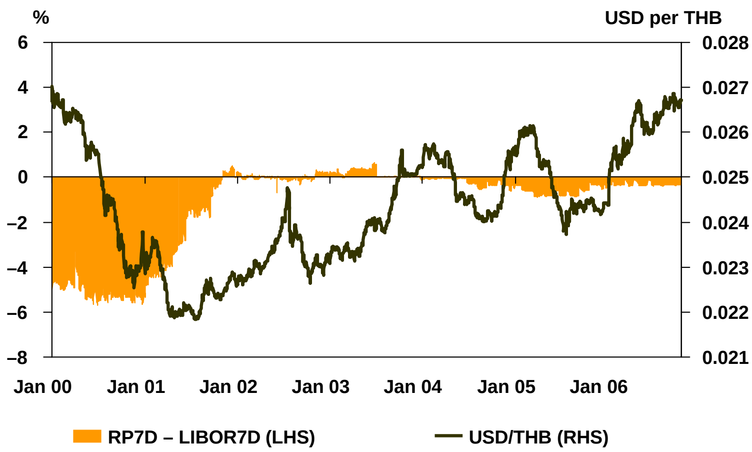


Source: Bank of Thailand.

Although the interest rate differential, which was quite large during 2000–2004, was consistent with the Thai baht's movements against the US dollar in 2000–2001 (Figure 17), it has not been the only reason for the exchange rate adjustments from 2002 onward. Despite a stable interest differential, the Thai baht continues to appreciate against the US dollar, supported by the deterioration in market sentiment over the US twin deficits and thus the US dollar, as well as market speculation on the Chinese renminbi revaluation, for which the Thai baht is a proxy currency in the eyes of investors. Both factors have brought about large capital inflows into the region and the trend appreciation in the Thai baht along with other regional currencies, as reflected in the improving capital account balance since 2001 and positive net capital inflows into Thailand since the second quarter of 2004 (Figure 18).

Figure 17

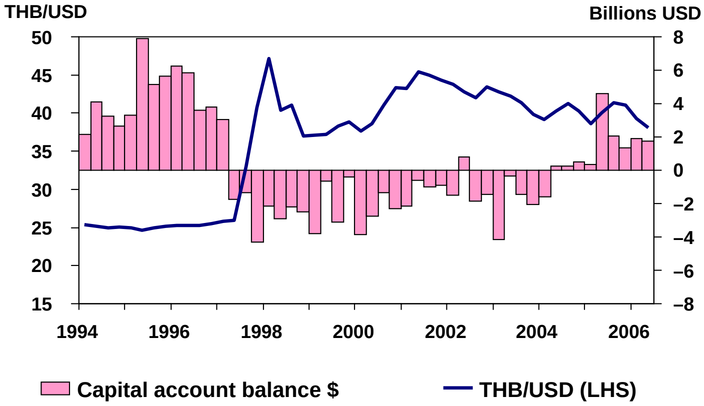
Thai-US interest rate differential and the exchange rate



Source: Bank of Thailand.

Figure 18

Capital flows and the exchange rate

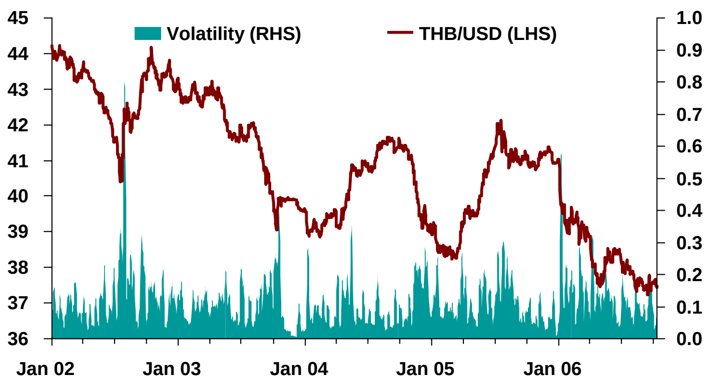


Source: Bank of Thailand.

The above empirical evidence is consistent with the conclusion drawn by the BOT's study that appeared in the October 2004 Inflation Report. The study concluded that unless the interest rate differential was sufficiently large, its impact on the exchange rate would be small compared to the daily exchange rate volatility. In particular, an increase in the policy rate of 25 basis points would cause the baht to appreciate by only 0.02 percent,[4] marginal compared to the daily exchange rate fluctuation of 0.3 percent (Figure 19). Extending the sample to September 2006 gave a similar result. While the estimated impact of the interest rate differential increased slightly, it remained significantly lower than the daily exchange rate volatility.

Figure 19

Exchange rate and volatility



Source: Bank of Thailand.

In conclusion, the Thai baht exchange rate appears to be determined by a number of factors, the interest rate differential being just one of them. The impact of the interest rate differential

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[4] According to the econometric relationship, a 1 percent increase in the interest rate differential induces an appreciation of the exchange rate by 0.088 percent with 90 percent confidence.

D(FX) = –1.996e–06*D(BP(–1)) + 0.153*D(YENDOLLAR) – 0.088*INTDIFF + [AR(1)=0.426].

GARCH = 0.003 – 0.060*RESID(–1)^2 + 1.027*GARCH(–1).

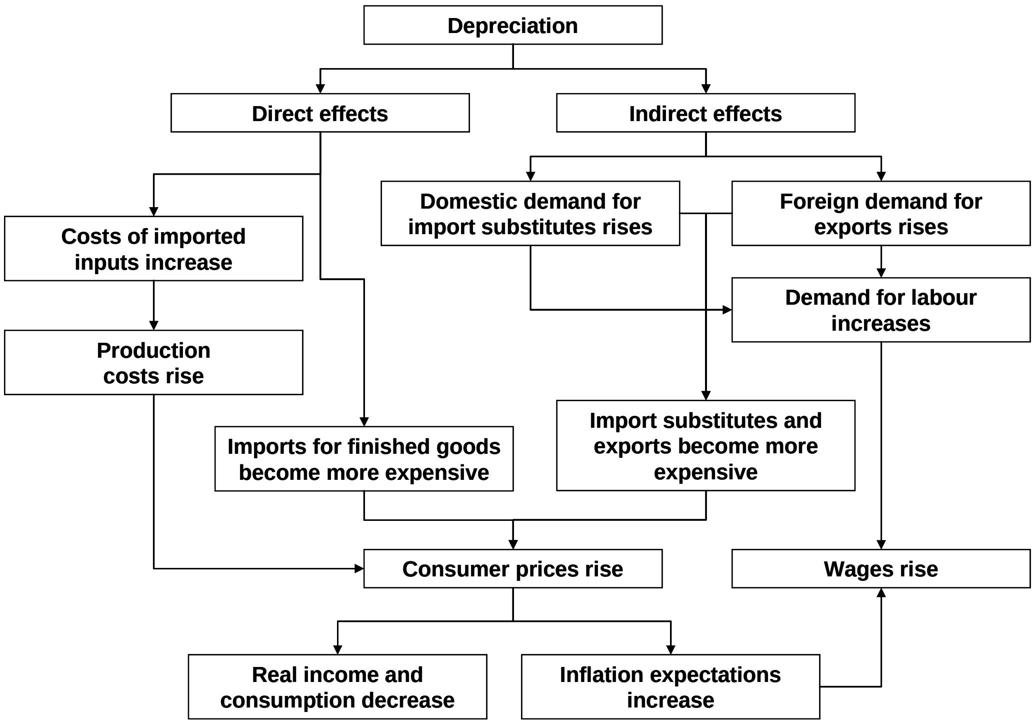
is also likely to be small and easily swamped by the exchange rate variability. Therefore, investors appear not to care much about the interest rate differential unless it becomes significantly wider than the present gap.

Pass-through from the exchange rate to inflation and the real economy

In general, as depicted in Figure 20, changes in the exchange rate transmit directly, and most likely quite quickly, to consumer prices via changes in the costs of imported inputs and finished goods. The magnitude and speed of pass-through depend on the prevailing demand conditions, price adjustment costs, and perceived persistence of the depreciation/appreciation. On the other hand, indirect or second-round effects on consumer prices occur over a longer period of time, through changes in the composition or levels of demand between domestic goods and import substitutes due to shifts in the country's external competitiveness or via inflation expectations of wage bargainers and price-setters due to adjustments of the domestic production level by firms.

Figure 20

Pass-through from exchange rate to consumer prices

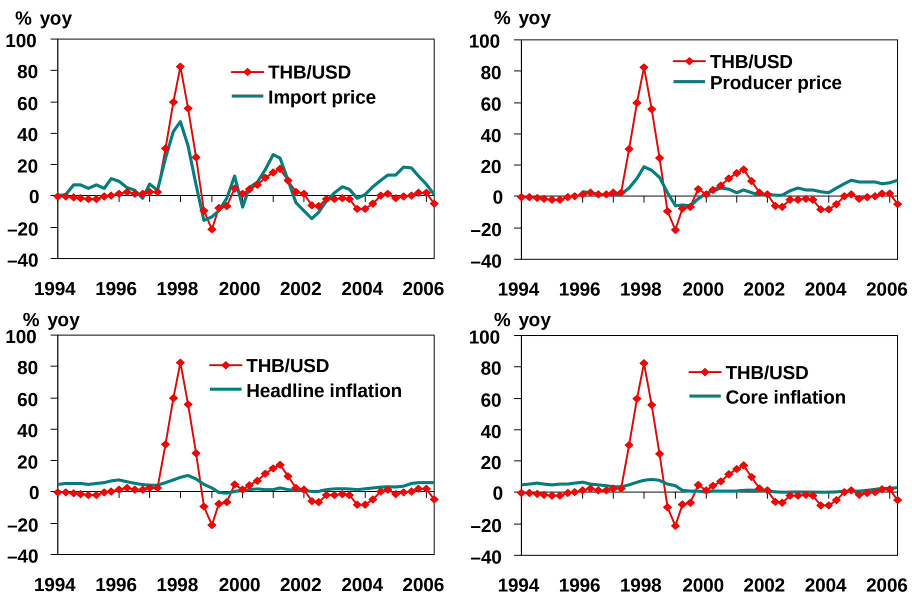


Source: Buddhari and Chensavasdijai (2003).

An analysis of the degree of exchange rate pass-through to consumer prices in Thailand was carried out by Buddhari and Chensavasdijai (2003). Using data from the period 1991–2003, they concluded that the degree of pass-through varied significantly. In particular, the pass-through declined at each stage along the pricing chain. That is, shocks to the exchange rate had the biggest impact on import prices in baht terms, followed by producer prices, headline consumer prices, and then core consumer prices (Figure 21). While import prices adjusted rapidly and completely to variations in the exchange rate, domestic consumer prices did not respond fully, even in the long run. The degree of pass-through also tended to vary across sectors, reflecting differences in the share of import content. Extending the study period to cover the most recent data shows that the degree of exchange rate pass-through to consumer prices has increased slightly (Table 1). Nonetheless, it is still small compared to the pass-through to import and producer prices.

Figure 21

Exchange rate pass-through to prices in Thailand along the pricing chain



Source: Bank of Thailand.

Table 1

Exchange rate pass-through coefficients

(1991–2003)	**Response horizon (Quarters)**		
	1	**4**	**8**
Local currency import price	0.79	1.86	1.79
Producer price	0.19	0.64	0.87
Headline CPI	0.06	0.23	0.34
Core CPI	0.04	0.15	0.26

Source: Buddhari and Chensavasdijai (2003).

(1995–2005)	**Response horizon (Quarters)**		
	1	**4**	**8**
Local currency import price	0.75	1.63	1.55
Producer price	0.22	0.67	0.76
Headline CPI	0.07	0.26	0.35
Core CPI	0.05	0.24	0.35

Source: Bank of Thailand.

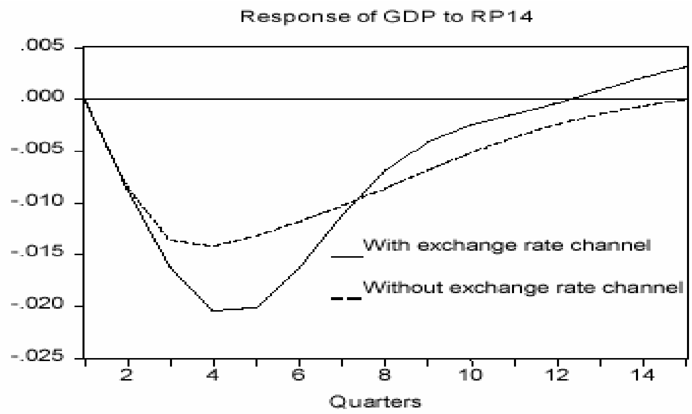
Buddhari and Chensavasdijai (2003) suggested a number of explanations for the fairly low exchange rate pass-through to consumer prices. Among them were the evolution in firms' pricing strategy, which depended in turn on the degree of firms' market power, the adoption of inflation targeting, which helped to anchor inflation expectations, and the increased prevalence of administered prices.

Monetary transmission via the exchange rate channel

Disyatat and Vongsinsirikul (2002) suggested that the exchange rate channel was not very strong in Thailand. Using a vector auto-regression (VAR) approach (Figure 22), they compared the response of output to innovations in the BOT's policy rate (RP14) with and without the real exchange rate endogenized. With the exchange rate channel blocked off, the output response was dampened somewhat, with the trough output being around 0.5 percent of baseline higher than the case where the exchange rate channel was allowed to operate. But given that the study was conducted over 1993–2001, which included a substantial period when the Thai baht was fixed, this result is not entirely surprising. Focusing on the post-fixed exchange rate period, a subsequent study by the BOT found that the significance of the exchange rate in propagating monetary policy shocks tended to increase.

Figure 22

Exchange rate channel



Source: Disyatat and Vongsinsirikul (2002).

In addition, Sriphayak and Vongsinsirikul (2006) used the BOTMM[5] estimated in January 2003 (BOTMMJan03) and July 2006 (BOTMMJul06)[6] to examine the relative importance of each monetary policy transmission channel, including the exchange rate channel, by following the same concept as that used in the aforementioned VAR approach.[7] Their results (Figure 23) suggested that, along with the interest rate channel, the exchange rate channel was

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5 The BOTMM is an ECM-approach system of equations covering four economic sectors, namely real, government, external and monetary sectors, and prices. It is used as the official economic forecasting tool at the BOT.

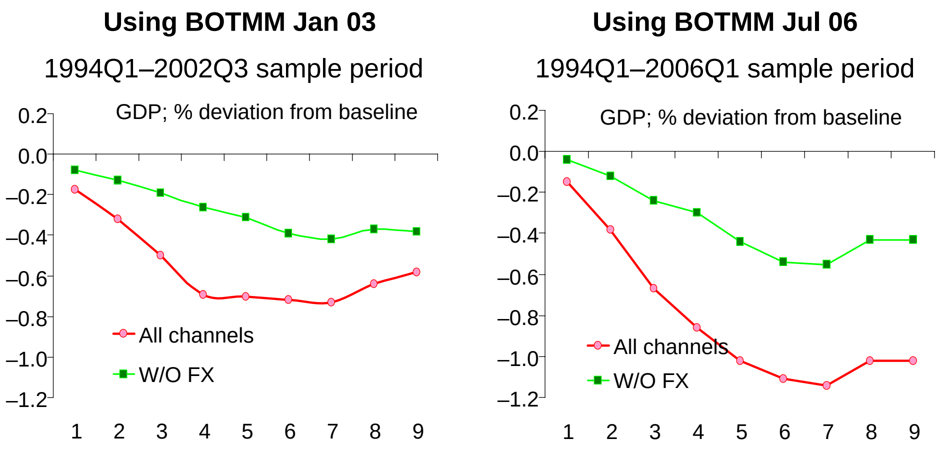
6 Key results for all transmission channels are shown in Appendix B.

7 As in Disyatat and Vongsinsirikul (2002), the study compared GDP responses to an innovation in the policy rate (a permanent shock of one standard deviation or approximately 1.75 percent) between the model with all transmission channels and the model with the channel of interest blocked off. The difference would be the impact of the channel of interest.

important and its influence on the economy became more prominent when more recent data were included in the model estimation.

Figure 23

Monetary policy transmission – exchange rate channel



Source: Sriphayak and Vongsinsirikul (2006).

In summary, the Thai economy, which is small and highly open, is inevitably affected by exchange rate changes. Although the role of interest rate differentials in the determination of the exchange rate is not substantial and tends to be overwhelmed by exchange rate volatility, the exchange rate channel is still quite important to both inflation and GDP growth under the floating exchange rate regime, and the impact appears to have increased in recent years.

2.3 Asset prices channel

A monetary tightening can dampen equity prices by making equity relatively less attractive compared to bonds (since interest rates rise), as well as worsening the earnings outlook for firms (since household spending declines). Lower equity prices lead in turn to a drop in the financial wealth of households and therefore lower consumption. They also reduce the market value of firms relative to the replacement cost of capital and thus delay investment (Tobin's q effect).

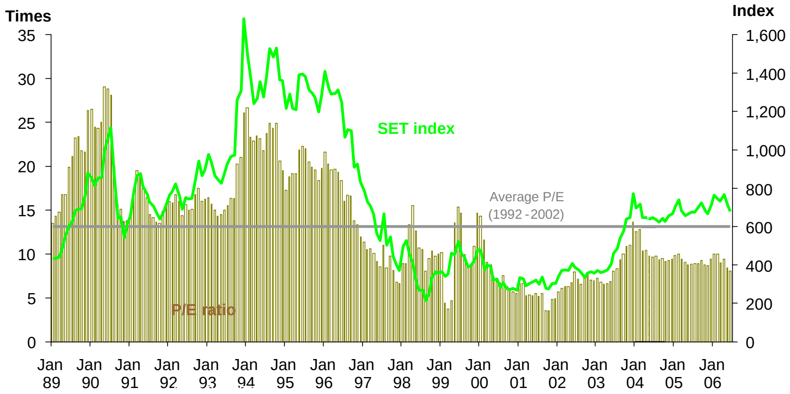
This section of the paper focuses on asset price adjustments during Thailand's recent monetary tightening cycle that began in August 2004, and the development of asset prices as one of the monetary policy transmission channels.

Equity prices or financial wealth

After a strong economic recovery, particularly in 2003 during which the Thai stock market gained 116 percent, the stock market began to level off in 2004 (Figure 24). This slowdown was attributed in part to avian flu, unrest in the southern provinces, oil price volatility, and tsunami. In early 2005, the stock market picked up again, though far more gradually than in 2003. However, there is thus far no sign of overheating in the equity market. The P/E ratio towards the end of the first half of 2006 stayed at around 8 percent. The low P/E ratio relative to Thailand's historical average of 14 percent before the 1997 financial crisis and to those of other regional markets – 16 percent for Malaysia and Singapore and 18 percent for the Philippines – suggests that there is potential for a further rally in the stock market.

Figure 24

Stock index and P/E ratio



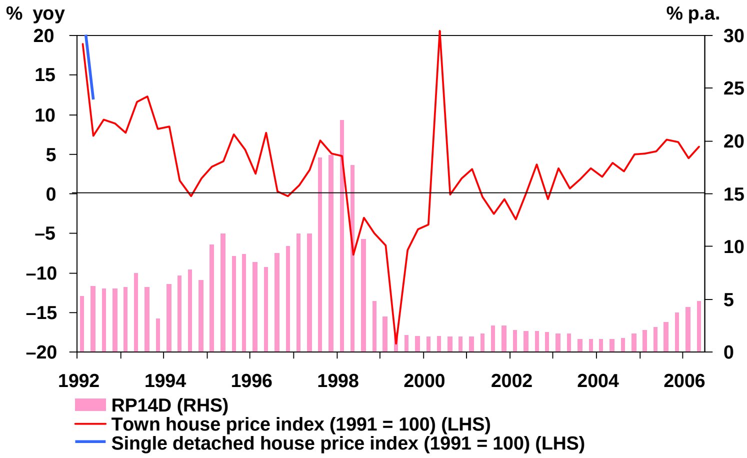
Source: The Stock Exchange of Thailand.

Property prices or physical wealth

As shown in Figure 25, housing price indices have been growing continuously since 2003, benefiting from the low interest rate environment and homeowners' greater access to bank loans together with some government stimulus measures related to a property transfer tax reduction which was scheduled to expire by the end of that year. Increased demand for housing due to these factors boosted commercial banks' housing loans. As a result, personal housing credits or mortgage loans grew by 19 percent in 2003, compared to 12.6 percent in 2002. This fast acceleration of housing credits led to the issuance by the BOT of new prudential guidelines regarding the property sector in December 2003.[8] The stricter prudential guidelines together with the expiration of the transfer fee reduction have caused overall real estate activities to somewhat slow down since then. However, house prices have continued to rise, partly as a result of higher construction and transportation costs.

Figure 25

Housing price indices and the 14-day repo rate



Source: The Stock Exchange of Thailand.

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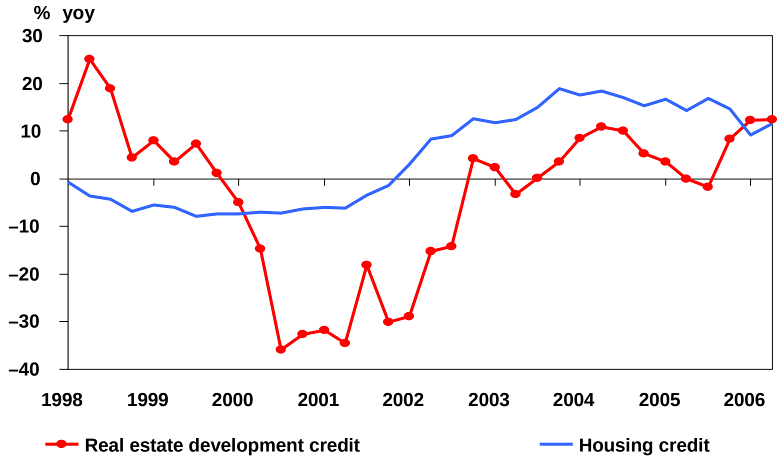
8 In December 2003, the BOT issued prudential guidelines for real estate loans to encourage financial institutions to become more cautious in extending real estate credits in order to avert market speculation. Key guidelines were (1) lowering the post-construction loan-to-value ratio to 70 percent for residential property with a transaction price exceeding 10 million baht, and (2) reporting to the BOT all new real estate loans over 100 million baht.

Figure 26

Real estate credits



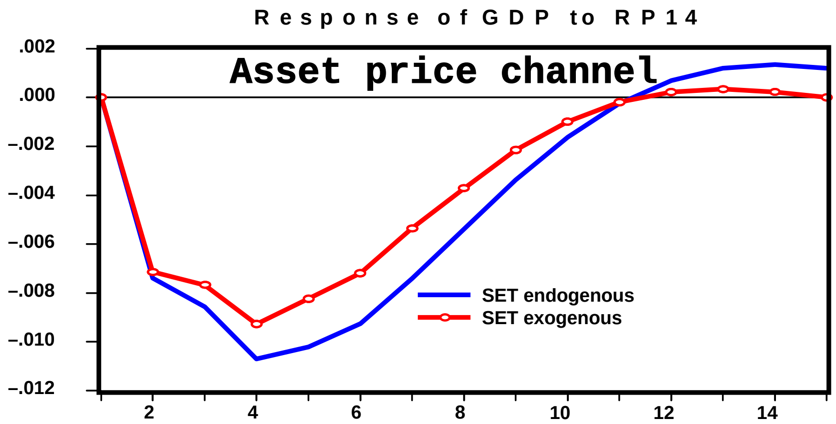
Source: Bank of Thailand.

Monetary transmission through the asset prices channel

There are a few studies by the BOT on the issue of monetary transmission via the asset prices channel. An analysis using the VAR approach was undertaken by Disyatat and Vongsinsirikul (2002). They found that the role of equity prices, specifically the Stock Exchange of Thailand's price index (SET), in the monetary policy transmission mechanism was less important than other channels during the period 1993–2001. A monetary tightening (corresponding to a rise in the policy rate by one standard deviation or around 200 basis points) led to an immediate but small fall in equity prices of approximately 4 percent that lasted for about six quarters, while innovations in stock prices by 16 percent boosted output by at most only 0.4 percent from the baseline. Therefore, not surprisingly, exogenizing the stock index dampened the response of GDP only slightly, as shown in Figure 27. Moreover, the accumulated responses suggested that movements in equity prices accounted for only around 17 percent of the total impact on output after two years.

Figure 27

Monetary policy transmission using VAR approach – asset prices channel



Source: Disyatat and Vongsinsirikul (2002).

The study explained this minimal impact by the fact that firms' reliance on equity financing was not very significant compared with bank loans and debt instruments, while stock holdings also made up only a small fraction of the household sector's wealth. Thus, at the macro level, both private investment and private consumption did not respond significantly to changes in equity prices. However, the study suggested that, given continued developments in the capital market in Thailand, monetary policy transmission through equity prices was expected to strengthen going forward.

For policy transmission via housing prices, the most recent study by Sriphayak and Vongsinsirikul (2006), using the BOTMM and cross-correlation analysis,[9] suggested, firstly, that **equity prices were more sensitive to interest rate changes than property prices** and, secondly, that **the asset prices channel in Thailand – including both equity and property prices – gained in effectiveness but remained weaker than other transmission channels.**

The low sensitivity of property prices to interest rate changes could be explained by the following reasons. Firstly, homeownership in Thailand is not very high in an international comparison (53 percent in Bangkok compared with about 70 percent in the UK and US). Secondly, demand for property is more responsive to other factors, such as income growth and tax reduction, than interest rate changes, especially in the case of a marginal change from a very low level during 1999–2002. Thus, a positive relationship between interest rates and price indices of townhouses with land was found during that period, dampening the negative effect of interest rate changes on house prices for the whole period of the study. Finally, since the present value of an asset depends on the future stream of earnings from that asset and future interest rates, the interest rate as a discounted factor should have the same impact on both equity and property prices. However, while the future stream of earnings from equity holdings depends on the investors' view of economic prospects, which also varies with interest rates, that from property holdings depends less on interest rates since a house purchase is often considered a necessity. This makes equity prices more sensitive to interest rates than property prices.

From the July 2006 BOTMM, a 10 percent increase in the policy rate leads to a fall of 0.6 percent in physical wealth (property prices) and a fall of 1.4 percent in financial wealth (equity holdings) from the baseline after a year, confirming that financial wealth is much more responsive to changes in the policy rate than physical wealth. In addition, 10 percent increases in the house price index and equity prices cause output to deviate by 0.05 and 0.1 percent from the baseline in a year's time, respectively. That is, the wealth effect from equity prices is stronger than from property prices, though both routes are still considered small.

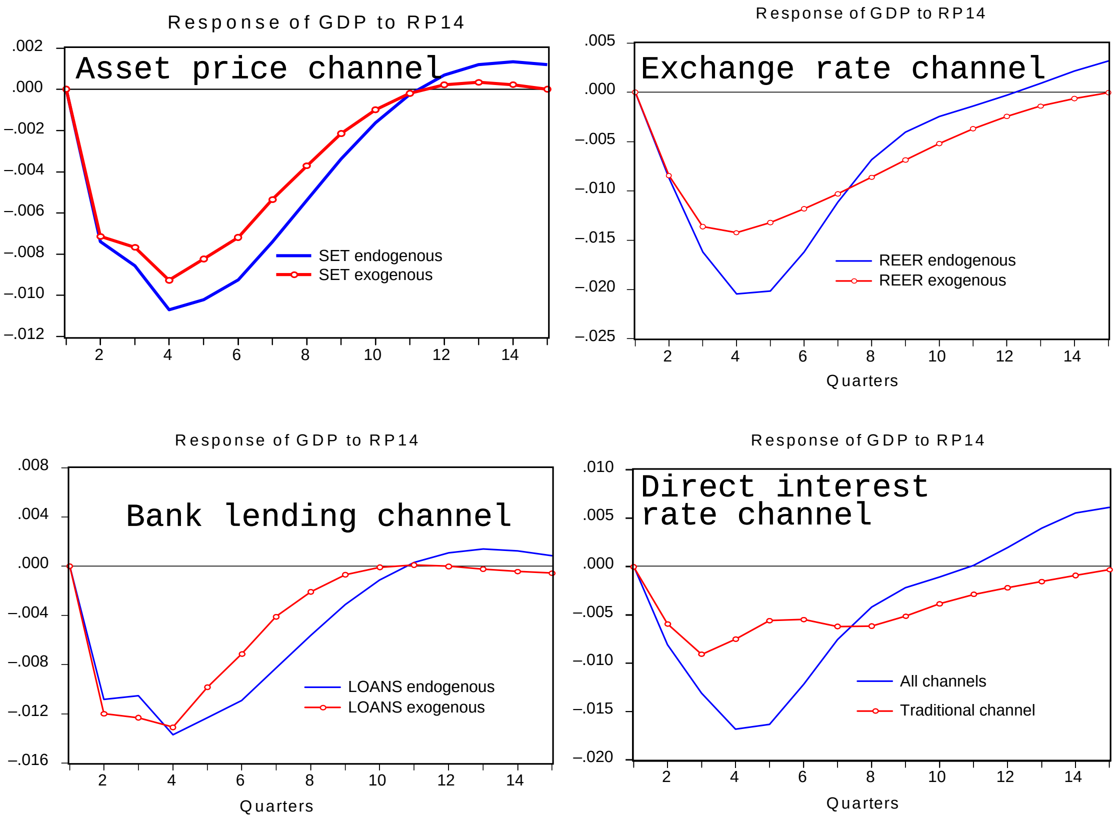
3. Conclusion

The financial crisis of 1997 brought about significant changes to the economy, including the monetary policy transmission mechanism. While the interest rate channel is generally the most important transmission channel in Thailand, its relative importance declined significantly for quite some time in the post-crisis period due to a heightened degree of risk aversion, in both the corporate and banking sectors, and excess liquidity in the banking sector. In the most recent period, however, there is evidence to suggest that this channel is regaining strength.

9 Results from the pair-wise cross-correlation approach by Sriphayak and Vongsinsirikul (2002) are shown in Appendix C.

Meanwhile, the **exchange rate channel** and **asset prices channel** have become relatively more important in the post-crisis period. For asset prices in particular, transmission via equity prices tends to be more important than via property prices, though both remain modest compared to the interest rate and exchange rate channels. However, the role of asset prices in transmitting monetary policy should strengthen going forward as households participate more actively in these asset markets and the assets constitute a growing portion of the household sector's total wealth.

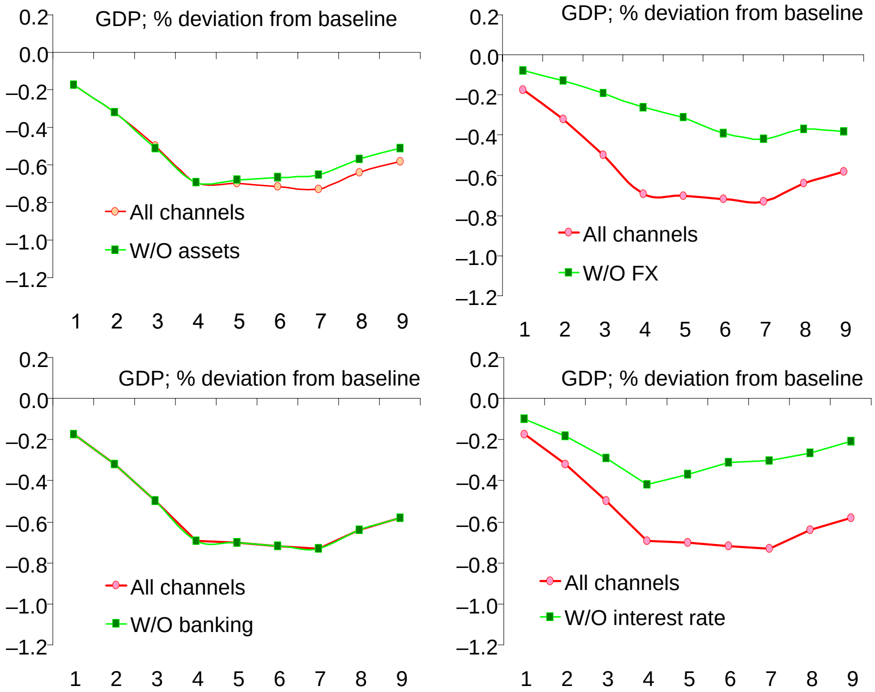
Appendix A:
Relative importance of monetary policy transmission channels using VAR approach[10]



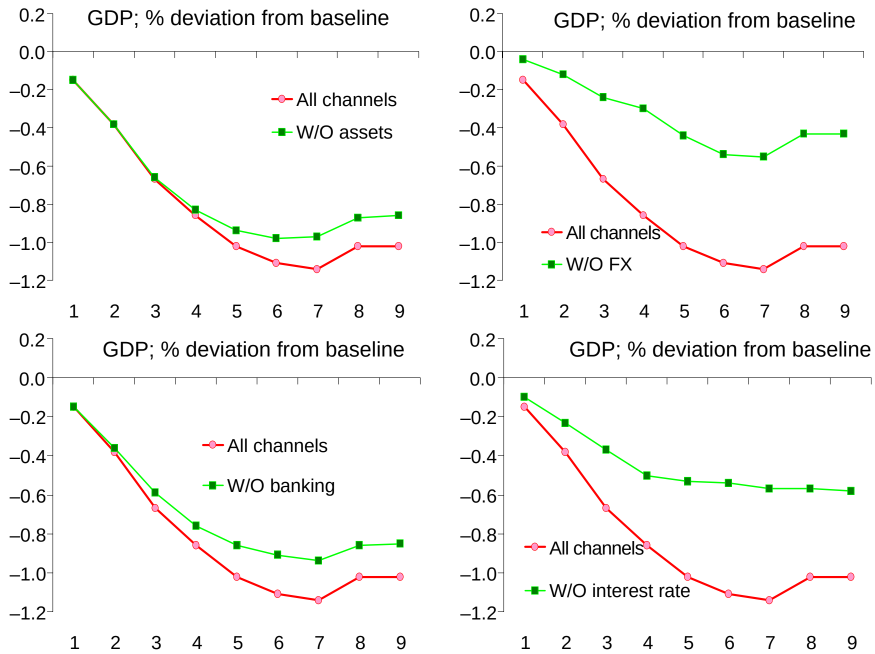
10 Disyatat and Vongsinsirikul (2002).

Appendix B:
Relative importance of monetary policy transmission channels using BOTMM[11]

1. Channels of monetary policy transmission using BOTMM Jan 03 from the 1994Q1–2002Q3 sample period



2. Channels of monetary policy transmission using BOTMM Jul 06 from the 1994Q1–2006Q1 sample period



[11] Sriphayak and Vongsinsirikul (2002).

Appendix C:
Pair-wise cross-correlation approach[12]

1. Pair-wise cross-correlation among the first differences of policy rate, securities value, and real durable consumption

Period		d(rp) and dlog(bmcap)*		d(mlr) and dlog(bmcap)		dlog(bmcap) and dlog(cpr1)	
		Leading**	Contemp.	Leading	Contemp.	Leading	Contemp.
Whole Sample							
93Q1-97Q4	Pre-crisis	**-0.41**		0.04	**0.36**		**0.56**
93Q1-02Q4	Post-crisis	**-0.55**			**-0.34**		**0.4**
93Q1-06Q1	Present	**-0.51**			**-0.32**		**0.39**
Sub-sample							
93Q1-97Q4	Pre-crisis	**-0.41**		0.04	**0.36**		**0.56**
99Q1-02Q4	Post-crisis		-0.63		**-0.53**	**0.46**	
02Q1-06Q1	Present		-0.35	-0.49	**-0.36**	**0.55**	

* d(a) is first difference of a, dlog(a) is first difference of log(a), rp =14-day repurchase rate or policy rate,

mlr = minimum loan rate, bmcap = securities value representing equity value, cpr1 = private durable-goods consumption

** Leading of correlation between A and B represents the correlation of A one quarter ahead and B.

2. Pair-wise cross-correlation among the first differences of policy rate, price index of townhouse with land, and real durable consumption

Period		d(rp),dlog(plandth)		d(mlr),dlog(plandth)		dlog(plandth),dlog(cpr1)	
		Leading*	Contemp.	Leading	Contemp.	Leading	Contemp.
Whole Sample							
93Q1-97Q4	Pre-crisis	**-0.27**	-0.16	0	**-0.35**	0.19	**0.19**
93Q1-02Q4	Post-crisis	**-0.04**	0.1	0.21	0.17		**0.13**
93Q1-06Q1	Present	**-0.03**	0.1	0.21	0.16		**0.14**
Sub-sample							
93Q1-97Q4	Pre-crisis	**-0.27**	-0.16	0	**-0.35**	0.19	**0.19**
99Q1-02Q4	Post-crisis	0.05	0.4	0.37	0.29	-0.17	**0.02**
02Q1-06Q1	Present	0	0.2	0.31	0.16	-0.58	**0.34**

* Plandth = price index of townhouse with land representing property prices.

* Leading of correlation between A and B represents the correlation between A one quarter ahead and B.

12 Sriphayak and Vongsinsirikul (2002).

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The monetary transmission mechanism in Turkey: new developments

Erdem Başçı, Özgür Özel and Çağrı Sarıkaya[1]

1. Introduction

Uncertainty about the underlying monetary transmission mechanism may be more pronounced in emerging market economies than in developed ones. Small open emerging market economies are typically characterized by, high exchange rate pass-through, asset and liability dollarization, currency and maturity mismatches in balance sheets of banks and firms, external financing constraints, and fiscal dominance. Macroeconomic relationships are generally blurred by the role of exchange rates in both growth and inflation dynamics. This implies that the credit and aggregate demand channels may not respond properly to a change in interest rates. Therefore, the small open economy context complicates the interest rate channel beyond that observed in conventional mechanisms. Instead, the macroeconomic environment may be shaped by exchange rates driven by the direction and magnitude of capital flows.

In Turkey, the ongoing structural transformation process, which was launched after the deep crisis of February 2001, involved the transition to inflation targeting, the introduction of the floating exchange rate regime coupled with the new central bank law, and structural reforms aimed at reducing the public sector burden on the economy as well as promoting competition and productivity. During this process, traditional monetary transmission channels have become more operative. Nevertheless, the evolution of the transmission channel cannot be solely attributed to the improvement in domestic fundamentals. The progress in financial integration, as well as in the European Union (EU) accession process, emerges as the major cause of changing dynamics of monetary transmission. For instance, global trends in risk appetite influenced by expectations regarding monetary policy actions to be taken by major economies have become more significant for domestic policy. A further critical issue for Turkey is that the EU convergence process not only provides an additional anchor to shape expectations, but also bears fruit by attracting more long-term capital to the economy. No matter what these factors individually imply, they indicate a common point that exchange rate fluctuations resulting from reversals in capital flows have a large effect on monetary policy.

2. Transmission mechanism in general

Monetary policy conduct in Turkey before 2001 incorporated the practice of fixed or managed exchange rate regimes where the exchange rate was the main policy instrument used to control inflation or to maintain financial stability. During past experiences with fixed or quasi-fixed exchange rate regimes, economic agents' expectations were heavily dependent on the movements of the nominal exchange rate, which were an easy-to-follow and compact information source regarding the future course of inflation. The influence of nominal

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exchange rates in the formation of expectations created an “indexation” mechanism in the price setting process. The most significant step towards normalization since the February 2001 crisis has been the transition to the inflation targeting regime, which requires the active use of short-term interest rates as the main policy tool while exchange rates are allowed to float. In this way, the exchange ratehas become more volatile and its information content for inflation has diminished to a large extent. The framework of monetary policy, in which interest rates are adjusted in response to deviations of inflation from a targeted path, allows the monetary authority to manage inflation expectations properly. In other words, the current policy framework puts the Central Bank of Turkey’s (CBT) short-term interest rate in the forefront by re-defining its role primarily as one of shaping expectations. For a small open economy, such a policy shift is expected to strengthen the interest rate channel in a standard transmission mechanism with a greater sensitivity of output and inflation dynamics to policy rates. The following section discusses the increasing effectiveness of the policy instrument in Turkey during recent years.

Evidence on strengthened output response to interest rates

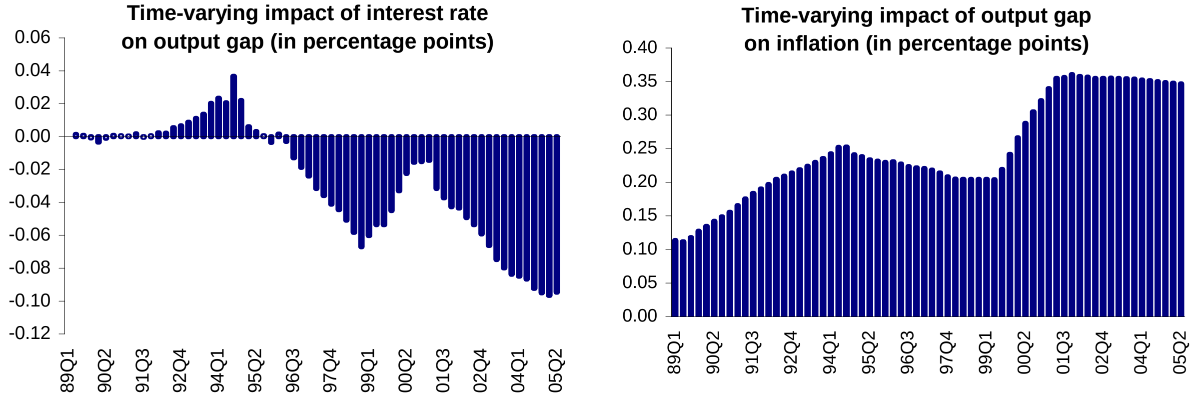
In the last three decades, the Turkish economy witnessed high and volatile inflation, coupled with increasing public debt burden that resulted in excessively high levels of real interest rates, which blurred the conventional channel of transmission to aggregate demand by inducing economic agents to become less sensitive to changes in interest rates. The major turning point for the Turkish economy was the financial crisis in February 2001, after which a comprehensive economic program was put in place. The program succeeded not only in reducing the fragility of the economy thanks to the measures aimed at restructuring the banking and public sectors, but also in alleviating historically problematic issues such as inflation and country risk. This achievement has been instrumental in bringing both inflation and real interest rates down to more reasonable levels. Accordingly, economic agents started to reveal their intertemporal preferences in response to changes in interest rates, and the link between real interest rates and spending decisions has strengthened significantly.

By using time-varying parameter estimation methods, Kara et al (2007) find that the effectiveness of the interest rates on the output gap, and the impact of the output gap on inflation, have been increasing since the implementation of implicit inflation targeting (Figure 2.1). As of the end of the second quarter of 2005, the contemporaneous impact of a one percentage point increase in real interest rates is a 0.1 percentage point decline in the output gap. Similarly, a one percentage point increase in the output gap is estimated to result in a 0.35 percentage point increase in the quarterly rate of inflation in the following quarter. Furthermore, the magnitude of both parameters displayed an increasing trend during the estimation period.

To sum up, the transition to inflation targeting and the evidence of a more responsive aggregate demand to real interest rates have emerged as remarkable developments with respect to the improvement in the functioning of the interest rate channel of transmission. Nevertheless, weakened fiscal dominance, reduced dollarization, and improved interest rate pass-through have also been noteworthy determinants of the increased effectiveness of short-term interest rates as a policy tool.

Figure 2.1

Evolution of the interest rate channel[1]



[1] Time-varying coefficients are estimated through the extended Kalman filter method. For more detailed information on the subject and the methodological explanations, see Kara et al (2007).

Fiscal dominance: interaction of the interest rate and the exchange rate

The literature on the monetary policy in emerging market economies points to the presence of fiscal dominance as an important constraint on the monetary transmission mechanism. Regardless of the maintenance of instrument independence, a high debt stock can be a serious threat to an independent monetary policy implementation. For the economies in question, Blanchard (2004) argues that an increase in interest rates is generally perceived as an upsurge in default risk due to a high debt burden, and thus leads to a rise in the risk premium. Depending on the extent of risk perception, subsequent capital outflows cause depreciation in domestic currency, which may hinder the conventional functioning of the UIP relationship.

However, the latest developments in Turkey suggest that this non-standard mechanism may have come to an end. Starting from May 2006, global liquidity conditions suddenly changed against developing countries, whereby higher global risk aversion triggered capital outflows from many emerging markets including Turkey along with a shift in the overall market sentiment. As a result, Turkey witnessed a sudden deterioration in the credit risk premium. The increase in the EMBI spread was around 150 basis points during May and June, and the New Turkish lira (YTL) depreciated more than 20 percent against the US dollar (USD) in the meantime. The CBT reacted decisively by increasing its policy rate by 400 basis points (bp). The USD/YTL exchange rate declined (ie the YTL appreciated) from 1.75 to 1.45 within a month. Therefore, based on the evidence from the recent financial turbulence in the Turkish economy, it can be argued that the "Blanchard" channel fades away as the interaction of the interest rate and the exchange rate continues to converge to its conventional form during the ongoing normalization process of the economy, thanks to continued fiscal prudence.

Interest rate pass-through

The main policy instrument of inflation targeters is short-term interest rates. In fact, there is a consensus in the literature that aggregate demand depends more on long-term rates than short-term ones.[2] The extent of short-term policy rates in affecting longer-term rates reflects

[2] See Woodford (1999), Rotemberg and Woodford (1999).

its power not only in steering aggregate demand but also in managing expectations. Hence, the assessment of the effectiveness of monetary policy also requires considering the linkage between short-term policy rates and long-term yields.

Aydın (2006) examines the sensitivity and speed of adjustment of credit interest rates to the monetary policy rate for corporate, housing, cash, and automobile loans. Estimation results reveal that, while corporate loans are not that sensitive to monetary policy rate changes, the long-term pass-through to cash and automobile loans is one-for-one and the elasticity of housing loan rates with respect to the policy rate is greater than unity. In other words, microstructures in the banking sector or external financial conditions have a statistically significant impact on corporate loans and housing loans, whereas the policy rate has a considerable impact on cash and car loans. Although these results indicate a significant degree of control of the monetary authority over the cost of consumer credit, one should bear in mind that the credit channel is at its early stages of development in Turkey, as the share of consumer credit to GDP is still at low levels (8 percent as of the second quarter of 2006) compared to other developing economies.

3. Exchange rate and other asset price channels

The exchange rate does not only operate through its effect on expectations but also provides an additional channel by affecting inflation directly through imported good prices and aggregate demand, thereby emerging as the quickest channel of transmission. In the emerging markets context including Turkey, the exchange rate has a distinct role, because its fluctuations may be more costly compared to those in developed economies. Based on the pre-float experience of the Turkish economy, the reason can be attributed to a number of problematic issues such as dollarization, fiscal imbalances, a high degree of exchange rate pass-through, the presence of weak and unhealthy banking and financial sectors with currency and maturity mismatches, lack of financial deepening, and the resulting financial fragility.[3] However, during the period subsequent to the 2001 crisis, the Turkish economy has made notable progress on the way to overcoming these chronic weaknesses, thanks to the structural measures put into practice. Therefore, instead of elaborating on the role of the exchange rate as a vulnerability indicator, the focus in this section will be on the changing behavior of fairly standard transmission channels, with special emphasis on the stylized facts peculiar to Turkey.

Yet another point that needs to be addressed is the role of the foreign currency as an asset in households' or firms' portfolios. Changes in the value of the exchange rate bring about wealth effects, since a considerable portion of household assets and firm liabilities are denominated in foreign currencies, especially the USD and the Euro. Clearly, other asset prices also influence the transmission mechanism, as discussed below.

Exchange rate pass-through

The extent of exchange rate effect on prices in Turkey must be discussed from two main aspects of pass-through, namely its pace and magnitude. Coupled with high and volatile inflation, the prolonged uncertainty environment resulting from frequent economic crises following failed stabilization programs – mostly incorporating fixed rate regimes – gave rise to

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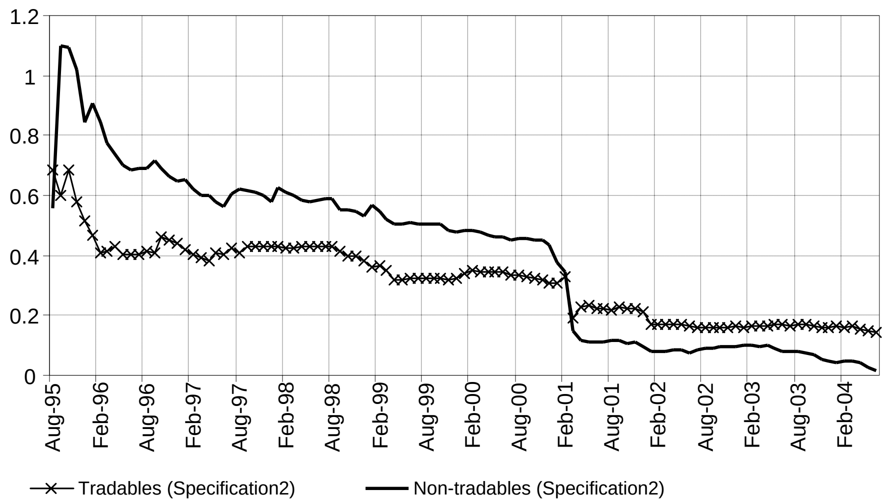
[3] Calvo and Mishkin (2003) define the main issues common in emerging market economies as weak fiscal, financial and monetary institutions, currency substitution, liability dollarization, and vulnerability to sudden stops of capital inflows.

a strong indexation behavior and made the exchange rate the main determinant of inflation expectations prior to the implementation of the floating exchange rate regime. Accordingly, depreciation-inflation spirals became a common characteristic of the Turkish economy. This means that not only the magnitude but also the speed of exchange rate pass-through had been excessively high before the adoption of the floating regime. A change in the exchange rate was transmitted quickly to prices irrespective of the nature of the shock being temporary or permanent. Moreover, automatic indexation behavior was so common among all sub-items of the CPI that pass-through was almost full even for non-tradables (Figure 3.1).

Figure 3.1

Indexation behavior:
pass-through coefficient in tradables vs non-tradables[1]



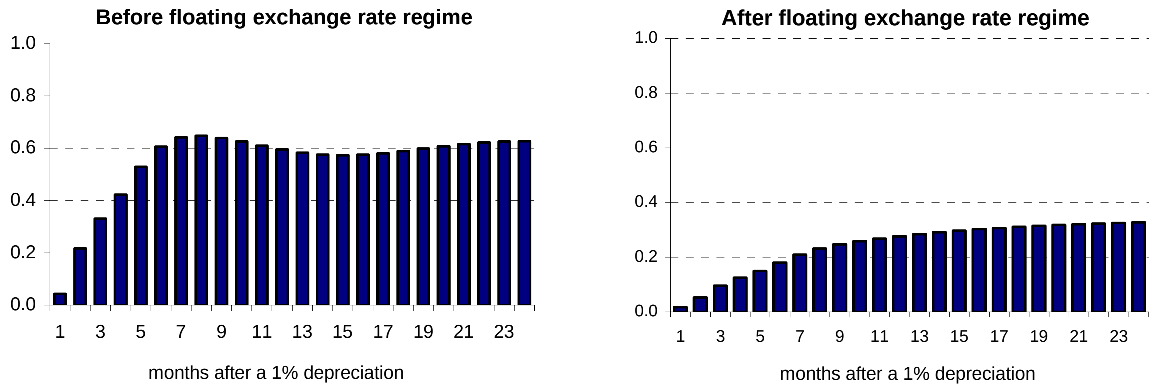
[1] For more detailed information on the subject and the methodological explanations, see Kara et al (2007).

However, the transition to inflation targeting along with the floating exchange rate regime can be expected to lower the degree of pass-through. In fact, recent empirical studies for Turkey find reduced exchange rate pass-through, in terms of both speed and magnitude. Kara et al (2007) differentiate between the tradable and non-tradable sectors' prices and compare the time-varying pass-through coefficients in these subgroups. They interpret the high pass-through to non-tradables inflation as a signal of strong indexation behavior during the pre-float period. Following the introduction of the floating exchange rate regime, they find evidence of weakened indexation behavior, based on the observation of a more pronounced downward shift in the pass-through to non-tradables inflation compared to tradables inflation (Figure 3.1).

In a further study, Kara and Öğünç (2005) analyze two subsamples to distinguish between the pre-float and the float behavior of exchange rate pass-through in Turkey. They estimate that most of the pass-through is completed within four to five months during the pre-float period, whereas it takes approximately one year under float (Figure 3.2). Their findings also indicate the diminished magnitude of pass-through, in addition to the slowdown in its pace. In a two-year horizon, the total pass-through is estimated as approximately 60 percent for the pre-float period, while it has fallen down to 30 percent under the floating regime.

Figure 3.2

Cumulative exchange rate pass-through to consumer inflation: VAR evidence[1]



[1] For more detailed information on the subject and the methodological explanations, see Kara and Öğünç (2005).

Although the common bottom line of recent empirical studies supports a relative improvement subsequent to the adoption of the floating exchange rate regime, the current degree of exchange rate pass-through is still relatively high. Putting aside the speed of pass-through, its magnitude points to aphenomenon peculiar to Turkey, due to the structure of aggregate production function of the economy. The large share of the import component in total value added signifies a high degree of dependence of production on foreign resources. For instance, intermediate and capital goods account for almost 90 percent of total imports in Turkey. The high weight of imported goods in the factors of production is also supported by a recent survey study based on selected firms in the manufacturing industry. The survey results of Karadaş et al (2006) show that the average share of imported raw materials in total expenses of firms in the manufacturing industry is 36.1 percent, whereas domestic raw materials and labor constitute 32.6 percent and 11.6 percent of total costs respectively. The survey also provides information on indexation behavior supporting the economic intuition that indexation is most pervasive among sectors processing imported raw materials intensively.

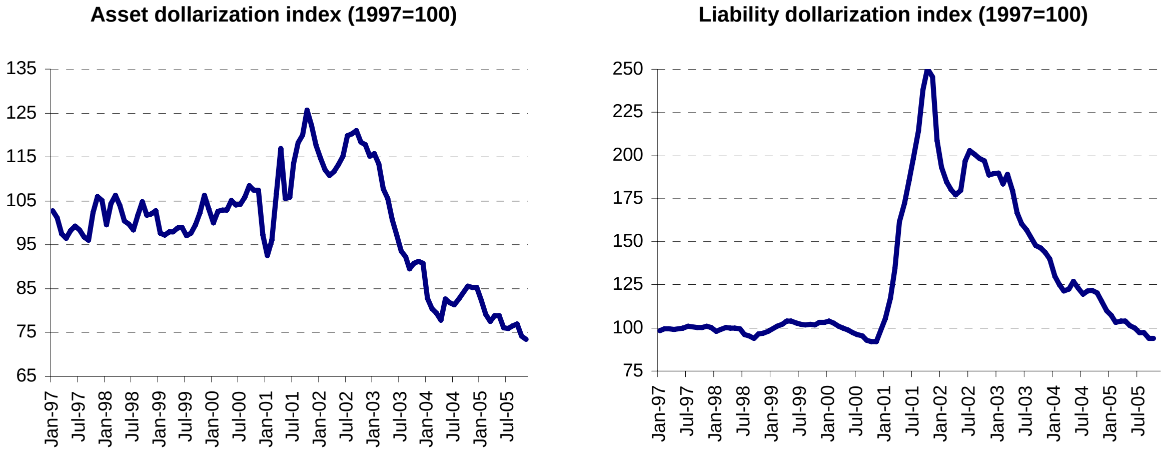
Finally, it is worth noting that recent econometric studies aiming to estimate a pass-through coefficient for Turkey may suffer from the sample characteristics since they cover a period witnessing only a sustained appreciation trend of the domestic currency. In this particular case, the downward trend of pass-through coefficient over time may solely be reflecting the disinflation process that has prevailed since the adoption of floating rates. In fact, a true identification of pass-through effect requires testing for the reaction of inflation to an opposite situation as well. The question of how estimated coefficients would have changed if the domestic currency had been exposed to a considerable depreciation remains to be seen.

Dollarization: weakened but still high?

Regarding the degree of monetary policy effectiveness, dollarization emerges as one of the most common limitations peculiar to emerging markets with unstable economies and lack of confidence in the domestic currency. Calvo and Vegh (1992) recognize dollarization as a consequence of high inflation resulting primarily from fiscal imbalances and unsuccessful stabilization programs. Besides, the presence of liability dollarization in both financial and real sectors, coupled with inadequate supervisory bodies, appears to be a serious threat to financial stability in these economies. Reflecting the aforementioned characteristics of an emerging economy, the pre-float period experience of Turkey can be seen as a case study. A fragile banking sector with poor loan quality along with maturity and currency mismatch problems, a real sector relying extensively on foreign currency financing, an imbalanced fiscal account with a large share of FX-denominated debt stock and a large stock of FX deposits were the main factors increasing the severity of dollarization in the Turkish economy. In such an environment, the role of dollarization was far beyond reducing the control of the CBT on monetary aggregates. A natural by-product was the emergence of exchange rate dominance in the economy manifesting itself in production and pricing decisions and thus leaving a smaller role for interest rates in monetary transmission. However, during the successful disinflation period following the 2001 crisis, the strengthened financial structure of the banking sector,reduced public debt stock with a healthier composition, and the increased confidence in the domestic currency has led to a decrease in the degree of dollarization in a broad sense (Figure 3.3).[4] Consequently, the economy is now less vulnerable to exchange rate shocks.

Figure 3.3

Dollarization indices for Turkey[1]



[1] For more detailed information on the subject and the methodological explanations, see Akıncı et al (2005).

Exchange rates and economic activity: demand vs supply side effects

Apart from its conventional impact on aggregate demand via foreign trade, the exchange rate has the fastest channel of transmission owing to its effects on key variables such as expectations, the risk premium, firms' balance sheets, production costs, and prices in Turkey. The existence of supply side effects – operating mainly through cost and balance sheet channels – may give rise to non-conventional relationships.

A historical glance at the relationship between the real exchange rate and business cycles in Turkey clearly shows that appreciation periods coincide with solid expansion phases whereas strong depreciation episodes are associated with recessions. This comovement can

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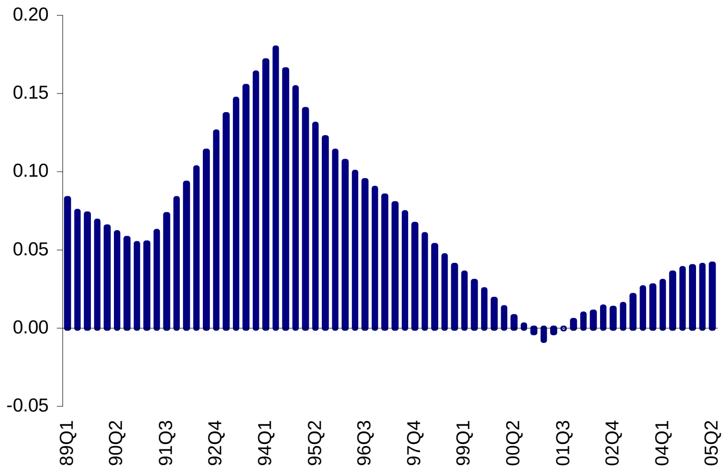
[4] While the figure displays a big jump in the liability dollarization index in the aftermath of the 2001 crisis, this jump is not accompanied by the asset dollarization index. The former index consists of the real sector's share of FX-denominated credit to total credit, the share of FX-denominated government debt in domestic debt stock, and the government's foreign debt to GDP ratio. The asset dollarization index, however, shows the share of FX-denominated domestic assets (government securities) and bank deposits in households' total portfolio. The value of all financial instruments in both indices is converted to YTL at current exchange rates. So, both indices are affected by the strong depreciation of the domestic currency. The reason for the jump in the liability index is twofold. First, the real debt denominated in foreign currency increased following the crisis. Second, the sharp decrease in GDP resulted in a large increase in the government's foreign debt to GDP ratio.

be attributed to the volatile nature of net capital flows, which reflects the intensive use of foreign credit in financing production and investment. A marked characteristic of the Turkish economy has been the sustained appreciation trend of domestic currency accompanied by strong capital inflows, which reduces the YTL value of existing foreign currency denominated loans, thereby increasing the net worth of firms. Here, the balance sheet channel of exchange rate appreciation implies accrued resources to be allocated for further investments and productive activities. However, related to the high weight of imported inputs in the production process, the cost channel also has a boosting impact on economic activity by not only creating an incentive for firms to supply the same amount at a lower price, but also by stimulating domestic demand thanks to the increase in purchasing power and affordability of consumers.[5] On the other hand, a real depreciation of domestic currency exerts pressure on marginal costs and on total economic activity that adversely affects the price level despite enhanced competitiveness resulting from subdued demand channel. A real depreciation may also have adverse balance sheet effects, reducing the net worth of firms and depleting productive resources.

Figure 3.4

Time-varying impact of real exchange rate on output gap[1]

In percentage points



[1] Time-varying coefficient of real exchange rate is estimated through the extended Kalman filter method. For more detailed information on the subject and the methodological explanations, see Kara et al (2007).

Hence, despite the conventional wisdom that a real appreciation is contractionary due to its impact on trade balance, it may turn out to be expansionary by inducing supply side effects in Turkey. Countering impacts of cost/balance sheet effects and competitiveness/demand channel effect are empirically demonstrated by Kara et al (2007). The time-varying impact of the real exchange rate on output gap fluctuates massively for the Turkish economy, while estimated values are positive at each point in time, implying that an appreciation leads to a rise in the output gap and thus a boost in economic activity (Figure 3.4).

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[5] It is worth mentioning that the increase in purchasing power stems from lower prices, whereas the rise in affordability can be attributed to extended credit opportunities with longer maturities and installments. These factors are generally associated with a general improvement in consumer confidence acting as a catalyst in stimulating consumption.

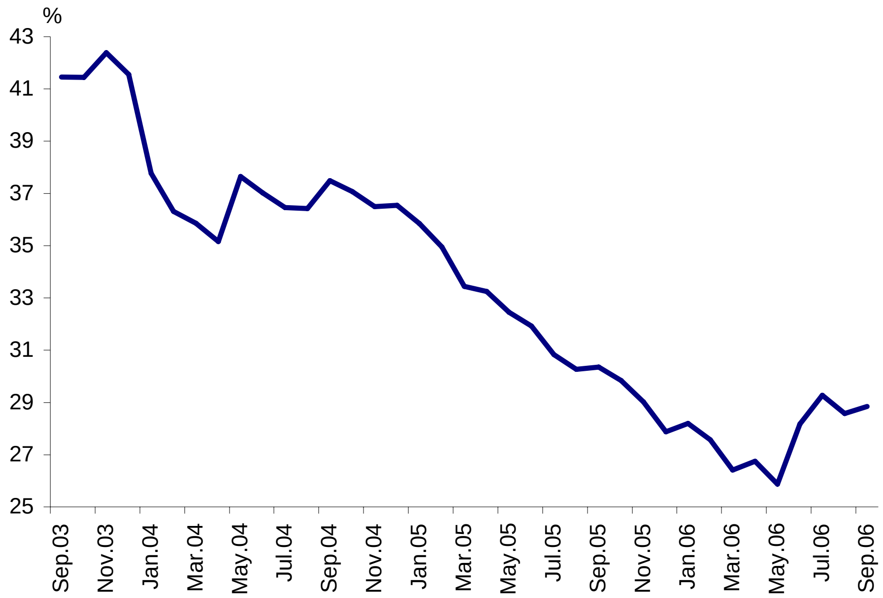
Asset price channel

In order to investigate the asset price channel properly, the first step should be to analyze Turkish households' asset positions. Real estate, YTL deposits, foreign currency deposits and holdings, government bonds, and gold comprise the asset universe in a typical Turkish household portfolio.[6]

The share of households' bank deposits denominated in foreign currency in total deposits has shown a declining trend since the 2001 crisis, although the nominal balance of households' foreign currency deposits is extremely sticky (Figure 3.5). Furthermore, households carry part of their foreign currency in the form of cash, and it is hard to provide an accurate estimate of such "under the mattress" cash holdings.

Figure 3.5

Share of FX-denominated deposits in total deposits



Source: CBT.

The amount of bonds issued by private firms is negligible in Turkey. The share of government bonds and bills denominated in YTL and hard currencies in the possession of households in total outstanding government bonds fluctuates between 10–15 percent (Figure 3.6). The amount of households' government bond holdings was YTL 32.3 billion as of end-September 2006.

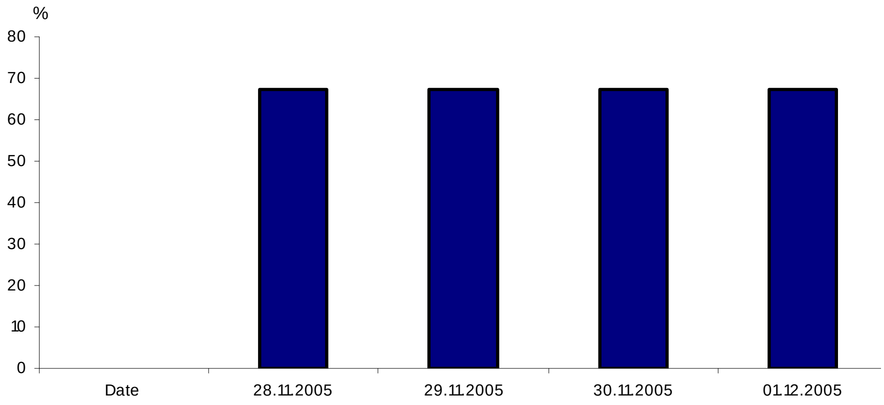
Only a small portion of gold is deposited into bank accounts, so again it is not possible to specify the exact amount of gold held by households.

The Futures and Options Exchange (FOE) became operational in 2005. Currently, only futures on currency, interest rates, stock indices, and some commodities are traded in the FOE. Option transactions will be launched soon. The daily trading volume is low and mostly concentrated on currency futures. Banks are the active players of this market. Households and firms have negligible access to the FOE.

6 Binay and Salman (2006) report that the home ownership ratio in Turkey is quite high at 71.95 percent.

Figure 3.6

Share of government market debt held by households in total government bonds

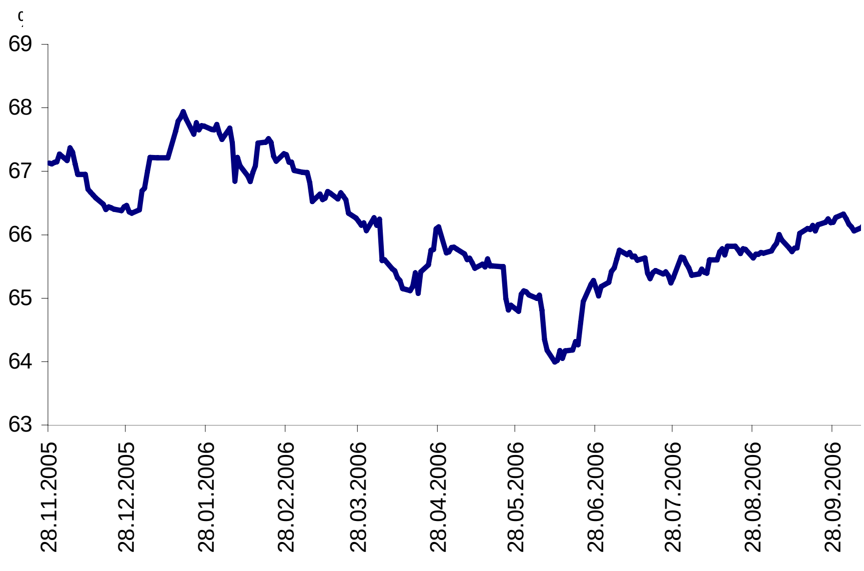


Source: CBT and Undersecretariat of Treasury.

At the beginning of October 2006, the free float market capitalization in the Istanbul Stock Exchange (ISE) was YTL 69.1 billion. On average, foreign investors have been holding 65 percent of the free float market cap in the ISE (Figure 3.7). Banks, brokerage houses and some affluent investors hold the majority of the remaining portion. Equities have the lowest share in an average household portfolio.

Figure 3.7

Foreign investors' share in free float market capitalization



Source: CBT and ISE.

Wealth channel

(i) Households

Modigliani (1970) models consumption as a function of wealth. Accordingly, an increase in households' wealth in real terms boosts consumption expenditures. Normally, a downward trend in policy interest rates has a positive impact on housing, stock, and bond prices. Yet in a disinflationary period, like the post-crisis episode in Turkey, this mechanism directly increases households' real wealth and consumption appetite. This mechanism also operates via the credit channel, because increased wealth means higher collateral value for further credit.

However, although domestic currency depreciation increases the domestic currency value of FX holdings, households do not consider the depreciation as a real increase in their wealth because of the relatively high level of pass-through, especially to consumer durables. Furthermore, hard currencies as well as gold are traditionally viewed as insurance against inflation and domestic currency depreciation.

Therefore, households consider hard currency holdings as an instrument for portfolio diversification. The amount of FX credit of households is negligible. So it is not possible to associate a trend of domestic currency appreciation with a real increase in households' wealth.

(ii) Firms

The exchange rate is an asset price prominently influencing the transmission mechanism through non-bank firm liabilities that are of considerable amount. So, the perception of a sustained domestic currency appreciation decreases firms' debt burden in YTL terms, which strengthens these firms' cash flows and equity positions, releasing funds for further investment.

Kesriyeli et al (2005) claim that firms match the currency composition of their debt with their income streams only partially, which makes them potentially vulnerable to negative balance sheet affects of real exchange rate depreciation shocks. Consistent with this argument, real exchange rate depreciations are found to be contractionary, in terms of investments and profits, for sectors with higher liability dollarization.

4. Credit channel

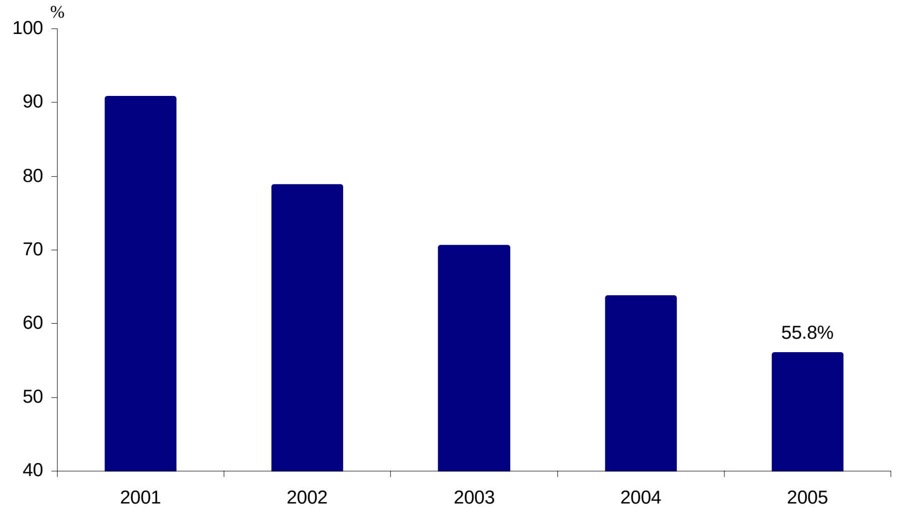
In Turkey, retained earnings and savings are the foremost sources of financing business and household investments, respectively. Years of high real interest rates and budget deficits have led banks to credit rationing, if not to disintermediation. While small and medium-sized enterprises (SMEs) and households take the brunt of financial instability and scarcity of long-term funds with reasonable interest rates, large firms have relatively easy access to bank credit.

Yalçın et al (2005) provide evidence for the above-mentioned stylized facts. They state that whereas large firms' utilization of bank credit surpasses that of small firms, the latter group heavily depends on trade credit to finance their operations.

These conditions have been alleviated after the 2001 crisis. In the post-crisis period, the government has been committed to a primary surplus as high as 6.5 percent of GDP. Structural reforms enabled the government to control expenditures and supported sustainable growth. Also, low interest rates in advanced economies such as the US, the Euro area and Japan, and high economic growth rates around the globe, resulted in liquidity abundance in emerging markets (EMs). Additionally, expectations regarding Turkey's accession to the EU attracted sizeable portfolio and FDI flows to Turkey, which created an appreciation pressure on the local currency. As a result, the net government debt/GDP ratio displayed a remarkable decline (Figure 4.1). These factors exercised downward pressure on real interest rates and boosted the supply of loanable funds.

Figure 4.1

Net government debt/GDP

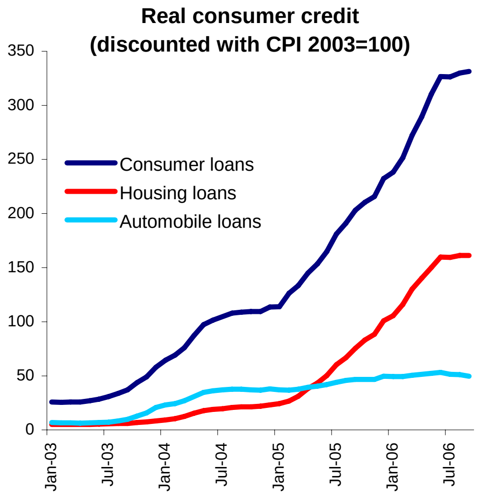


Source: Undersecretariat of Treasury.

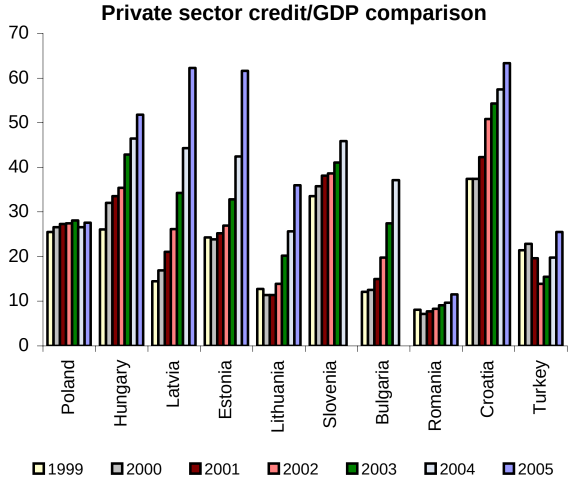
In the post-crisis period, the bank credit to GDP ratio picked up.[7] Consumer credit increased more rapidly than firm credit. As a subcategory under consumer credit, housing loans showed the most rapid increase (Figure 4.2, left-hand panel). However, the private sector credit to GDP ratio is still low in international standards (Figure 4.2, right-hand panel).

Figure 4.2

Consumer loans and private sector credit use



Source: CBT.



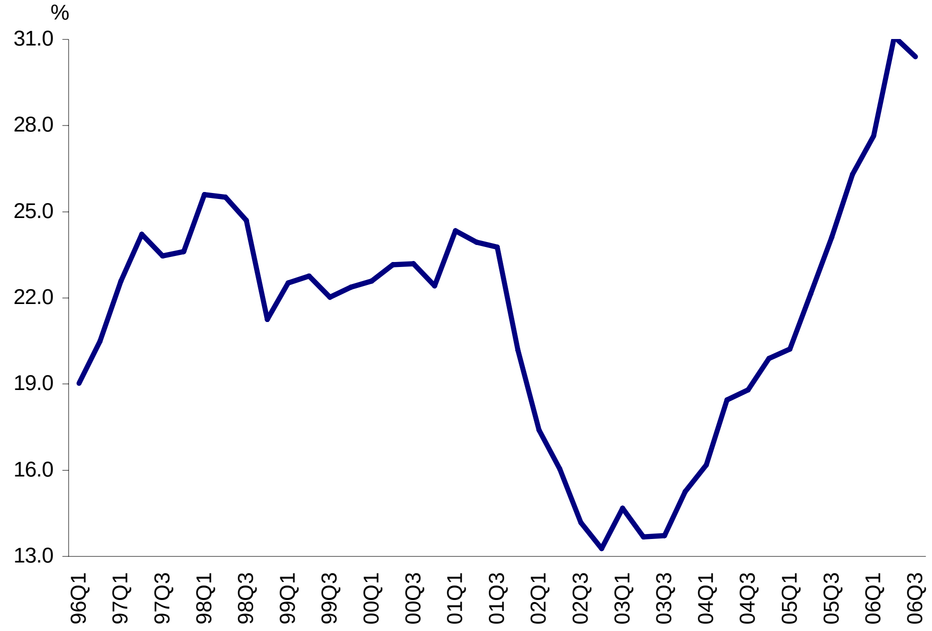
Source: IFS.

[7] For more detailed information on the subject, see Başçı (2006).

YTL-denominated corporate bonds have been issued since August 2005. Corporates' inability to extensively tap the local debt market has contributed to the strengthening of the bank lending channel in Turkey. All these developments have led banks to revert back to their traditional role of financial intermediation instead of financing government expenditures. As a result, the ratio of private sector credit used by households and firms to GDP has rapidly increased (Figure 4.3).

Figure 4.3

Private sector credit/GDP



Source: CBT.

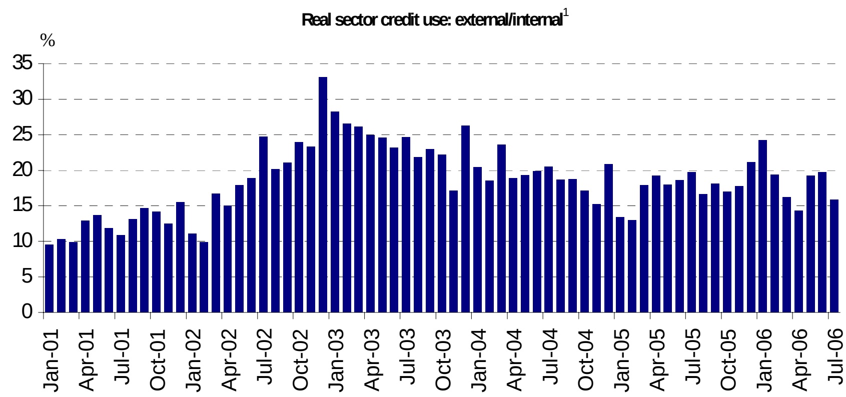
The bank lending channel in Turkey operates through two sub-channels.

Balance sheet channel

In Turkey, real sector firms have been borrowing not only from the Turkish banks, but also from abroad in terms of foreign currency (Figure 4.4). So, the appreciation of the domestic currency decreases the real value of existing foreign currency denominated liabilities when converted to domestic currency. The resulting lower levels of liabilities increase firms' debt absorption capacity. Thus, a perception of sustained currency appreciation may lead to an increase in demand for FX credit.

Figure 4.4

Credit from abroad vs from Turkish banks



[1] External credit refer to the sum of trade and other credit to the private sector, collected from balance of payments statistics. Internal credit are those extended to the real sector by domestic banks. Source: CBT.

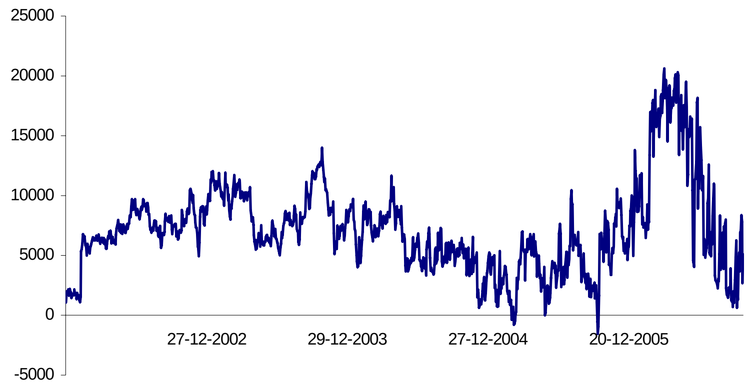
Loan supply

Among the factors increasing the supply of loanable funds, one is peculiar to Turkey. The Turkish banking sector has been operating in a Turkish lira liquidity surplus environment since October 2001 (Figure 4.5). The CBT has been mopping up the excess liquidity on a daily basis. There are also weekly or bi-weekly open market operations (OMO) that are used in exceptional cases.

Figure 4.5

Daily liquidity surplus in the money market

Millions of YTL



Source: CBT.

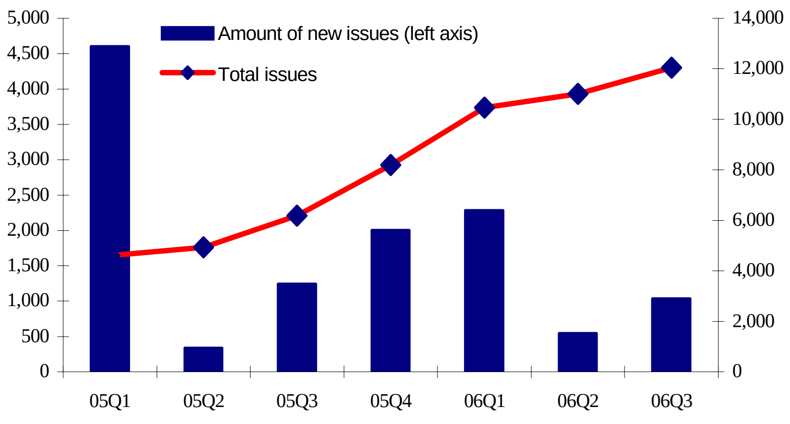
Another source of funds increasing loan supply is the over-the-counter (OTC) swap market in London. Specifically, cross-currency swaps, where Turkish banks make interest payments in YTL to the counterparty during the maturity of the contract, have the largest volume, and the most heavily traded contract has a maturity of five years. At the outset of the contract, Turkish banks pass hard currency to the counterparty in order to receive YTL. The emergence of this market has increased the capacity of Turkish banks to provide long-term housing loans denominated in YTL.

The YTL-denominated bond issues of foreign banks and financial institutions with high credit ratings have enabled the proper functioning of the swap market since the beginning of 2005. The outstanding amount of the total face value of such bonds reached YTL 10.9 billion as of end-September 2006 (Figure 4.6). Cross-currency swaps remedy the currency and maturity mismatch problems between assets and liabilities.

Figure 4.6

Amount of YTL-denominated bonds by foreign banks

Millions of YTL



Source: Reuters.

Loan demand

A stronger interest rate channel leads consumption and investment decisions to respond to real interest rates. The May–June 2006 financial turmoil is a good example of the fall in consumer loan demand growth in face of a sharp rise in interest rates (Table 4.1). High real interest rates not only bring about tighter budget constraints, but also increase the probability of financial distress that may lead households and firms to refrain from taking out new loans.

Table 4.1

Recent developments in consumer loans

3-month real percentage change

	2005Q2	2005Q3	2005Q4	2006Q1	2006Q2	2006Q3
Consumer loans	23.4	23.3	18.6	18.7	24.3	3.2
Housing loans	61.9	50.6	38.1	30.8	27.2	2.6
Automobile loans	11.7	11.4	9.9	3.2	8.9	–4.8
Other loans	11.7	11.3	5.3	13.1	28.7	7.8
Credit cards	8.4	6.3	6.0	3.2	10.6	3.8

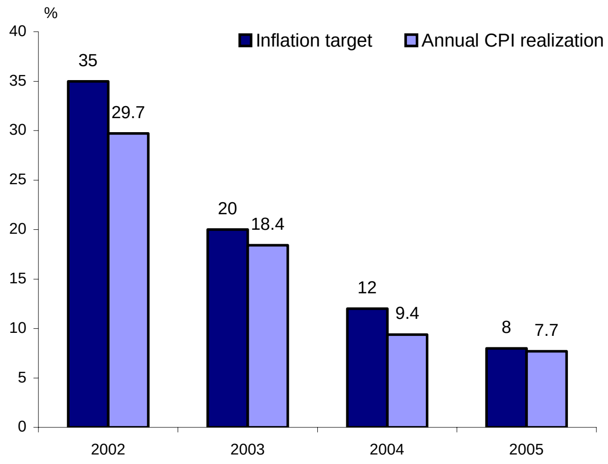
Source: CBT.

5. Expectations channel and communication

The current literature on monetary policy emphasizes the critical roles of policy commitment to a rule and agents' beliefs in the policy commitment for correct functioning of the expectations channel. In order to stress the importance of the expectations channel, Woodford (2001) states that economic agents' anticipation regarding both the policy action and its effects leave a smaller role for interest rate adjustments. Under a credible monetary policy, commitment to raise interest rates in response to inflationary pressures is sufficient for forward-looking economic units to bring about the required contraction in aggregate demand. However, in a chronically high and persistent inflation environment, agents tend to form their expectations in a backward-looking manner. The strong weight of habits in expectation formation acts as a brake in aligning expectations with targets, restricting the disinflationary ability of the policy instruments. Therefore, prior to transition to the explicit inflation targeting regime, maintaining a track record was the key to bringing the misalignment between inflation expectations and targets down to reasonable levels. From this point of view, the outstanding disinflation performance for four consecutive years contributed to the credibility accumulation of the CBT (Figure 5.1).

Figure 5.1

Inflation targets and realizations



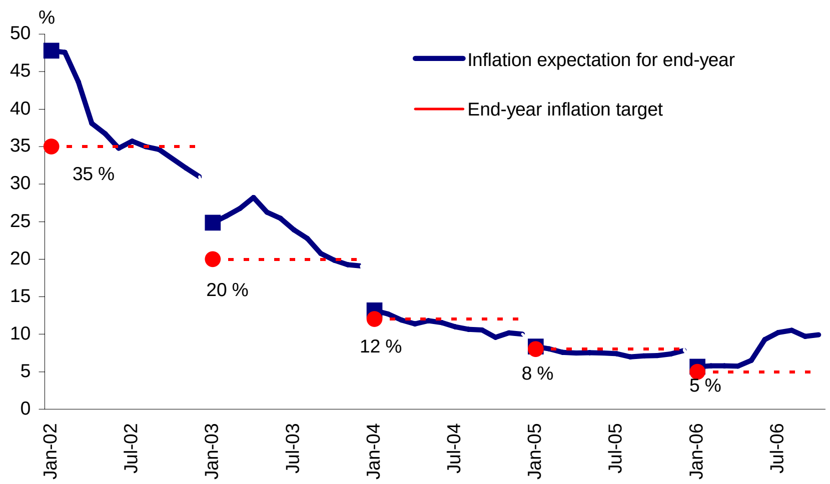
Source: TURKSTAT.

Building up credibility, increasing predictability and enhancing expectations management

The potency of monetary policy – through both the policy instrument and other communication tools such as inflation reports and press releases – in shaping expectations is a crucial element for the success of the inflation targeting regime. For the Turkish case, the poor track record with unsuccessful stabilization programs handicapped the persuasive power of the monetary authority during the early phases of implicit inflation targeting. Besides, expectations were so sensitive to developments on the fiscal front that concerns on debt sustainability acted as a major obstacle against independent monetary policy-making. In this section, the discussion on the evolution of the expectations channel after the transition to inflation targeting focuses on two main aspects, namely the improvement in both the speed of convergence of expectations to policy targets and the practicability of policy rate hikes.

Figure 5.2

Credibility gap



Source: CBT.

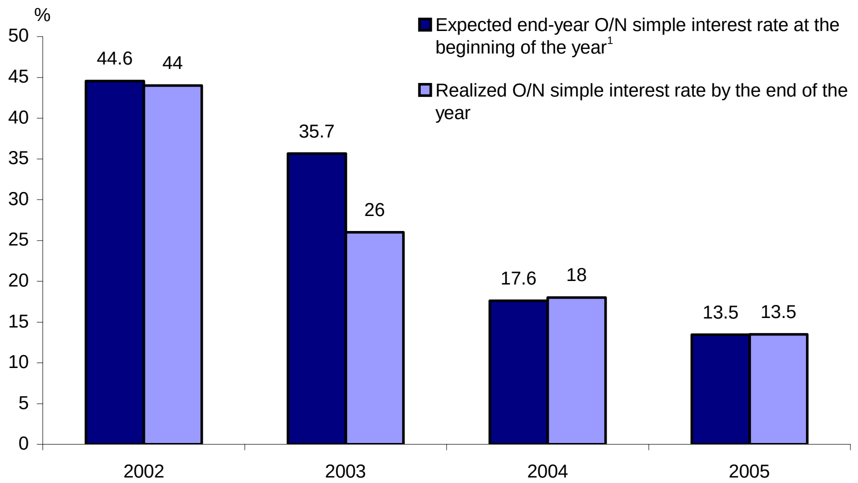
The credibility of predetermined inflation targets bears importance in providing the benchmark for forward-looking contracts including wage negotiations in the economy. However, chronically persistent and high inflation in Turkey had been a serious hindrance to the credibility of the targets at the start of inflation targeting implementation. The credibility gap, measured by the difference between the inflation expectations at January for end-year and the target, clearly demonstrates the initial distrust of economic agents towards policy goals (Figure 5.2). The expectation at the beginning of 2002 was almost 13 percentage points above the end-year target of 35 percent, while the misalignment could only be eliminated in mid-year thanks to good news on the actual inflation figures.

While the CBT builds up credibility owing to achievements in meeting inflation targets, the progress in public understanding of CBT actions has also been crucial for proper functioning of the expectations channel. Securing the alignment of expected policy moves with respect to policy actions is desirable for a central bank aiming at increasing the efficiency in expectations management. For the Turkish case it can be argued that, as agents have been more precise about the policy perspective and correctly interpret the signals of the monetary authority, they have become able to make more accurate predictions about the future path of the policy rate (Figure 5.3).

Besides the remarkable pace in credibility accumulation, the recent practice of policy rate hikes has signified the independence of monetary policy conduct from concerns about debt dynamics. At this point, it would be useful to examine the impact of the latest financial turbulence on inflation expectations and the subsequent policy reaction of the CBT. Starting from May 2006, the reversal of global liquidity conditions triggered capital outflows from many emerging markets includingTurkey, which had been encountering a number of supply shocks that led inflation to surpass the upper limit of the uncertainty band around the target path at that time. Along with the shift in overall market sentiment, Turkey witnessed a rapid deterioration in the credit risk premium and strong depreciation during May and June 2006.

Figure 5.3

Predictability of CBT rate



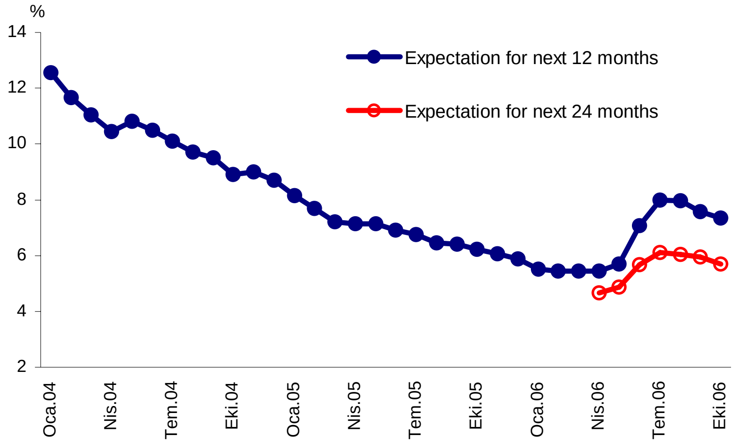
[1] Expectation at March for end-year interest rate.

Source: CBT.

The high-rated depreciation of the domestic currency led to a deterioration in inflation expectations starting in May (Figure 5.4). The inflation expectations for the next twelve months increased by almost 2.5 percentage points from April to July and reached 8 percent. Furthermore, the 24-month-ahead expectations worsened by around 1.5 percentage points in the same period and became 6 percent as of July. Furthermore, the deterioration in inflation expectations also manifested itself as a worsening in their distributional properties, with vanished normality and an increase in the degree of skewness and number of outliers, reflecting a rise in inflation uncertainty (Figure 5.5).

Figure 5.4

Inflation expectations



Source: CBT.

Table 5.1

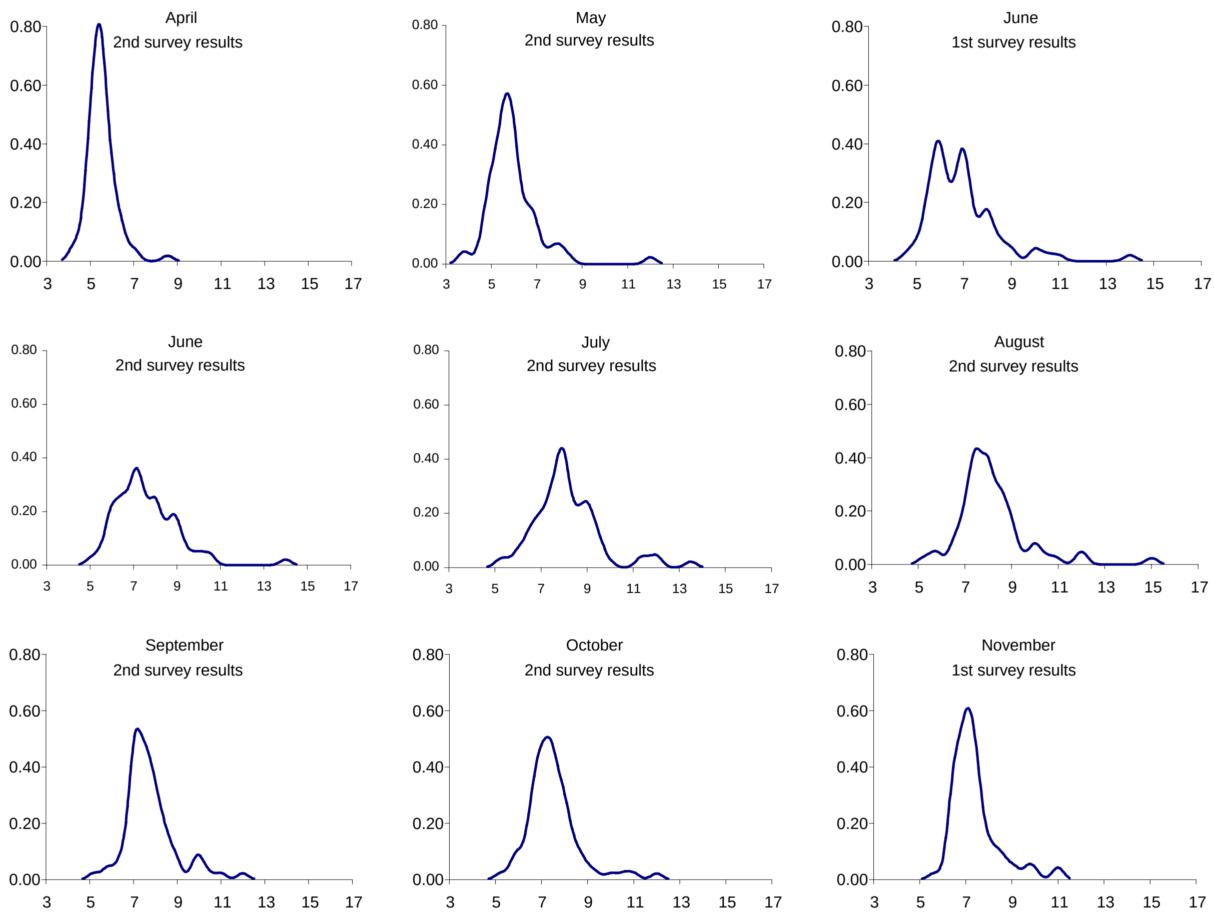
Monetary policy actions in 2006

Dates for MPC meeting	Decision on interest rate	Interest rate
January 23, 2006	No change	13.50
February 23, 2006	No change	13.50
March 23, 2006	No change	13.50
April 27, 2006	–0.25	13.25
May 25, 2006	No change	13.25
June 7, 2006(1)	+1.75	15.00
June 20, 2006	No change	15.00
June 25, 2006(1)	+2.25	17.25
July 20, 2006	+0.25	17.50
August 24, 2006	No change	17.50
September 26, 2006	No change	17.50
October 19, 2006	No change	17.50

Source: CBT.

Figure 5.5

The distribution of twelve-month-ahead inflation expectations[1]



[1] Horizontal axis shows inflation rate; vertical axis indicates Kernel forecast.

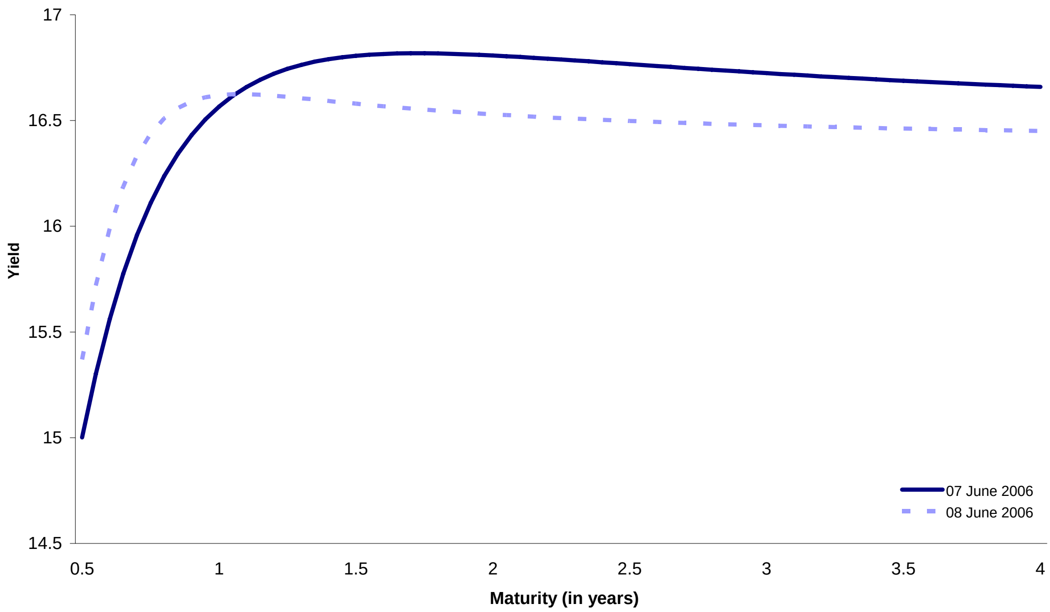
Source: CBT.

Therefore, not only the upsurge in inflation expectations, but also the dispersed structure in their distributional pattern, called for an immediate policy response. In this circumstance, the CBT reacted decisively with two policy rate hikes in the June extraordinary meetings (Table 5.1). In this way, the CBT explicitly demonstrated its commitment to the medium-term inflation targets and stiffened its reputation in the fight against inflation. The policy reaction has been successful in bringing inflation expectations down starting from July, and expectations seem to have converged to a normal distribution as of November, albeit with a higher mean compared to the pre-volatility period (Figure 5.5).

A similar phenomenon can be observed in the response of market interest rates to the policy reaction. The monetary tightening on June 7, 2006, when the CBT raised the short-term policy rate from 13.25 to 15, showing decisiveness in the struggle against inflation, has been successful in reducing long-term bond yields mainly due to improved medium-term inflation expectations (Figure 5.6).

Figure 5.6

Yield curve response to recent policy tightening[1]



[1] For more detailed information on the subject and the methodological explanations, see Akıncı et al (2006).

Based on the recent evidence, interest rate-exchange rate-inflation expectation spiral, which was historically driven by debt dynamics, has vanished to a great extent, and markets have full confidence that the CBT would not abstain from further monetary tightening when necessary. This points to the rise of a new era for monetary policymaking in Turkey, in which the vicious cycle of fiscal dominance no longer prevails and any rate hike under inflationary pressures is perceived as a proper policy measure to bring the economy back to the desired path. Hence, it can be argued that the flexibility of the policy instrument in expectations management has improved considerably.

6. Globalization and monetary policy in Turkey

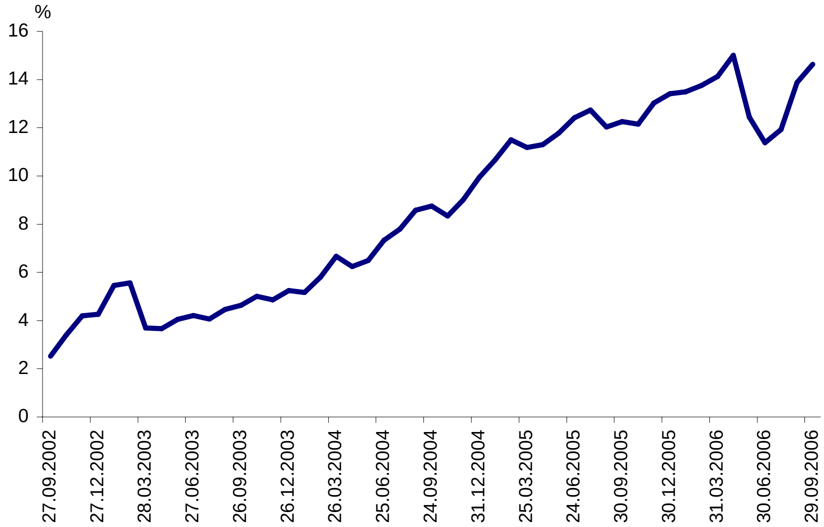
The challenges and opportunities of globalization

Bond holdings of foreigners exhibited an upward trend after the 2001 crisis (Figure 6.1). In the recent May–June 2006 turbulence, bond holdings of foreign investors declined sharply, whereas their stock portfolio displayed an immaterial change. As a result, both the interest rates and exchange rates increased sharply in a very short period of time.

As exemplified by the May–June 2006 episode, globalization is a challenge to monetary policy through at least two channels. First, it accentuates the role of the exchange rate channel. A sharp deterioration in risk appetite resulting in a sizeable portfolio outflow may pose the threat of deteriorating both current and expected inflation. Second, the control of the monetary authority over aggregate demand via controlling interest rates declines, as the risk of depreciation of the domestic currency results in a high and volatile risk premium. As a result, this blurs the monetary policy stance because judging the neutral rate of interest becomes more challenging.

Figure 6.1

Share of foreign investors in government bonds



Source: CBT.

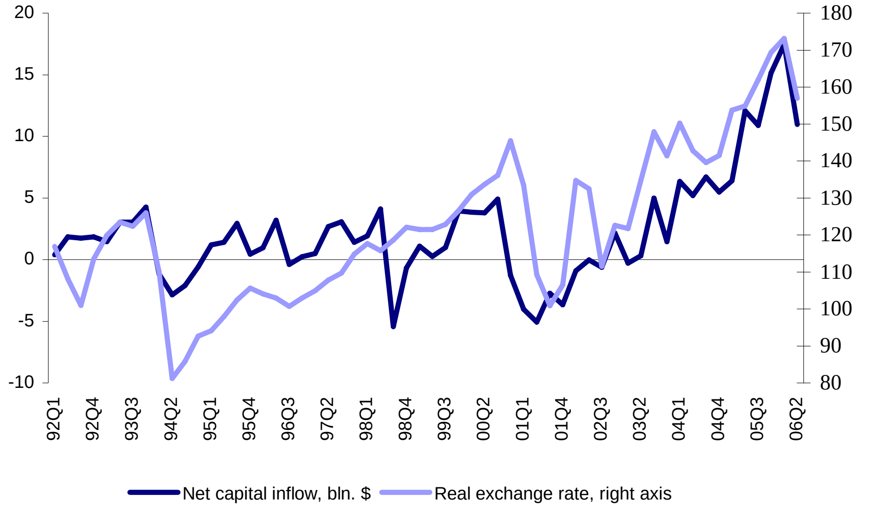
Openness and financial integration vs independent monetary policy

As real and financial sector interdependence among economies develop further, the exchange rate channel deserves more attention as a shock transmitter. Calvo and Mishkin (2003) draw attention to the dependence of emerging market economies on capital market developments in large economies, and consider it as a major practical difficulty for domestic policymaking. In this context, as emphasized by Moron and Winkelried (2003), a common feature of emerging markets distinguishing them from developed countries is their inability to smooth out large external shocks, which are mainly characterized by sudden capital outflows. As an outcome, interest rates may fluctuate in line with external developments, restricting the effectiveness of policy actions.

Moreover, in parallel with the progress in financial openness and innovations in financial markets, integration among economies goes far beyond the degree of trade openness. Although an increased presence of domestic financial instruments in international markets may be expected to reduce financial vulnerability through an efficient reallocation of risks, hedging behavior remains at an early phase of development in emerging markets, which may still encounter risky positions regarding the balance sheets of both real and financial sectors. While these factors increase the sensitivity of these economies to capital flows, the most striking upshot for Turkey is that the volatile nature of capital flows tends to shorten the duration of business cycles and complicate the conduct of monetary policy (Figures 6.2 and 6.3).

Figure 6.2

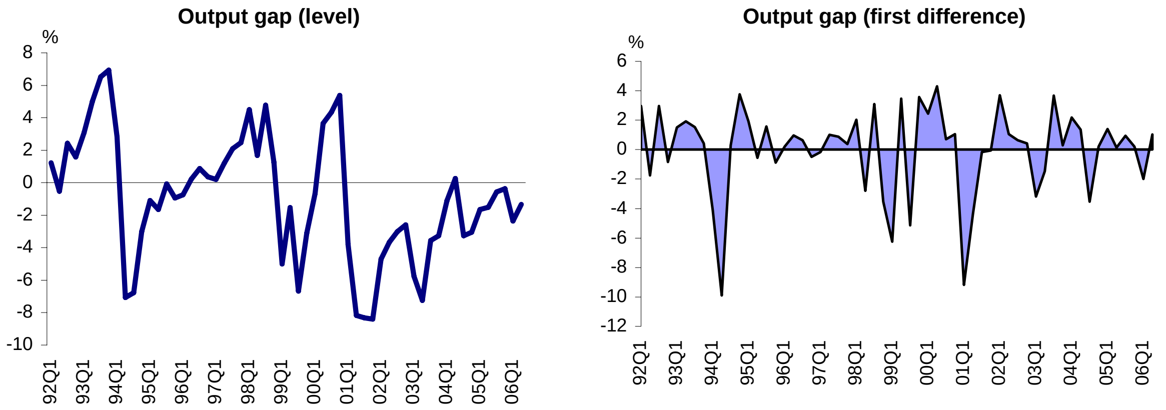
Capital flows and real exchange rate



Source: CBT.

Figure 6.3

Business cycle in Turkey: output gap



Source: Kara et al (2007).

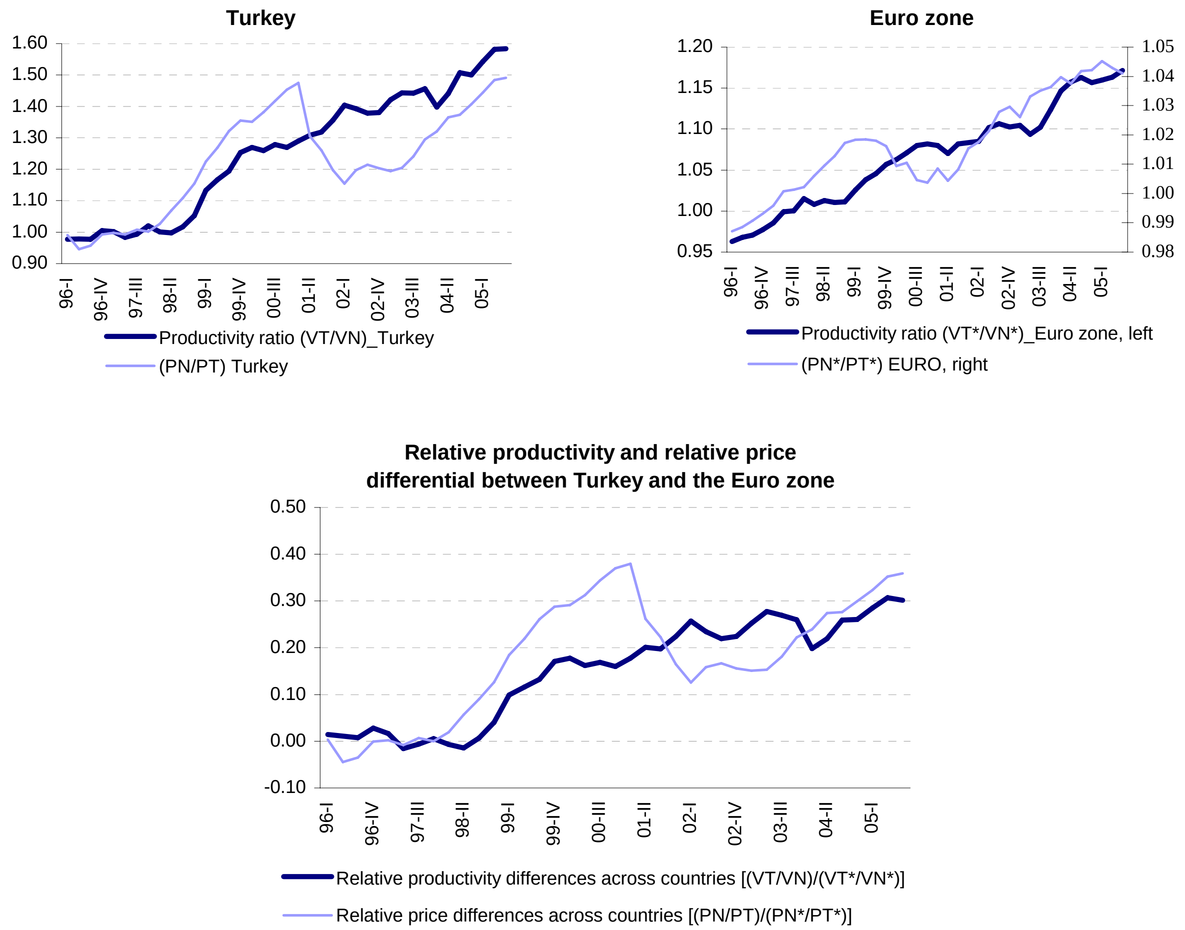
EU convergence: productivity, relative price differentials, and real exchange rate

Beyond the impact of financial integration, recent trends in exchange rate behavior in Turkey have their roots in the dynamics of EU accession process. Recognizing the experiences of developing countries in the process of convergence with the EU, the sustained appreciation trend of the YTL over the last couple of years can be partly attributed to these dynamics.

As hypothesized by Balassa (1964) and Samuelson (1964), economic theory puts international productivity differentials in the foreground, in explaining prolonged episodes of appreciation of the real exchange rate. The Balassa-Samuelson effect explains a significant part of sustained real exchange rate appreciation observed in EU accession countries. As a new accession country, Turkey's economy has been following a similar pattern in recent years. The simultaneous occurrence of the real appreciation trend of the YTL and the price differential between tradable and non-tradable goods points to the need for a closer analysis of the sources of this relation. Rapid productivity growth has been contributing to this process in Turkey. The role of relative productivity growth may be significant in the relative price differential between tradables and non-tradables. Although this link seems to be broken by the effect of the 2001 crisis, the comovement of relative productivity and relative prices has been significant recently. Therefore, it can be argued that productivity developments have been playing a considerable role as a driving force of relative price differential and real exchange rate behavior in Turkey (Figure 6.4).[8]

Figure 6.4

Productivity and relative price differentials among tradable and non-tradable sectors



Source: ECB, CBT, and TURKSTAT.

At this point, it would be useful to mention that the link between productivity and real exchange rate represents a feedback relation in Turkey, rather than a one-way causality. Real appreciation also has a stimulating impact on investment demand, by inducing relatively cheaper imported capital goods, which in turn adds to the labor productivity in tradables

[8] Needless to say, the price differential between tradable and non-tradable goods cannot be totally attributed to productivity developments. For a more detailed discussion, see CBT's April 2006 Inflation Report, Box 3.1, pp 31–34.

through capital deepening. Thereby, real exchange rate appreciation is observed to generate its own inertia through a multiplier effect.

7. Summary and concluding remarks

The transition to the inflation targeting regime in Turkey has put short-term interest rates in the forefront in demand and expectations management. Besides the new role assigned to interest rates, the ongoing improvement in economic fundamentals subsequent to the regime shift has supported the increased effectiveness of monetary policy. Moreover, weakened fiscal dominance and dollarization, and diminished exchange rate pass-through to prices, have enhanced the effectiveness of monetary policy.

The May–June 2006 turbulence subjected monetary policy to scrutiny, and the CBT displayed its decisiveness in fighting inflation. As a result of interest rate hikes, credit use decelerated, economic activity slowed down, inflation expectations improved, and the domestic currency appreciated. The monetary tightening brought about the desired effects, which show the strengthened role of monetary policy in determining key macroeconomic variables.

The CBT has managed to align inflationary expectations towards its target, as evidenced by the narrowing credibility gap. Improved communication channels enable the CBT to reach its target with relatively less fluctuation in output compared to a state of high positive credibility gap.

The increased integration of global financial markets renders monetary policy a more challenging task, especially for a small open inflation targeter like Turkey, as it makes the Turkish economy more vulnerable to data disseminated by large open economies, particularly the US and the Euro area. However, financial integration accelerates economic reforms, transparency, and communication efforts.

There are also some domestic challenges for monetary policy in Turkey. Despite their declining trend, the levels of asset and liability dollarization indicate that more efforts are needed to further improve the store of value function of the domestic currency as well as the degree of risk awareness of the economic agents.

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The differential impact of real interest rates and credit availability on private investment: evidence from Venezuela

Omar A Mendoza Lugo[1]

1. Introduction

Private spending on fixed capital goods has been an important topic of discussion among economists and policy makers. The influence of investment on growth and its volatility contributing to business cycles justify this focus. Recent empirical research has evaluated the effects of economic reforms, especially financial reforms, on capital formation and growth in developing countries. This issue sheds light on the link between financial and real variables. In traditional theory, this link is given by means of the real interest rate. However, credit may also have a direct effect on real variables by affecting consumption and investment when asymmetric information and/or excessive government intervention characterize the financial market.

In the 1970's, some economists, led by McKinnon (1973) and Shaw (1973), began to argue in favor of financial liberalization as a medium of promoting saving, investment, and growth. This was based on the argument that real interest rates are frequently negative in developing countries due to administrative controls on the nominal interest rates and heavy regulation in the financial market. This argument implies that real interest rates have a net positive effect on private investment, contradicting the traditional view of a negative relationship between private investment and real interest rates. Nevertheless, the financial liberalization literature argues in favor of higher interest rates due to what was observed in developing economies at the time, and the possibility of a negative relationship between investment and interest rates was not ruled out. McKinnon (1973) argued that in those countries where self-finance is very important and the interest rate is negative or very low, an upward increase in real deposit rates encourages saving (the substitution effect dominates the income effect) and the substitution from goods to bank deposits. Both have positive effects on private investment because self-financed investment rises and because there is a rise in the availability of funds to finance any profitable investment project. However, at higher rates, economic agents would prefer to hold deposits that yield a higher return than investment in physical capital. Therefore, at high rates, investment and real bank rates are expected to be negatively related. Hence, McKinnon's arguments imply a nonlinear relationship between real interest rates and private investment.

Furthermore, private investment can be nonlinear in credit availability (Günçavdı et al (1998)). That is, if we expect that credit constraints are present at all levels of interest rates, then when the effect of an increase in the real interest rates in the loan supply is higher than the costs brought about by higher rates due to asymmetric information problems, a decrease in the sensitivity of private investment on credit availability at higher rates should be expected as well.

Investigating the effects of financial factors on private investment, especially the role of interest rates, constitutes an important issue for developing countries where economic

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authorities in general believe that real interest rates play an important role in investment decisions and therefore on growth. In particular, the current Venezuelan government emphasizes the need to lower interest rates to encourage private investment. However, Venezuela is one of the countries that has maintained, on average, low real interest rates in recent years (see Mendoza Lugo (2001), Appendix A, Tables A.1 and A.2), with long periods of negative real rates and with periods of administrative control and decontrol on the nominal interest rates.

To investigate the nonlinear relationship and, therefore, the differential impact of real interest rates and credit availability on private investment, we use Venezuelan quarterly data for the period 1983:1–2000:4. The variables used in this study, besides private investment, are bank lending real interest rates, bank loans to the private sector as an indicator of credit availability, public investment and real gross domestic output generated by the private sector or private GDP. All these variables are, in principle, treated as endogenous, but the main focus is given to private investment spending. In addition to the mentioned variables, some dummy variables are taken into account to control for special events, structural economic reform and seasonality. Since we are interested in a model specification where the variable defining the states of the economy is known, the proposed econometric model is a logistic smooth transition vector error correction (LSTVEC) model, which is a generalization of the smooth transition regressive (STR) models proposed by Granger and Teräsvirta (1993).[2]

We estimate a LSTVEC model for private investment and its determinants with lagged values of DLCREDIT explaining the states of the economy in four of the five equations considered in this study.[3] To estimate the LSTVEC model, we use as a benchmark a linear specification, namely a subset or restricted in coefficients VEC model, and follow, with some modifications, the procedure recommended by Granger and Teräsvirta (1993) to estimate a STR model. From the LSTVEC model, generalized impulse response functions are constructed (Koop et al (1996), Weise (1999)) to explore, especially, the effects of positive and negative shocks to the real interest rate and credit availability on private investment when facing credit contractions or expansions. The impulse responses show evidence for asymmetric effects of shocks of the growth rate of these financial variables to the growth rate of private investment. However, these asymmetries are not totally in line with the predictions of the financial liberalization theory.

Section 2 summarizes some theoretical issues and empirical evidence reported in the literature with special focus on developing countries. However, it is not our purpose to present an exhaustive survey of the literature, but merely present a review of results of previous research that support and allow for comparison to the results of this research. Section 3 presents the data. Section 4 introduces a smooth transition specification for a VEC model with special emphasis on the modeling of a nonlinear private investment function. Section 5 is related to the estimation procedure and presents the results. Section 6 shows the impulse response functions on the growth rate of private investment (DLPRIVINV) to shocks on the five endogenous variables considered in the study. Finally, Section 7 presents the conclusions.

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[2] The STR models belong to the category of regime-switching models. Among the regime-switching models, two general categories can be distinguished. They are: (1) the smooth transition regressive (STR) models (the threshold models are a particular case of this category), which assume that the variable defining a regime or state of the world process is observable; and (2) the switching regression models, which assume that the regime is not known with certainty but some probabilities of its occurrence can be assigned. Franses and van Dijk (2000) discuss the properties and applications of these two categories in modeling financial variables.

[3] Even though the linearity test indicates that the equation for the growth rate of private GDP is nonlinear when the transition variable is the growth rate of public investment lagged four periods, a satisfactory nonlinear equation was not found. Therefore, the specification of this equation is assumed linear.

2. On the determinants of private investment in developing countries

Some economists argue that when studying investment in developing countries, special features not accounted for in traditional theories of investment should be considered. Agénor and Montiel (1999, pp 97–99) list six of those factors. First, financial variables may influence private investment because of underdeveloped financial systems and financial repression. Second, foreign exchange rationing and the exchange rate in the free market may influence investment decisions because of the importance of imported capital goods. Third, due to their importance in the production process in developing countries, imported intermediate goods should be taken into account in the specification of relative prices. Fourth, debt overhang inhibits investment because of the possibility of higher taxes to finance future debt service. Fifth, public investment has played an important role in the process of capital formation in developing countries. It may have a positive or negative effect on private investment depending on whether public investment is complementary to or a substitute for private investment. And sixth, macroeconomic instability and its resulting uncertainty, which have characterized developing countries, may have an important effect on private investment. Despite the understanding that all these elements may be important determinants of investment, the present study focuses on the first and fifth issues; that is, this research is basically limited to the role of financial factors, credit availability and interest rates as determinants of private investment. Public investment is considered in the analysis because it may affect private investment by means of its effects on financial variables as well as its direct effect by means of positive externalities enhancing the productivity of the private sector. In addition, gross domestic product and economic reform policies are taken into account because they have been found in previous research to be important determinants of private investment. Further, these two variables might play an important role in understanding private investment spending in the presence of asymmetric information and the transition from a heavily regulated economy to a more market-oriented economy.

2.1 Real interest rates as a determinant of private investment

The effect of real interest rates on private investment spending was first formalized in an investment equation by Jorgenson (1963), who derived the desired stock of capital as a function of real output and the opportunity cost of capital. In this approach, known as the neoclassical approach, a representative firm maximizes the present value of its future cash flows. The desired capital stock is directly related to output and inversely related to the cost of capital. A decrease in the real interest rate lowers the opportunity cost of capital and, therefore, raises the desired capital stock and investment spending.

Other literature, emphasizing the role of financial markets on capital formation (McKinnon (1973); Shaw (1973); Fry (1988)) includes suggestions that an increase in real interest rates has a positive effect on the volume and on the quality of investment in financially repressed economies.[4] The former effect is seen because self-finance is important and investment is lumpy. Then, the economic agents must accumulate resources before any investment project is executed. An increase in real interest rates thus stimulates both total and financial savings and, consequently, investment. The latter effect, improvement in the quality of investment, occurs because a higher interest rate will rule out investment projects with low productivity. At the same time, higher rates move resources from less efficient (eg goods facing some

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4 Financial repression is defined as high intervention by the government in the financial markets by setting ceilings on nominal interest rates, imposing high legal reserve ratios, and direct intervention on credit allocation.

depreciation) to more efficient forms of accumulation (eg bank deposits with a more favorable return).[5]

In particular, McKinnon (1973), when explaining the link between interest rates, money and investment, suggests a nonlinear relationship between the real interest rates on deposits and the rate of private investment. When the real return to money is lower than the average real return to physical capital, a further increase in money returns induces the accumulation of cash balances to finance a significant number of investment projects. But at higher interest rates, more economic agents may prefer to hold money rather than finance investment projects because money offers a higher return than their investment possibilities in physical capital. Therefore, one expects to find a positive (negative) relationship between these two variables at low (high) returns holding the average return to physical capital constant.

McKinnon's investment equation is given by

$$\frac{I}{Y} = F(r, d)$$

with, $\partial F / \partial r > 0$ and $\partial F / \partial d \underset{<}{\overset{>}{-}} 0$ if $d \underset{>}{\overset{<}{-}} r$. Where I denotes private investment, Y is output, r is the average return on physical capital, d is the real return on money, and the last derivative expresses the nonlinear relationship between real interest rates for money and the rate of investment.

Warman and Thirlwall (1994) study the effects of real interest rates on saving, investment and growth. They use data from Mexico for the period 1960–90 to quantify the level effects of low and high interest rates on private investment. They use the following investment equation.

$$I = a_1 + b_1 r + c_1[(r - r^e)D] + d_1 C + d_2 \Delta GDP_{-1}$$

where $b_1>0$, $c_1<0$, $d_1>0$, $d_2>0$.

They specify investment (I) as a function of the real interest rate (r), credit to the private sector (C), the first difference of GDP (ΔGDP), and a term, $(r–r^e)*D$, to capture the non-linearity between interest rates and private investment. r^e is the threshold rate or the border rate between two regimes in which the interest rate affects investment in different (positive and negative) ways. D is a dummy variable taking values of one when $r–r^e$ is positive and zero otherwise.

Under the above specification, Warman and Thirlwall find that the coefficients for interest rates and for the term measuring nonlinearity are very low and statistically insignificant. When a linear relationship is assumed, the real interest rate has an important negative and statistically significant effect on private investment. However, they may have failed to find a nonlinear relationship between the real interest rate and investment because of a misspecified nonlinear investment equation.

A further study of the nonlinearity of investment in financial factors is provided by Günçavdı et al (1998). They argue that after financial liberalization, the investment equation should become more sensitive to the cost of capital and less sensitive to the flow of credit to the private sector because of the relaxation of the credit constraints. Based on the fact that after financial liberalization the real interest rate became positive in Turkey, Günçavdı et al test for structural changes in the coefficients for cost of capital and credit availability in an estimated

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5 Empirical research in general finds a positive but statistically insignificant effect of real interest rates on savings. Bandeira et al (2000) verify that result from previous research in a country by country study for eight developing countries (Chile, Ghana, Indonesia, Korea, Malaysia, Mexico, Turkey, and Zimbabwe).

private investment equation for Turkey. They find that the sensitivity of private investment on credit availability decreases after financial liberalization but they do not find evidence for an increase in the sensitivity of investment on the cost of capital.[6]

Furthermore, some economists argue that when analyzing the effect of interest rate policies in developing countries, the assumption of perfect competition in the banking system is unrealistic because in these countries the banking sector is characterized by a small number of banks. In addition, credit markets face asymmetric information. For example, Demetriades and Luintel (2001) argue that under imperfect competition, mild repression[7] in the lending rates has a positive effect on bank loans. That is, under government intervention with an interest rate fixed below the monopoly equilibrium level, it is optimal for bankers to increase the amount of loans. However, repressing interest rate levels below those that would prevail under perfect competition will likely reduce the amount of loans and consequently have a negative effect in the economy.

Data on interest rates is only available since the eighties or early nineties for most of developing countries; therefore there is not an abundance of empirical work testing the effects of interest rates or the cost of capital on private investment for developing countries. Previous work for developing countries is not only sparse but also shows mixed results for the effect of interest rates on investment spending. For instance, Warman and Thirlwall (1994) show a negative and significant relationship using data for Mexico. De Melo and Tybout (1986) report a negative but statistically insignificant effect using data for Uruguay. Laumas (1990) and Athukorala (1998) find a positive relationship between real interest on deposits and private investment in India. With respect to the relationship between the cost of capital and investment, the relation is found to be negative in Athukorala (1998) but positive in Günçavdı et al (1998) for Turkey.

2.2 Bank lending as a determinant of private investment

When studying developing countries, bank lending to the private sector is an important determinant of private investment due to the banking system's importance as a source of external finance in those countries. That is, bank loans do not have close substitutes. Therefore, a contraction in the bank supply of credit may limit spending financed by credit. If the supply of bank credit is limited by the size of deposits, then a contraction of deposits will contract the supply of credit.

The financial repression literature, or the literature in favor of financial liberalization, takes the special role of the banking system as a source of finance in developing countries into account. When administrative controls are imposed on interest rates, credit is not allocated according to the expected return on the projects, but according to the quality of collateral, loan size, political pressure, and covert benefits to loan officers. With interest rate ceilings, financial institutions do not take risk because higher interest rates cannot be charged. Consequently, many high-yielding projects may face credit rationing (Fry (1988), page 18). An increase in real interest rates encourages deposits and, hence, increases the availability of funds to the private sector to finance investment projects while deterring low-yield projects.

In contrast, the theory emphasizing the role of asymmetric information in financial markets predicts that an increase in interest rates causes credit rationing because the lenders' expected profitability is not monotonically increasing in interest rates. At higher rates, lenders

[6] In contrast, Jaramillo et al (1996), using data from Ecuador at the firm level, do not find support for a relaxing of the credit constraints for small firms after financial reform.

[7] Mild repression may be understood as interventions in the capital market leading to fixing the interest rate between the equilibrium level of monopoly and that which would exist under perfect competition.

may experience a decrease in profits due to adverse selection, moral hazard, and monitoring costs. Therefore, lenders are not willing to lend at a rate higher than that which maximizes their expected profits, even though there are agents willing to borrow at that higher rate (see, for instance, Walsh (1998), Chapter 7).[8]

The opposite predictions of these two literatures do not imply that they exclude each other. If we interpret the type of constraint predicted by the financial liberalization theory as more closely related to price rationing than a credit constraint, then both effects might be present in an economy. That is, higher interest rates may lead to higher credit availability but, for a given amount of credit, some firms may have access to bank loans and others may not. This would imply that credit constraints might be present not only at low interest rates, but also at high interest rates. If both causes of credit constraints exist, then it is expected that credit availability will have a direct effect on private investment at both high and low interest rates. At the empirical level, if the finding is that credit availability affects investment only when interest rates are low, this will be an indicator of financial restraints and shed light in favor of higher interest rates to encourage investment. If credit availability also enters into the investment equation at high interest rates, then the sensitivity of investment to credit availability would depend on the net effect of interest rates on credit. That is, lenders may be willing to lend more if the effect of an increase of interest rates on deposits is higher than the cost brought about by the asymmetric information problem. If this were the case, we would expect a decrease in the sensitivity of investment on credit availability at higher interest rates. This suggests a nonlinear relationship between credit allocated to the private sector and private investment.

Previous empirical studies have generally found a positive and statistically significant effect of credit availability (net flow of credit to the private sector) on private investment. Oshikoya (1994) finds that credit to the private sector has a significant positive effect on private investment in middle and low income African countries.[9] Shafik (1992) reports both short- and long-term positive and significant relationships between private investment and credit allocated to the private sector using data for Egypt. Leff and Sato (1988), using data for 21 Latin American countries, found, in general, a positive relationship between private investment and the change in total real credit. Ramirez (2000) also found a positive coefficient for the lagged ratio of credit to the private sector to gross domestic product (GDP) in an equation for the private investment-GDP ratio for eight Latin American countries.[10]

There is also evidence of financial development causing investment and growth. For instance, Bell and Rousseau (2001), using data for India, find that credit allocated to the private sector, and two other broader financial indicators,[11] Granger cause aggregate investment and output without evidence of feedback.

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8 A more recent development in this area emphasizes that credit rationing could be a consequence of the weakness of the legal system to enforce contracts (see for instance, La Porta et al (1998), and Levine et al, (2000)). Thus, credit market imperfections may have large impacts on financial markets in developing countries due to the weakness of their legal institutions enforcing contracts.

9 In this study, the middle income countries considered for the estimation of the private investment equation are Cameroon, Mauritius, Morocco, and Tunisia. The low income countries are Kenya, Malawi, and Tanzania.

10 See also, for instance, Warman and Thirlwall (1994), Günçavdı et al (1998), and Athukorala (1998).

11 These two indicators are domestic assets of deposit money banks and total domestic credit excluding credit to money banks.

2.3 Public investment as a determinant of private investment

In developing countries, the government has played an important role in capital formation. That is, public investment constitutes an important portion of total investment. Thus, evaluating the effect of this expenditure on private investment decisions may be worthwhile.

According to theory, the effect of public investment on private investment is indeterminate. Public investment can act as a substitute (negative effect on private investment) to or a complement (positive effect on) for private investment. The sign of the effect depends on the area in which the government executes the investment projects. Public investment may encourage private investment when such expenditure contributes to increasing private-owned firms' productivity. On the other hand, it may crowd out private investment when: (i) the government invests in inefficient state-owned firms; (ii) private investors expect higher taxes to finance such expenditures; and/or (iii) the public sector competes with the private sector for domestic loanable funds.[12]

Empirical studies on this issue report contrasting results for both developing and developed countries.[13] Oshikoya (1994) finds a positive and statistically significant relationship between private and public investment in middle income African countries. Paradoxically, this effect is weak or negative in low income countries. Recently, Apergis (2000) evaluated the effect of public spending (consumption and investment) on Greece for the period 1948–96. He found that for early years both variables are positively cointegrated. However, for a more recent sub-period, 1981–96, the cointegration relationship between those variables is negative. Ramirez (2000) finds a positive relationship between public and private investment in eight Latin American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, and Uruguay) for the period 1980–95. Cardoso (1993) found a similar result with data for six Latin American countries (Argentina, Brazil, Colombia, Chile, Mexico, and Venezuela) using a panel comprising information for three sub-periods between 1970 and 1985.[14]

Separating public investment into infrastructure and non-infrastructure investment, some empirical studies have found evidence of a positive relationship between public investment in infrastructure and private investment. By contrast, the effect of government spending on non-infrastructure has a negative effect on private investment (see, for instance, Blejer and Mohsin (1984)). Pereira (2000) reports that five types of total public investment have a positive effect on private investment and output in the US for the period 1956–97 using a four variable VAR in first difference.[15] Due to the type of spending considered,[16] the result is consistent with the view that public investment in infrastructure tends to encourage private activity by means of a rise in private sector productivity.[17]

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[12] See Apergis (2000) for references on each of these possibilities.

[13] For early references on this issue, see Agénor and Montiel (1999, page 101).

[14] Another study reporting complementarity between public investment and private investment is Athukorala (1998) for India.

[15] The VAR contains the first difference of the logarithm of private investment, private employment, private GDP, and one of six indicators of public investment.

[16] Infrastructure: classified in three groups, including buildings for the provision of quasi-public goods (health, education, etc) and conservation structures.

[17] See also Rioja (1999) and Feltenstein and Ha (1999). Both studies, using a general equilibrium framework, conclude that investment in infrastructure is not always welfare improving. Rioja argues that Latin American countries need an additional 4% of GDP to dedicate to investment in infrastructure to optimize their welfare gains from this type of investment. Feltenstein and Ha use data for 16 sectors of the Mexican economy and conclude that only small increases in public infrastructure have a positive impact in the real economy.

2.4 On the other determinants of private investment[18]

In addition to the determinants mentioned above, private investment spending depends on output, economic reform policy, and on its owned lagged values. Since the early study of Clark (1917), the change in output is considered as a determinant of investment spending. This effect is the well known "accelerator effect". Output also plays an important role in the neoclassical approach of investment introduced by Jorgenson (1963), although the central feature of this theory is to evaluate the effects of relative prices on the demand for capital. Output affects investment decisions due to its effect on firms' profitability and also by means of the output-saving-aggregate investment channel.[19] Empirical results usually confirm a strong and positive effect of changes in GDP on private investment or GDP growth on the investment-GDP ratio.

Moreover, recent empirical studies for developing countries have found evidence for important changes in the investment equation due to economic reform. For instance, Fielding (1997) evaluates the impacts of policy reform in six African countries (Kenya, Nigeria, Zimbabwe, Côte d'Ivoire, Cameroon, and Mauritius) and finds evidence for economic reform altering the investment equation. Also, Athukorala (1998) finds that market-oriented reforms positively affected the private investment function in India. Other empirical researchers have found evidence of the impact of financial reforms on private investment. In general, this line of research tests for structural changes in the parameters of the investment function. For example, Günçavdi et al (1998) and De Melo and Tybout (1986) test for structural breaks in the investment equation after financial liberalization policies were implemented in Turkey and Uruguay.

3. Data

The data cover the period 1983:1–1999:4. In Section 2, we discussed the determinants of private investment considered in this research. For empirical implementation, those variables, except for the real interest rate, are transformed into natural logarithms. These variables are denoted as follows:

v = LPRIVINV or the logarithm of real private investment spending;

w = DLCREDIT or first difference of logarithm of real stock of credit to the private sector;

x = RIQ or the real bank lending interest rate;

y = LPRIVGDP or logarithm of private GDP; and

z = LPUBINV or logarithm of public investment.

Data for GDP and investment have been provided by the econometrics department (Departamento de Apoyo Cuantitativo) of the Central Bank of Venezuela (BCV). Data on the nominal stock of credit to the private sector are obtained from the IMF, *International financial statistics*, CD-R April 2001. The real stock of credit is the nominal stock of credit deflated by the consumer price index (CPI). Investment (total, public, and private), GDP, and the real stock of credit are expressed in billions of bolivares and in 1984 prices. The natural logarithm transformation is applied to those variables as well.

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18 Due to the large number of variables that economists consider when studying developing countries, the term "other determinants of private investment" should be understood as the other variables considered in this research.

19 In the Q-theory of investment, future output stream affects the market value of the firm and consequently the firm's investment decisions.

What matters for investment spending in period *t* is the amount of funds available in that period rather than the credit stock. Credit allocated to the private sector in real terms should be measured by means of the first difference of the nominal stock of credit deflated by the price index. This takes into account not only the change in the real stock of credit but also the replacement of the stock due to inflation. However, when the series are transformed into logarithms there is an important loss of information because the logarithm is not defined for negative numbers. Nevertheless, in this research, the indicator for credit availability is obtained as the first difference of the logarithm of real stock of credit.

Furthermore, the real interest rate in quarterly terms is constructed from monthly data on nominal lending interest rates from the six most important banks, and the CPI is provided by the BCV. See Mendoza Lugo (2001, Appendix A) for details on the procedure used in the calculation of the real interest rate series. In Venezuela, the public sector constitutes an important proportion of total GDP. It represents 37.5% of total GDP throughout the period under analysis. Therefore, it seems better to use GDP generated by the private sector rather than total GDP as a determinant of private investment. Private GDP for 1983:1–1990:3 is calculated by interpolation based on proportions of private GDP to total GDP using annual data obtained from Antivero (1992), Tables II-8 and II-9, and the quarterly total GDP for the same period obtained from the BCV. That is, the proportion of private GDP to total GDP is obtained from annual data and the four observations of quarterly total GDP for each year are multiplied by this proportion. The computed new series is used as the indicator of private GDP.

The series used in this research are intentionally left seasonally unadjusted. Even though much empirical work uses seasonally adjusted data, some time series analysts suggest working with seasonally unadjusted data because: (i) seasonally adjusted data may lead to misleading inferences about the relationship among the variables; and (ii) seasonal adjustments imply a loss of important information when seasonal fluctuations explain an important part of the behavior of the variables in analysis (see for instance, Lee (1992), Lee and Siklos (1997), and Bohl (2000)). Thus, the data is tested for unit roots at all frequencies (seasonal and long-run) using the HEGY (Hylleberg, Engle, Granger, and Yoo) test for unit roots, which allows discrimination of unit roots at long-run, semiannual, and annual frequencies. Also, the augmented Dickey-Fuller (ADF) test and the Phillips and Perron (PP) test are performed for comparison purposes. The PP test is applied in this research only when the residuals from the ADF regression are hereroskedastic as reported by the Q statistic on the square of the residuals. The HEGY test indicates that the Venezuelan data in this research does not have seasonal unit roots. While at the long-run frequency, unit roots are found for LPRIVGDP, LPRIVINV, and LPUBINV. Results and discussion about unit root tests are reported in Mendoza Lugo ((2001), Appendix B).

4. Modeling a nonlinear private investment function

The literature offers a wide variety of nonlinear models. Among the nonlinear parametric specifications, the smooth transition regression (STR) models and the threshold regression (TR) models have recently been increasingly used in modeling economic relationships. However, since the TR models are a particular case of the STR models, it is convenient to start investigating a nonlinear relationship with the STR models to avoid specification problems.

The smooth transition models belong to the category of regime switching models and are introduced in the literature in their autoregressive (STAR) version by Chan and Tong (1986); Luukkonen, Saikkonen, and Teräsvirta (1988); Teräsvirta and Anderson (1992); and

Teräsvirta (1994). Granger and Teräsvirta (1993) extend the STAR models to a multivariate context resulting in the STR models.[20]

4.1 A smooth transition specification for private investment within a VEC model

We model a nonlinear specification for private investment within a smooth transition vector error correction (STVEC) model in which private investment depends on its own lagged values and on the lags of other variables determining investment. In other words, it is claimed that if a linear specification for private investment is rejected, then there exists a nonlinear dynamic that is appropriately described by an STR model. The STR models, in addition to offering a less restrictive framework, are recommended when analyzing aggregates as in the case of private investment spending (Granger and Teräsvirta (1993, page 40)). That is, at the micro level the decisions to invest may be constrained to "invest given a state of the economy, say state or regime 1" or "do not invest given state or regime 2". However, at the macro level the lack of coordination among individual decisions may lead to a smooth transition from one regime to the other.

A general STVEC model can be expressed as follows:

$$\Delta X_t = \Pi_{0,1} D_t + \Pi_1 X_{t-1} + \sum_{m=1}^{p-1} \theta_{m,1} \Delta X_{t-m} + [\Pi_{0,2} D_t + \Pi_2 X_{t-1} + \sum_{m=1}^{p-1} \theta_{m,1} \Delta X_{t-m}] F(TV_{t-d}) + \varepsilon_t \tag{4.1}$$

where,

D is a (n_0 x 1) matrix of deterministic terms, X is a (n x 1) vector, n is the number of endogenous variables; $\pi_{0,i}$ i = 1,2, is a (n x n_o) vector of coefficients for the ith regime, and π_i and $\theta_{m,i}$ are (nxn) matrices of coefficients. The rank of $\pi_{0,i}$, r, is the number of cointegrating vectors. The matrix $\pi_{0,i}$ can be expressed as $\pi_{0,i} = \gamma_i \alpha_i ; \gamma_i$ and α_i are (n x r) matrices with rank r. The former is the matrix containing the adjustment coefficients and the latter is the matrix of cointegrating vectors. In the estimation procedure, we assume $\alpha_1 = \alpha_2 = \alpha$; αX_t is the cointegrating vector (CIV_t) for both regimes. $\pi_{0,2}$ is a matrix of zeros the coefficient denoting the constant term. That is, the model is lineal in determinist variables the constant term. In addition, ΔX_t = [dv_t, dw_t, dx_t, dy_t, dz_t] and $F(TV_{t-d})$ is the indicator or transition function taking values between zero and one, both extremes, inclusive. When taking intermediate values, it allows a smooth transition between regimes. In general, $F(TV_{t-d})$ is specified by one of the following two forms:

$$F(TV_{t-d}) = \{1 + Exp[-\gamma(TV_{t-d} - c)]\}^{-1}, \ \gamma > 0 \tag{4.2}$$

or

$$F(TV_{t-d}) = 1 - Exp\{-[\gamma(TV_{t-d} - c)]^2\}, \gamma > 0 \tag{4.3}$$

[20] The smooth transition models have been applied to explain the dynamic behavior of some macroeconomic variables. For instance, Weise (1999) tests for asymmetric effects of monetary policy in the United States using a logistic smooth transition vector autoregression (LSTVAR) model. Taylor and Peel (2000) find that the exponential smooth transition autoregressive (ESTAR) model explains the behavior of the deviations of the dollar-mark and dollar-sterling exchange rates from the long-run equilibrium rate. Sarantis (1999) finds that STAR models approximate the nonlinearity in the effective real exchange rate for eight of the G10 countries. Byers and Peel (2000) model the hyperinflation in Germany, Brazil, and Argentina using the ESTAR model. Other recent applications of smooth transition models are in Chen and Wu (2000), Öcal and Osborn (2000), van Dijk and Franses (1999), Lutkepohl et al (1999), Leybourne and Mizen (1999), Bradley and Jansen (1998), and Greenaway et al (1997).

These are the logistic and the exponential transition or indicator functions. Notice that the indicator function has been restricted to contain only one transition variable. This is equivalent to assuming that the transition variable, *TV*, and the delay parameter, *d*, are known. A model combining (4.1) and (4.2) is a logistic smooth transition vector error correction (LSTVEC) model. When using (4.1) and (4.3), the model is the exponential smooth transition vector error correction (ESTVEC) model. The LSTVEC model allows the VEC to behave differently when the transition variable takes low values. That is, two regimes can be defined: the low regime and the high regime. The ESTVEC models, instead, assume that the VEC behaves the same when the transition variable takes extreme values. This behavior differs from when the transition variable takes values located in the middle of its own range of values. In this case the two regimes are called the outer regime and the middle regime.

In the logistic function, when $\left(TV_{t-d} - c\right)$ is large and positive, $Exp\left[-\gamma\left(TV_{t-d} - c\right)\right]$ tends to zero and the transition function takes a value of one. In the opposite case, $Exp\left[-\gamma\left(TV_{t-d} - c\right)\right]$ tends to infinity and the transition function goes to zero. Therefore, in the low regime, the estimated regression is given by the set of estimated coefficients in the first and second terms of (4.1). While in the high regime, the whole set of estimated coefficients for all terms in (4.1) describe the dynamics of investment or the variable being analyzed. In the case of the exponential function, when $\left(TV_{t-d} - c\right)$ takes either large positive or negative values, $Exp\left\{-\left[\gamma\left(TV_{t-d} - c\right)\right]^2\right\}$ tends to zero and the transition function takes a value of one. Thus, this function restricts the dynamics of the equation to be the same when the transition variable takes extreme values. When TV_{t-d} takes values close to *c*, $Exp\left\{-\left[\gamma\left(TV_{t-d} - c\right)\right]^2\right\}$ tends to one and the transition function goes to zero.

Between the logistic and the exponential transition functions, we have chosen the logistic function to investigate nonlinearities in the VEC. This choice is based on the theory discussed previously.

4.2 The choice of transition variable

The search for a transition variable will be done focused on possible nonlinearities in the VEC model due to nonlinearities in the private investment equation.[21] We suspect that the investment equation behaves differently when the interest rate takes high as opposed to low values. It could also be that the investment equation behaves differently when there is a credit constraint and when constraints are relaxed. One additional possibility is that whether the economy is expanding or contracting could define the state of the world or regime. That is, the theory of financial constraints states that the severity of agency costs should vary with the general macroeconomic conditions. It is expected that during recessions a firm's internal finance falls and the demand for external funds rises. Since the cost of external finance increases when the firm's balance sheet deteriorates, investment falls and thus intensifies the magnitude of the recession (Bernanke and Gertler (1989) and Walsh (1998), pp 298–302). Consequently, during recessions, the investment equation may be more sensitive to credit than in periods of expansion. This implies a nonlinear relationship between investment and credit with changes in output defining the state of the economy. Finally, public investment can be the transition variable depending on its impact on the credit market.

[21] Weise (1999) shows that in a structural multiple-equation model, a nonlinear equation in at least one of its coefficients may lead to a nonlinear representation for all equations in the reduced form of the system.

We have not found a theoretical explanation for using private investment itself as the transition variable. However, we do not rule out this possibility. Provided that the investment function is nonlinear, differential impacts of real interest rates and credit availability on investment can arise from the dynamic interactions of the other variables included in the model. Therefore, all lagged variables explaining investment other than CIV are considered potential transition variables.

5. Estimation

Teräsvirta (1994) elaborates on the procedure for estimating a smooth transition model in the univariate case. Granger and Teräsvirta (1993) discuss this procedure in the multivariate context. The technique consists of the following three broad stages. First, specify the linear model. Second, apply the test for linearity against STR models following the third order test procedure introduced by Luukkonen et al (1988), but using only one transition variable each time for all possible values of *d*. And third, if linearity is rejected, then choose between the logistic smooth transition regressive (LSTR) and the exponential smooth transition regressive (ESTR) model by testing a sequence of hypotheses.

5.1 The linear model

Since no evidence for seasonal unit roots are found in the Venezuelan data, cointegration and the number of cointegrating vectors are tested within a linear VEC model from one to four lags.[22] Cointegration is tested using the maximum likelihood procedure proposed by Johansen (1988, 1991) and well documented in Hamilton (1994). Evidence of cointegration is found for one and three lag specifications with LPRIVINV, LPUBINV, and LPRIVGDP as endogenous variables. The CIV for one lag is discarded because its coefficients do not look reasonable. Therefore, the selected CIV comes from a system specification with three lags and it is $LPRIVINV_t = 0.191 - 0.759 * LPUBINV_t + 0.861 * LPRIVGDP_t$.The trace statistic is 33.772, significant at 5%.[23]

As a second step, given the existence of one cointegrating vector, the term $LPRIVINV_{t-1} + 0.759 * LPUBINV_{t-1} - 0.861 * LPRIVGDP_{t-1}$ is used to estimate a linear version of (4.1) where dummies for some special events and structural economic reforms are introduced.[24] The

[22] In general, it is recommended that the lag length of the VAR in levels should be chosen before testing for cointegration (see, for instance, Enders (1995), page 396). However, when using the Akaike information criterion (AIC) and Schwarz information criterion (SIC) for lag length selection, with the same sample size and up to six lags in the VAR, both criteria indicate one lag in the VAR in levels. This implies zero lags in the VEC model. Since a longer lag is preferable to one that is too short (Banerjee et al (1993), page 286), an alternative procedure is followed to test and estimate the cointegrating vector. That is, using the same effective sample size (1984:2–2000:4), cointegration is tested from one up to four lags in the VEC model and the cointegrating vector with more reasonable coefficients is selected.

[23] The maximum eigenvalue does not indicate evidence for cointegration.

[24] The dummy variables are DC and DPC, which attempt to control for structural economic reform as specified in Section 3. The dummies to control for special events (See Mendoza Lugo (2001), Section 2.3) are introduced only after an initial stimation evidences the need to control for some outliers in those periods. These dummies are D891 and D942 in the real interest rate equation, D944 and D962 in the credit equation, and D861 in the public investment equation. D891 is defined as +1 in 1989:1, –1 in 1989:2 and 0 otherwise. D944 takes the value of +1 in 1994:4, –1 in 1995:1 and 0 otherwise. D962 is specified as +1 in 1996:2, –1 in 1996:3 and 0 otherwise. And finally, D861 is defined as +1 in 1986:1, –1 in 1986:2 and 0 otherwise. D942 is specified as 1 in 1994:2 and 0 otherwise. After the introduction of these dummies, all equations pass the diagnostic check in terms of normality, serial correlation, and heteroskedasticity. The subset VEC model is re-estimated, starting

VEC lag length is set arbitrarily equal to 4.[25] Furthermore, insignificant coefficients are eliminated using the modified version of the likelihood ratio test suggested by Sims (1980). This second step is performed using generalized least squares or seemingly unrelated regressions (SUR). As we can observe, the procedure applied differs from the two-step Engle and Granger (1987) method only in the method of estimation applied in each step. The resulting estimated subset VEC model is shown in Table 5.1.[26]

5.2 Linearity test

A linearity test is performed using its one equation and system version. For the multivariable equation setup, we use the augmented first order test proposed by Luukkonen et al (1988), which is more suitable for small samples and has more power under the null hypothesis. This test can be performed using the following auxiliary regression.

$$dv_t = \phi_0 + \phi_1 H + \phi_2 HTV_{t-d} + \psi_d TV_{t-d}^3 + \upsilon_t^* \tag{5.1}$$

where,

$$H = [\mathrm{dv}_{t-1}, \ldots, \mathrm{dv}_{t-p}, \mathrm{dw}_{t-1}, \ldots, \mathrm{dw}_{t-q}, \mathrm{dx}_{t-1}, \ldots, \mathrm{dx}_{t-r}, \mathrm{dy}_{t-1}, ..., \mathrm{dy}_{t-s}, \mathrm{dz}_{t-1}, \ldots, \mathrm{dz}_{t-k}, \mathrm{CIV}_{t-1}]' ;$$

ϕ_0 and ψ_d are scalars and ϕ_i , i = 1,2 are 1 x k^* vector of coefficients, $k^* = p + q + r + s + k$. The test consists of a hypothesis contrast, using the F statistic, in which the null for linearity is set as the coefficients of ϕ_2 and Ψ_d are zero λ_2, λ_3 and λ_4 are zeros. This test is performed for each possible TV_{t-d}. With this test we cannot perform nested hypothesis tests for model selection. However, both models can be estimated and the final model can be chosen based on a forecast evaluation. In the particular case of investigating nonlinearities of the investment equation on financial factors, the theory suggests the use of a logistic model. Therefore, we restrict estimation to this kind of model and without any complication for model selection when using the augmented first order linearity test.[27]

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from a full coefficient or unrestricted VEC model accounting for those especial events that the new dummies attempt to control for.

25 One problem encountered when specifying an unrestricted VEC model using the Venezuelan data is related to the lag length selection. Both SIC and AIC suggest a VAR in levels with one lag or its corresponding VEC with no lags. However, it is observed that when estimating the unrestricted VEC with a higher number of lags that significant coefficients are not uniform with respect to the lag length for the lagged values of each variable in each regression in the VEC model. The main problem in continuing with an unrestricted VEC with lag length selected arbitrarily, say four lags, is the presence of too many insignificant coefficients. The price of too many insignificant coefficients is higher variance and consequently imprecise impulse response functions. But proceeding with too short a lag specification may lead us to conclude that a variable, or variables, does not affect the others because of a misspecification in the lag order for such a variable. Thus, it may be preferable to choose the lag length arbitrarily, which we set equal to 4, and estimate with a restricted-in-coefficients version or subset VEC model. An early proponent of subset VAR is Hsiao (1981), who proposes a procedure for choosing, different number of lags for each variable in the VAR based on the final prediction error (FPE) criterion. McMillin (1985) applies a subset VAR to investment in the United States. Lütkepohl (1993, Chapter 5), discusses specification procedures, advantages, and disadvantages for restricted VAR, which are also applicable to a VEC.

26 E-views is used for all computational procedures but the impulse response functions. In this case, we use GAUSS.

27 In general, third order linearity test proposed by Luukkonen et al (1988), which is based on the following multivariate auxiliary regression. However, in a multivariate context the auxiliary regression contains 1 + 4k^* parameter estimates, which in small samples implies the use of too many degrees of freedom.

Table 5.1

Venezuela: estimated subset VEC model for private investment and its determinants

Period 1984:3–2000:4

	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$	
	Coeff.	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**
C	–0.273	–6.844	–0.004	–0.601	0.008	1.308	–0.115	–8.181	–0.563	–9.858
DS2	0.575	5.722	–	–	–	–	0.175	7.013	0.866	8.197
DS3	–	–	0.028	1.969	0.020	1.750	0.142	8.218	0.804	10.613
DS4	0.422	6.231	–	–	–0.043	–3.720	0.191	8.745	0.737	8.533
D861									0.359	5.705
D891					–0.211	–12.417				
D942					–0.098	–4.124				
D944			–0.246	–7.220						
D962			–0.230	–6.853						
DPC	–	–	–	–	–	–	–	–	–	–
$DLPRIVINV_{t–1}$	–0.321	–3.669	–	–	–	–	0.043	2.211	–	–
$DLPRIVINV_{t–2}$	–0.190	–2.157	–	–	–	–	–	–	–	–
$DLPRIVINV_{t–3}$	–	–	–	–	–	–	0.079	4.528	0.182	2.634
$DLPRIVINV_{t–4}$	–0.304	–3.591	–	–	–	–	–	–	0.157	2.090
$DDLCREDIT_{t–1}$	0.520	2.881	–0.201	–2.776	–0.103	–2.682	–	–	–0.270	–1.730
$DDLCREDIT_{t–2}$	–	–	–	–	–0.117	–3.041	–	–	–	–
$DDLCREDIT_{t–3}$	–	–	–0.158	–2.230	–0.087	–2.266	–	–	–	–
$DDLCREDIT_{t–4}$	–	–	–	–	–0.069	–1.849	–	–	–	–
$DRIQ_{t–1}$	–	–	0.294	2.436	–	–	–	–	0.873	3.475
$DRIQ_{t–2}$	–	–	–	–	–	–	–	–	1.184	4.613
$DRIQ_{t–3}$	–0.783	–2.581	–	–	–0.184	–2.901	–	–	–0.542	–1.926
$DRIQ_{t–4}$	–	–	–	–	–	–	–0.151	–2.331	–0.661	–2.524
$DLPRIVGDP_{t–1}$	1.876	3.800	–	–	–	–	–0.206	–2.141	1.992	5.105
$DLPRIVGDP_{t–2}$	1.115	2.764	–	–	0.231	2.629	–	–	1.702	4.806
$DLPRIVGDP_{t–3}$	2.420	5.521	–0.397	–3.377	–0.228	–2.537	–	–	–	–
$DLPRIVGDP_{t–4}$	–	–	–	–	–	–	–0.189	–1.928	–1.509	–3.999
$DLPUBINV_{t–1}$	0.172	1.787	–	–	0.045	4.276	0.082	4.098	–0.350	–4.388
$DLPUBINV_{t–2}$	–0.279	–4.566	–	–	–	–	0.064	3.554	–0.136	–1.917
$DLPUBINV_{t–3}$	–	–	–	–	–	–	0.085	4.826	–0.178	–2.669
$DLPUBINV_{t–4}$	–	–	–	–	–	–	–	–	–	–
CIV	–	–					–0.036	–2.841	–0.174	–3.493

Table 5.1 (cont)

Venezuela: estimated subset VEC model for private investment and its determinants

Period 1984:3–2000:4

	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$	
	Coeff.	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**
R^2adj.		0.482		0.647		0.738		0.763		0.917
Q(1)		0.121		0.474		1.547		1.020		0.346
Q(4)		1.064		2.422		5.489		3.158		3.835
Qsr(1)		1.678		0.416		0.169		0.867		1.517
Qsr(4)		4.032		1.371		0.405		4.866		2.515
Hausman				–0.196						0.756
JB		2.076		2.645		1.652		2.278		0.092

Notes: The restricted VEC model is estimated using seemingly unrelated regressions (SUR). R^2 adj. is the adjusted R^2. Q(i) (Qsr(i)) is the Ljung-Box Q-statistic for the *i*th lag of the residuals (squared of residuals). JB accounts for the Jarque-Bera statistic for normality. JB is distributed as a χ^2 with two degrees of freedom. The Q-statistics are distributed as χ^2 with *i* degrees of freedom. The critical values for $\chi^2_{I,0.05}$ ($\chi^2_{i,0.1}$), for *i* = 1 and 4 are 3.84 and 9.49 (2.71 and 7.78) respectively. CIV denotes the cointegrating vector. Hausman corresponds to the t-statistics for the Hausman test. The Hausman test is performed for the credit and public investment equations. Due to the way interest rates are calculated in this research (see Mendoza Lugo (2001, Appendix A) RIQ_{t-1} contains information for one month of quarter *t*, then there exists the possibility that $DRIQ_{t-1}$, which enters in the credit and public investment equations, is an endogenous variable. For the Hausman test: (i) $DRIQ_{t-1}$ is regressed on the right hand side variables of each of the above-mentioned equations plus the variables on the right hand side of the interest rate equation (all of them lagged one period); contemporaneous variables to $DRIQ_{t-1}$ are omitted from the regression; (ii) the residuals from the estimated interest rate equation are retrieved; and (iii) the credit or public investment equation augmented for the residuals from the previous step is estimated. The Hausman statistic is the t-statistic on the estimated coefficient for the residuals obtained from the interest rate equation. If the estimated coefficient is not statistically different from zero, we must conclude that $DRIQ_{t-1}$ is not an endogenous variable. The test statistics do not indicate evidence for endogeneity in $DRIQ_{t-1}$.

Weise (1999) introduces a linearity test for a multiple-equation framework. This is a likelihood ratio test. Instead of a first order test extended to a multiple-equation framework proposed by Weise, we use a multi-equation version of the augmented first order test and correct for small sample bias.[28]

Table 5.2 reports the results of the linearity tests for each equation, the F test, and for the whole system, the LR test. The first 10 columns show the linearity test statistics and their respective P-values for each dependent variable described at the top of the table. The last two columns contain information about the LR statistics for each transition variable and their

[28] Due to the cumbersome joint tests for no cointegration and linearity against cointegration and nonlinear (threshold) specification, where not only nostationarity and nuisance parameters are present under the null but there is also a large class of nonlinear (threshold) specifications, Balke and Fomby (1997) suggest breaking up this analysis into two parts. These are: (i) a test for cointegration; and (ii) a test for nonlinear behavior. An important argument in favor of this separation is that standard time series analysis for linear cointegration is asymptotically valid for the threshold cointegration because the order of integration is not affected by a threshold specification. From a Monte Carlo experiment, they find that no serious problems arise when testing for cointegration using a linear misspecified model. Van Dijk and Franses (1995) use the same procedure to estimate a smooth transition vector error correction model. For other references on threshold and smooth transition EC models, see Franses and van Dijk (2000), page 133.

respective P-values. The LR test suggests the use of DLCREDIT as the transition variable. It reports low P-values for delays of 1, 2, and 4 being the lowest one for DLCREDIT_{t-1}. The LR test also reports P-values lower than 5% when DRIQ and DLPRIVGDP are the transition variables with delays of 4 and 1 respectively. On the other hand, the F test does not always suggest using as the transition variable the same variable indicated by the LR test. For instance, the LR test indicates DLCREDIT_{t-2} as a good choice when searching for a common transition variable and delay parameter. However, the F test in the equation for DLPRIVGDP reports a P-value of 0.941, which suggests that the use of DLCREDIT_{t-2} as transition variable may not be a good choice to explain the potential nonlinearity in the output equation, even though this equation is estimated in a multi-equation context.

The F test reports evidence against linearity in all five equations. In the private investment equation, linearity is rejected at the 5% significance level when DLCREDIT_{t-1} and RIQ_{t-4} are the transition variables. For the remaining four equations, only in the output equation does the test fail to reject linearity when financial variables are used as transition variables. However, the test rejects linearity in the output equation when DLPUBINV_{t-4} is the transition variable. In addition, the linearity test for each single equation does not report evidence for the use of a unique transition variable and delay parameter in all equations.

Teräsvirta (1994), following Tsay (1989), recommends choosing the delay parameter, *d*, in the univariate model as the value with the minimum P-value. Generalizing this decision rule to a multivariate context, it should be to choose the transition variable, *TV*, and the delay parameter *d*; that is, TV_{t-d}, as the *d*th order lagged variable with the minimum P-value. We could also select, among the potential *TV*s with tests reporting P-values lower than 5%, each variable with the lowest P-value for each potential *TV* and proceed to estimate the model for each of these candidates and then make the final selection based on specification tests. We explore this possibility by attempting to estimate the nonlinear model equation by equation using as *TV*s all possible candidates with F tests reporting a P-value lower or equal than 5%. We also attempt to estimate the nonlinear model, within a system procedure, using the same transition variable for all equations as suggested by Weise (1999) according to the LR test. The next subsection explains in detail the estimation procedure for the nonlinear model.

Table 5.2

Venezuela: linearity test using the estimated subset VEC model as benchmark

Transition variable	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$		SYSTEM	
	F-stat.	**P-val.**	**F-stat.**	**P-val.**	**F-stat.**	**P-val.**	**F-stat.**	**P-val.**	**F-stat.**	**P-val.**	**LR-stat.**	**P-val.**
$DLPRIVINV_{t-1}$	1.277	0.276	0.551	0.737	0.360	0.947	1.326	0.252	1.546	0.157	57.452	0.219
$DLPRIVINV_{t-2}$	0.735	0.699	0.613	0.691	0.759	0.654	0.996	0.464	1.015	0.470	41.227	0.807
$DLPRIVINV_{t-3}$	1.650	0.125	1.233	0.308	0.695	0.709	1.947	0.068	0.231	0.998	58.078	0.202
$DLPRIVINV_{t-4}$	1.164	0.344	1.306	0.277	0.611	0.780	1.996	0.062	0.720	0.745	59.976	0.158
$DDLCREDIT_{t-1}$	0.908	0.542	0.609	0.693	1.690	0.124	0.692	0.726	0.920	0.554	43.933	0.714
$DDLCREDIT_{t-2}$	0.651	0.773	1.076	0.385	1.452	0.200	0.476	0.895	1.665	0.121	50.648	0.448
$DDLCREDIT_{t-3}$	0.782	0.656	0.673	0.646	1.024	0.438	0.740	0.682	0.674	0.786	42.725	0.758
$DDLCREDIT_{t-4}$	1.311	0.257	1.257	0.298	0.451	0.898	0.912	0.532	0.549	0.888	45.014	0.673
$DRIQ_{t-1}$	0.694	0.735	0.176	0.970	1.044	0.424	0.802	0.628	0.853	0.617	43.830	0.718
$DRIQ_{t-2}$	1.493	0.176	1.253	0.299	1.198	0.324	1.903	0.075	2.153	**0.040**	66.501	0.059
$DRIQ_{t-3}$	1.174	0.338	1.062	0.393	3.942	**0.001**	0.933	0.514	1.046	0.444	64.561	0.081
$DRIQ_{t-4}$	1.535	0.160	2.127	0.078	1.527	0.173	0.990	0.469	0.729	0.736	68.767	**0.040**
$DLPRIVGDP_{t-1}$	1.314	0.255	1.221	0.313	4.340	**0.001**	1.342	0.244	0.761	0.705	68.972	**0.039**
$DLPRIVGDP_{t-2}$	1.288	0.270	1.132	0.356	2.460	**0.025**	0.660	0.753	1.060	0.432	57.201	0.225
$DLPRIVGDP_{t-3}$	0.334	0.972	1.043	0.403	1.121	0.371	0.417	0.930	1.325	0.254	53.271	0.350
$DLPRIVGDP_{t-4}$	0.981	0.481	0.249	0.939	1.622	0.143	1.092	0.393	1.087	0.411	56.573	0.243
$DLPUBINV_{t-1}$	1.750	0.100	1.020	0.416	4.180	**0.001**	0.745	0.678	0.914	0.559	56.082	0.257
$DLPUBINV_{t-2}$	1.016	0.452	0.938	0.465	0.810	0.610	1.204	0.320	0.814	0.655	46.310	0.622
$DLPUBINV_{t-3}$	0.735	0.698	0.357	0.875	0.721	0.687	1.905	0.075	2.322	**0.027**	61.843	0.122
$DLPUBINV_{t-4}$	1.031	0.440	0.112	0.989	4.164	**0.001**	2.227	**0.037**	0.492	0.924	64.271	0.084
$DLCREDIT_{t-1}$	2.088	**0.047**	3.919	**0.005**	1.901	0.081	1.116	0.376	1.372	0.230	87.865	**0.001**
$DLCREDIT_{t-2}$	1.118	0.375	3.169	**0.015**	3.763	**0.002**	0.395	0.941	2.146	**0.041**	76.466	**0.009**
$DLCREDIT_{t-3}$	1.227	0.304	3.438	**0.010**	2.210	**0.042**	0.491	0.885	0.458	0.942	61.725	0.124
$DLCREDIT_{t-4}$	2.013	0.055	2.777	**0.028**	1.008	0.451	1.206	0.318	1.031	0.457	75.493	**0.011**
RIQ_{t-1}	1.836	0.083	1.282	0.287	0.989	0.465	0.926	0.521	0.559	0.880	45.504	0.654
RIQ_{t-2}	0.719	0.713	2.725	**0.030**	1.187	0.330	1.176	0.336	0.700	0.763	47.885	0.559
RIQ_{t-3}	0.869	0.577	0.859	0.516	2.055	0.059	0.765	0.660	1.528	0.164	65.158	0.073
RIQ_{t-4}	2.532	**0.017**	1.378	0.249	2.187	**0.044**	0.949	0.501	0.705	0.758	67.361	0.051

Notes: P-values lower than 5% are reported in dark numbers.

5.3 Estimation procedure for the logistic STVEC model

Due to the lack of evidence for estimating the logistic STVEC (LSTVEC) model for a single TV_{t-d}, the nonlinear system is estimated equation by equation and then the five equations are put together and the logistic STVEC (LSTVEC) model is re-estimated using SUR. We start the estimation procedure by performing a two-dimensional grid search for the transition parameter, *c*, and the smooth parameter, γ, using as TV_{t-d} all possibilities in Table 4.3 that are associated with linearity tests having P-values lower than 5%. Previously, the argument of the transition function, $F(TV_{t-d})$, is rescaled downward by dividing by the standard deviation of TV_{t-d} as recommended by the estimation of the logistic model when the smooth parameter is large. This rescaling helps the computing process in the model estimation. See for instance, Granger and Teräsvirta (1993), page 123.[29]

We arrange the values of TV_{t-d} in ascending order and divide the range of values taken by that variable into 10 intervals, which gives 11 grid values. We assure all intervals contain information by discarding atypical observations from the range of values for TV_{t-d}. The search for the transition parameter, *c*, is performed for the nine grids located between both extremes. The search for the smooth parameter, γ, consists of 25 values from 1 to 49 augmenting two by two. For those cases where γ is located in the upper extreme, a new search is made for higher values of γ. Thus, there are at least 225 combinations for *c* and γ in each two-dimensional grid search. We select that combination of *c* and γ reporting the maximum log-likelihood.[30]

Those cases where the log-likelihood takes the maximum value for *c* located in any of the extremes of the range of values for the transition variable are ruled out.[31] We proceed using only those cases where the value of *c* maximizing the log-likelihood is located between the third and eighth grid values. The best value of *c* should be a value of TV_{t-d} located in some part within the middle of its observed range of values such that it guarantees both regimes contain enough observations for reliable estimates of the coefficients.

With starting values from the two-dimensional grid search, the parameter γ is allowed to vary while *c* is fixed to the value obtained in the previous step. Once γ is estimated, a new grid search is performed; this time only for the parameter *c*. Next, with starting values from the previous step, γ is allowed to vary again. Finally, we allow all parameters to vary setting initial values from the previous step. In each step involving the estimation of γ or the joint

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29 In previous work, we tried to estimate the nonlinear model by performing a grid search for the transition parameter, *c*, and fixing the standardized smooth parameter, γ, equal to the standard deviation of TV_{t-d}. However, in most of the cases the value of *c* maximizing the log-likelihood was located at the extremes of the range of values taken by the transition variable. Such a result suggests that the equation is linear or the value given to γ is not the most adequate.

30 Other alternative measures of fit are AIC, SIC, and R^2, obtaining similar results.

31 Within a two-dimensional grid search, a transition parameter taking values in any of the extremes of the range of values of the transition variable is probably a consequence of the presence of outliers. A problem facing the linearity tests for smooth transition models is that they may be biased toward rejecting the null hypothesis due to the presence of outliers. See for instance, Franses and van Dijk (2000), page 105. In the present study, some alternatives for TV_{t-d} are discarded when the transition parameter is found in the extreme values of the range of TV_{t-d} when performing the two-dimensional grid search. The discarded choices for TV_{t-d}, in the credit equation, are all lagged DLCREDIT, but DLCREDIT_{t-3}. In addition, RIQ_{t-4}, DRIQ_{t-2}, and DLPUBINV_{t-4} are rejected as TV_{t-d} in the equations for DRIQ, DLPUBINV, and DLPRIVGDP. Since the linearity test does not indicate other possible TV for the output growth equation, then this equation is treated as linear. Moreover, information for the estimated equation for DDLCREDIT under the assumption that RIQ_{t-2} is TV_{t-d} is not reported in Table 4.3 since a unique solution for this alternative was not found.

estimation of γ and c, each equation is estimated using nonlinear least squares (NLS). The estimated coefficients $\hat{\gamma}$ and $\hat{c}$ for each equation are reported in Table 5.3.[32]

Fixing the parameters c and γ to those values obtained from the single equation procedure, the LSTVEC model is estimated, using SUR. To alleviate computing problems, insignificant coefficients on lagged variables are eliminated. As a second step, in theory, all coefficients are allowed to vary using the estimated coefficients from the previous step as initial values. However, some computing problems, which may be associated with the estimation of logistic models in small samples and large adjustment parameters, as is the case in general for the logistic smooth transition (LSTR) models, leads us to seek the maximum number of smooth and transition parameters that can be jointly estimated while fixing the remaining ones to those values obtained from the estimation for each single nonlinear equation.

We evaluate three combinations of transition variables and delay parameters in order to proceed to the estimation of the LSTVEC model. These three options are illustrated in Table 5.4. In Option 1 we allow for the same transition variable. In this case it is DLCREDIT but allowing for different delay parameters. Option 2 is selected according to the TV_{t-d} associated with the higher log-likelihood value for each nonlinear equation. Finally, Option 3 differs from Option 2 only in the TV_{t-d} chosen for the private investment equation. In this case, RIQ_{t-4} is used as TV_{t-d}. This option is taken into account because the log-likelihood values are only slightly different from the case when $\mathrm{DLCREDIT}_{t-1}$ is TV_{t-d} (see Table 5.3). The final specification(s) for the LSTVEC model will be chosen based on diagnostic tests on the residuals and long-run dynamic evaluation.

32 Teräsvirta (1998), page 527, recommends the use of a two-dimensional grid search to get reasonable starting values for the NLS estimation and to reduce the size of the model by imposing exclusion restrictions.

Table 5.3

Venezuela: summary of the estimation of each single nonlinear equation for each potential TV

	$\hat{\gamma}$	**T-stat.**	$\hat{c}$	**T-stat.**	**P-value, F-test** $(\theta_2^{'} = 0)$	**Loglk**
TV for DLPRIVINV Equation						
$DLCREDIT_{t-1}$	37.543	0.560	0.006	1.228	0.094	66.056
RIQ_{t-4}	44.156	1.122	0.034	19.040	0.400	65.956
TV for DDLCREDIT Equation						
$DLCREDIT_{t-3}$	65.438	0.236	0.036	5.374	0.000	120.467
TV for DRIQ Equation						
$DRIQ_{t-3}$	33.127	0.679	0.036	5.141	0.036	173.960
$DLPRIVGDP_{t-1}$	33.102	0.955	0.014	2.313	0.004	175.100
$DLPRIVGDP_{t-2}$	–3.046	–0.944	0.021	0.897	0.937	167.577
$DLPUBINV_{t-1}$	6.963	0.530	–0.076	–0.563	0.045	172.317
$DLPUBINV_{t-4}$	92.768	0.188	0.132	12.437	0.001	178.846
$DLCREDIT_{t-2}$	60.176	0.467	–0.013	–4.341	0.438	162.068
$DLCREDIT_{t-3}$	84.711	0.308	–0.049	–1.911	0.074	167.728
TV for DLPUBINV Equation						
$DLPUBINV_{t-3}$	10.672	0.944	–0.046	–0.978	0.020	97.364
$DLCREDIT_{t-2}$	3.221	1.992	–0.053	–2.068	0.368	92.275

Notes: Loglk denotes log-likelihood. F-test $(\theta_2^{'} = 0)$ is the test of whether the estimated coefficients accompanying the transition function in each single equation are jointly equal to zero. It tests for the specification of the LSTR models against a linear specification. However, when the equations are estimated in a system, in particular for DLPRIVINV and DLPUBINV equations with RIQ_{t-4} and $DLCREDIT_{t-2}$ as TV_{t-d}, and insignificant coefficients are dropped from the system applying a LR test, there is no evidence that all those coefficients are equal to zero. Even though the t-statistics for the estimated coefficients *c* and γ are reported in this table, the lowest t-statistics cannot be interpreted as evidence for linearity. A precise estimation of γ needs many observations around *c* and becomes more difficult when this parameter is large. See for instance, Franses and van Dijk (2000), page 91 and Granger and Teräsvirta (1993), page 123. Another element we should consider is that these parameters are not identified under the null hypothesis of linearity (Davies problem), so they do not follow the standard distribution.

Table 5.4

Venezuela: estimation options for the nonlinear system according to the selection of transition variables

	Transition variables		
Equation for:	**Option 1**	**Option 2**	**Option 3**
$DLPRIVINV_t$	$DLCREDIT_{t-1}$	$DLCREDIT_{t-1}$	RIQ_{t-4}
$DDLCREDIT_t$	$DLCREDIT_{t-3}$	$DLCREDIT_{t-3}$	$DLCREDIT_{t-3}$
$DRIQ_t$	$DLCREDIT_{t-3}$	$DLPUBINV_{t-4}$	$DLPUBINV_{t-4}$
$DLPUBINV_t$	$DLCREDIT_{t-2}$	$DLPUBINV_{t-3}$	$DLPUBINV_{t-3}$

After estimation, we evaluate each of the three specifications. For such purposes, we use diagnostic tests on the residuals and evaluate the long-run properties while computing impulse response functions.[33] Only in Option 1 is convergence achieved. Options 2 and 3 are discarded because they are globally unstable. How the impulse response functions are computed is the subject of the next section. A diagnostic test is performed on the residuals of Option 1. We apply the F test version of the LM serial correlation test proposed by Eitrheim and Teräsvirta (1996) in the four nonlinear equations. This test can be seen as a generalization of the Breusch and Pagan LM test for autocorrelation for linear specifications (Franses and van Dijk (2000), page 110). In addition, the Jarque-Bera normality test and the Engle's ARCH-LM test are applied to all five equations.[34] All equations passed diagnostic tests except the credit equation, which presented serial correlation. Adding own lag values omitted in the linear specification, $DDLCREDIT_{t-2}$ and $DDLCREDIT_{t-4}$, solves serial correlation, in the credit equation. The residuals of this equation also present an important outlier in 1989:1, the period of implementation of the structural reform program. Thus, D891 was included to control for this effect. Under the new specification all equations pass the diagnostic test. The statistics for these tests are reported in the bottom of Table 5.5.

33 The evaluation of the long-run dynamic of smooth transition models cannot be done analytically. A numerical solution is instead recommended. See Teräsvirta et al (1994), page 2945 and Granger and Teräsvirta (1993), page 128. Also, we can evaluate the dynamic properties of the model when computing the impulse responses. That is, if the effects of a shock die out, this implies the model is stationary.

34 Eitrheim and Teräsvirta (1996) do not recommend using the Ljung-Box Q-statistic to analyze the residuals of smooth transition models because its distribution is unknown under the null. Eitrheim and Teräsvirta also propose a test for remaining nonlinearity and parameter constancy for smooth transition models. However, because of data limitations and the large number of additional parameters to be estimated in this research, their application is impractical.

Table 5.5

Venezuela: estimated logistic smooth transition subset vector error correction (LSTVEC) model for private investment and its determinants with lagged rate of growth of real stock of credit used as transition variable (Option 1)

Period 1984:3–2000:4

	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$	
	Coeff.	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**
C1	–0.300	–8.719	–0.002	–0.385	0.013	2.281	–0.112	–7.798	–0.515	–14.110
DS2	0.582	6.843	–	–	–	–	0.171	6.755	0.897	13.401
DS3	–	–	0.026	2.347	0.041	3.495	0.141	8.001	0.917	14.237
DS4	0.481	8.110	–	–	–0.036	–3.078	0.185	8.277	0.666	13.768
D861	–	–	–	–	–	–	–	–	0.346	7.159
D891	–	–	–0.089	–3.635	–0.220	–13.853	–	–	–	–
D942	–	–	–	–	–0.077	–3.388	–	–	–	–
D944	–	–	–0.237	–9.846	–	–	–	–	–	–
D962	–	–	–0.296	–10.003	–	–	–	–	–	–
$DLPRIVINV_{t-1}$	–0.500	–4.644	–	–	–	–	0.043	2.190	–	–
$DLPRIVINV_{t-2}$	–	–	–	–	–	–	–	–	–	–
$DLPRIVINV_{t-3}$	–	–	–	–	–	–	0.080	4.446	0.832	4.853
$DLPRIVINV_{t-4}$	–0.194	–2.253	–	–	–	–	–	–	0.170	3.167
$DDLCREDIT_{t-1}$	0.523	3.213	–0.147	–2.362	–	–	–	–	–	–
$DDLCREDIT_{t-2}$	–	–	–0.088	–1.547	–0.085	–2.081	–	–	–	–
$DDLCREDIT_{t-3}$	–	–	–0.240	–3.597	–	–	–	–	–	–
$DDLCREDIT_{t-4}$	–	–	–0.074	–1.007	0.203	2.360	–	–	–	–
$DRIQ_{t-1}$	–	–	0.367	4.046	–	–	–	–	2.251	5.926
$DRIQ_{t-2}$	–	–	–	–	–	–	–	–	2.839	9.431
$DRIQ_{t-3}$	–0.706	–2.770	–	–	–0.150	–2.403	–	–	–	–
$DRIQ_{t-4}$	–	–	–	–	–	–	–0.149	–2.242	2.099	3.667
$DLPRIVGDP_{t-1}$	1.680	3.878	–	–	–	–	–0.220	–2.258	–	–
$DLPRIVGDP_{t-2}$	1.331	3.270	–	–	0.292	2.480	–	–	–	–
$DLPRIVGDP_{t-3}$	2.321	5.183	–0.201	–2.265	–0.153	–1.712	–	–	–	–
$DLPRIVGDP_{t-4}$	–	–	–	–	–	–	–0.167	–1.666	–	–
$DLPUBINV_{t-1}$	0.182	2.262	–	–	0.097	5.458	0.080	3.925	–	–
$DLPUBINV_{t-2}$	–0.389	–6.672	–	–	–	–	0.062	3.397	0.781	5.689
$DLPUBINV_{t-3}$	–	–	–	–	–	–	0.079	4.394	–	–
$DLPUBINV_{t-4}$	–	–	–	–	–	–	–	–	–	–

Table 5.5 (cont)

Venezuela: estimated logistic smooth transition subset vector error correction (LSTVEC) model for private investment and its determinants with lagged rate of growth of real stock of credit used as transition variable (Option 1)

Period 1984:3–2000:4

	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$	
	Coeff.	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**
CIV	–	–	–	–	–	–	–0.038	–2.924	–0.452	–4.790
C2 F(.)	–	–	–0.055	–2.936	–0.021	–2.687	–	–	–0.074	–1.741
$DLPRIVINV_{t-1}$ F(.)	0.471	2.940	–	–	–	–	–	–	–	–
$DLPRIVINV_{t-2}$ F(.)	–	–	–	–	–	–	–	–	–	–
$DLPRIVINV_{t-3}$ F(.)	–	–	–	–	–	–	–	–	–0.770	–3.823
$DLPRIVINV_{t-4}$ F(.)	–0.565	–2.973	–	–	–	–	–	–	–	–
$DDLCREDIT_{t-1}$ F(.)	–	–	–0.653	–3.252	–0.165	–2.708	–	–	–	–
$DDLCREDIT_{t-2}$ F(.)	–	–	–0.468	–2.145	–0.184	–2.168	–	–	–	–
$DDLCREDIT_{t-3}$ F(.)	–	–	0.341	2.436			–	–	–	–
$DDLCREDIT_{t-4}$ F(.)	–	–	0.080	0.638	–0.243	–2.570	–	–	–	–
$DRIQ_{t-1}$ F(.)	–	–	–3.674	–5.136	–	–	–	–	–3.662	–4.672
$DRIQ_{t-2}$ F(.)	–	–	–	–	–	–	–	–	–2.437	–4.069
$DRIQ_{t-3}$ F(.)	–	–	–	–	–0.251	–1.997	–	–	–	–
$DRIQ_{t-4}$ F(.)	–	–	–	–	–	–	–	–	–4.586	–4.456
$DLPRIVGDP_{t-1}$ F(.)	–	–	–	–	–	–	–	–	2.065	5.418
$DLPRIVGDP_{t-2}$ F(.)	–1.569	–2.187	–	–	0.196	1.752	–	–	2.172	5.234
$DLPRIVGDP_{t-3}$ F(.)	1.387	2.624	–	–	–	–	–	–	–	–
$DLPRIVGDP_{t-4}$ F(.)	–	–	–	–	–	–	–	–	–2.004	–5.123

Table 5.5 (cont)

Venezuela: estimated logistic smooth transition subset vector error correction (LSTVEC) model for private investment and its determinants with lagged rate of growth of real stock of credit used as transition variable (Option 1)

Period 1984:3–2000:4

	$DLPRIVINV_t$		$DDLCREDIT_t$		$DRIQ_t$		$DLPRIVGDP_t$		$DLPUBINV_t$	
	Coeff.	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**	**Coeff.**	**T-stat.**
$DLPUBINV_{t-1}$ F(.)	–	–	–	–	–0.075	–3.480	–	–	–0.377	–4.749
$DLPUBINV_{t-2}$ F(.)	0.312	2.492	–	–	–	–	–	–	–0.997	–5.957
$DLPUBINV_{t-3}$ F(.)	–	–	–	–	–	–	–	–	–0.346	–4.520
$DLPUBINV_{t-4}$ F(.)	–	–	–	–	–	–	–	–	–	–
CIV F(.)	–	–	–	–	–	–	–	–	0.392	2.835
$\hat{\gamma}$	33.295	0.819	65.438	(fixed)	87.711	(fixed)	–	–	3.110	3.792
$\hat{c}$	0.008	2.223	0.035	22.195	–0.049	(fixed)	–	–	–0.047	–5.366
R^2adj	0.600		0.789		0.788		0.767		0.949	
JB	1.067		4.009		0.404		1.982		1.484	
FAR(1)	0.001		2.449		0.541		1.298		0.064	
FAR(4)	0.325		1.048		0.541		0.722		0.117	
FARCH(1)	0.002		0.015		1.132		0.611		0.510	
FARCH(4)	0.369		0.753		0.466		0.851		1.159	

Notes: To calculate FAR(*i*), *i* = 1,4, missing observations at the beginning of the series of lagged residuals are replaced by zeros as recommended by Teräsvirta (1998), page 520. C1 and C2 denote the constant term in the linear and augmented part of each equation, respectively. R2 adj. is the adjusted R2. F(.) denotes the logistic smooth transition function. JB accounts for the Jarque-Bera statistic to test for normality. It is distributed as a χ^2_2. CIV denotes the cointegrating vector.

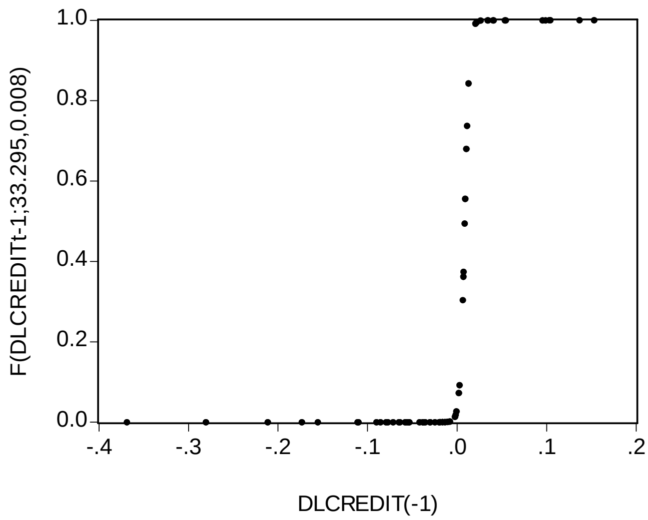
The estimated transition functions

Figures 5.1 and 5.2 depict the four estimated transition functions for Option 1. Transition is very fast from one regime to the other in all equations but public investment. In the credit and interest rate equations, with too few observations around the estimated transition parameters and a high speed of adjustment given by the estimated smooth parameters, the transition function takes mainly values of zero and one, indicating threshold specifications. The transition function for the private investment equation depicts a fast transition from the low to the high regime.

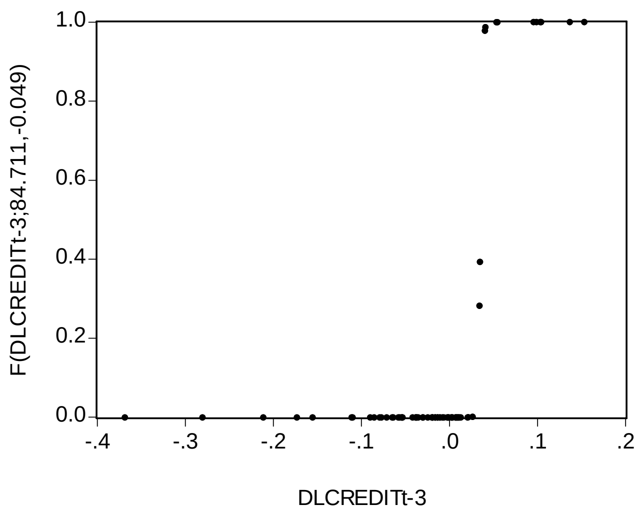
In the private investment equation, the estimated value of *c* = 0.008 – which is close to zero – allows the association of these two regimes to credit contraction (F(.) = 0) and credit expansion (F(.) = 1). However, this cannot be generalized to other equations in the system because estimated transition parameters close to zero are not observed in those equations. For instance, the estimated value of *c* has similar negative values, –0.047 and –0.049, in the public investment and interest rate equations respectively while it is positive and equal to 0.035 in the credit equation.

Figure 5.1

Private investment and credit equations: estimated logistic transition functions versus transition variables



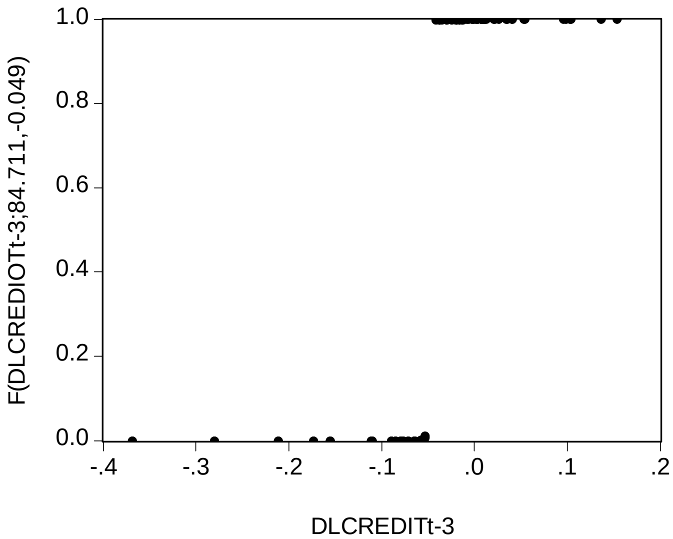
(a) Transition function for DLPRIVINV equation



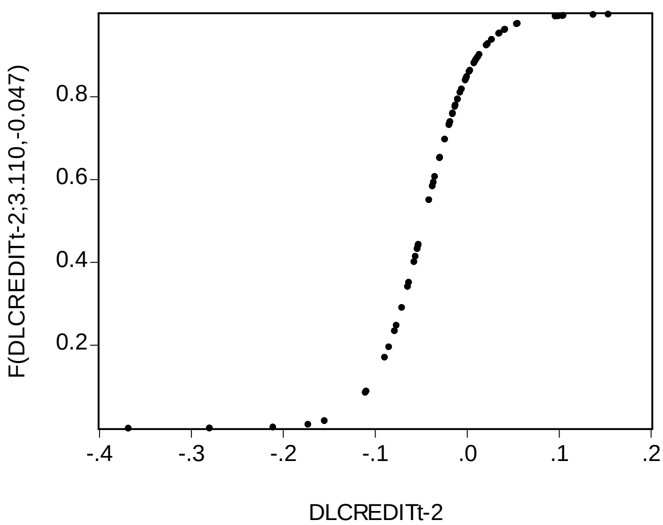
(b) Transition function for DDLCREDIT equation

Figure 5.2

Real interest rate and public investment equations: estimated transition functions versus transition variables



(c) Transition function for DRIQ equation



(d) Transition function for DLPUBINV equation

6. Testing for differential effects of real interest rates and credit availability on private investment

To investigate the differential effects of interest rates and credit availability on private investment, we compute generalized impulse response functions[35] using the Monte Carlo

[35] Generalized impulse response functions can be used for linear and nonlinear models. However, they are particularly recommended for computing the effect of shocks in one variable on the forecast of another

technique described in Koop et al (1996) and applied by Weise (1999) to study the asymmetric effects of monetary policy using data for the US. We explore how private investment responds to shocks of different sizes and signs and how different this response is when there is a credit contraction or expansion. In addition to shocks to financial variables, we also investigate how the growth rate of private investment responds to shocks to the growth rate of public investment, private GDP, and to its own growth rate.[36]

This section presents the impulse response functions for one-standard-error positive, negative, and average shocks.[37] Negative shocks are multiplied by minus one to make them comparable to the responses to one-standard-error shocks. We also compute impulse response functions to two-standard-error shocks and normalize them by dividing by two to make them comparable to the responses to one-standard-error shocks.

However, these results are not shown because, in general, we found similar impulse response functions to one-standard-error shocks.

6.1 Response of DLPRIVINV to shocks of different sign to DRIQ

Shocks to DRIQ have the opposite sign on DLPRIVINV. Figure 6.1 reports the effect of shocks of different signs to DRIQ on DLPRIVINV. This figure shows that DLPRIVINV is more responsive to negative shocks than to positive shocks to DRIQ, and this effect is stronger for both positive and negative shocks when the shock is caused in the low credit regime. At longer periods, a negative shock has a cumulative positive effect on DLPRIVINV, and this effect seems to be stronger when the shock occurs in the low credit regime. Positive shocks are also found to be stronger in the lower credit regime, but this effect, in absolute terms, is smaller than the effect of negative shocks to DRIQ.

6.2 Response of DLPRIVINV to shocks of different signs to DDLCREDIT

Figure 6.2 reports that positive shocks to DDLCREDIT have positive impacts on DLPRIVINV and that these impacts are stronger and less volatile when the economy is initially in the high credit regime. While negative shocks cause a contraction in DLPRIVINV in earlier periods, the cumulative response of DLPRIVINV to DDLCREDIT oscillates between positive and negative values in later periods. We interpret this last result as having no effect on the rate of growth of private investment.

When the economy is initially facing a credit contraction, in earlier periods, a negative shock to DDLCREDIT has a stronger effect on DLPRIVINV than a positive shock (see Figure 6.2.c). This result is mild evidence for a more responsive private investment to credit when credit restrictions are more severe, as the theory of financial liberalization predicts.

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variable when using a nonlinear model. Generalized impulse response functions take into account that in a nonlinear model impulse response functions depend on the initial conditions and on the sign and magnitude of the shocks.

[36] Structural shocks are identified using a Choleski decomposition following the order DLPUBINV, DLPRIVGDP, DLPRIVINV, DRIQ, DDLCREDIT. With this ordering, it is assumed that the government takes investment decisions based on the past information of private sector variables. Also, it is probable that DLPRIVGDP affects DLPRIVINV rather than the other way around in the short run. Since the correlation between DLPRIVINV and DRIQ is contemporaneously positive, then DLPRIVINV should affect DRIQ. The converse does not make theoretical sense even though we investigate whether the effects of the real interest rate on private investment can be positive given some economic conditions. A similar ordering is used for the ordering of DRIQ and DDLCREDIT. For more specific details on how the generalized impulse response functions are constructed in this study, see Mendoza Lugo (2001), Chapter IV.

[37] One-standard-error shock to these five variables, in the same order as is listed, are of the following size: 1.044, 1.074, 0.996, 1.178, and 1.018.

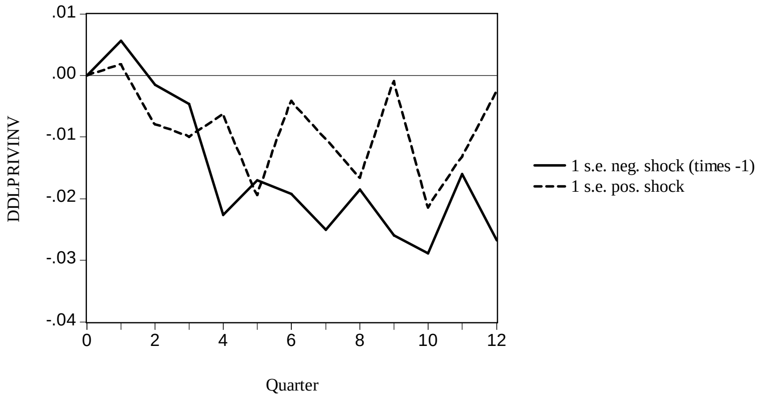
6.3 Response of DLPRIVINV to shocks of different signs to DLPUBINV

Shocks to DLPUBINV have opposite effects on DLPRIVINV. A negative shock to DLPUBINV has an important cumulative positive effect on DLPRIVINV up to period 12. Some asymmetries are observed after the third period between positive and negative shocks. That is, DLPRIVINV is more volatile with positive shocks and more responsive to negative shocks to DLPUBINV (Figure 6.3).

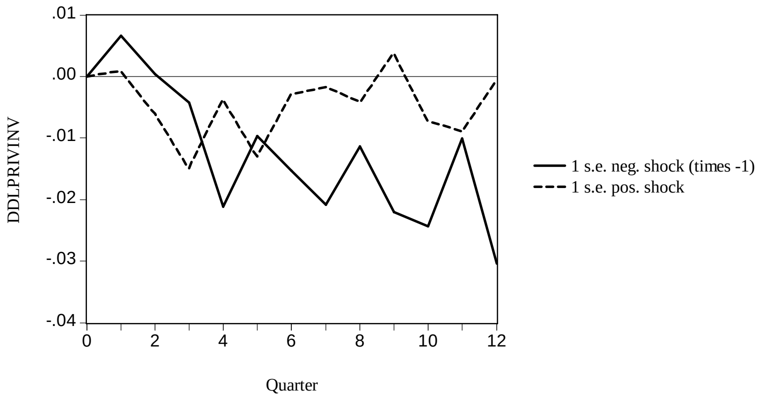
Figure 6.1

Venezuela: effects of one-standard-error positive and negative shocks to DRIQ on DLPRIVINV

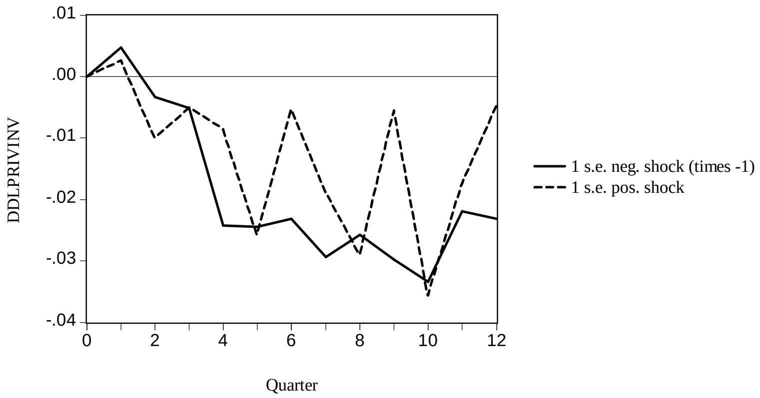
Total average and given the initial state of the economy



(a) Cumulative response of DLPRIVINV to DRIQ: Total average



(b) Cumulative response of DLPRIVINV to DRIQ: High credit regime

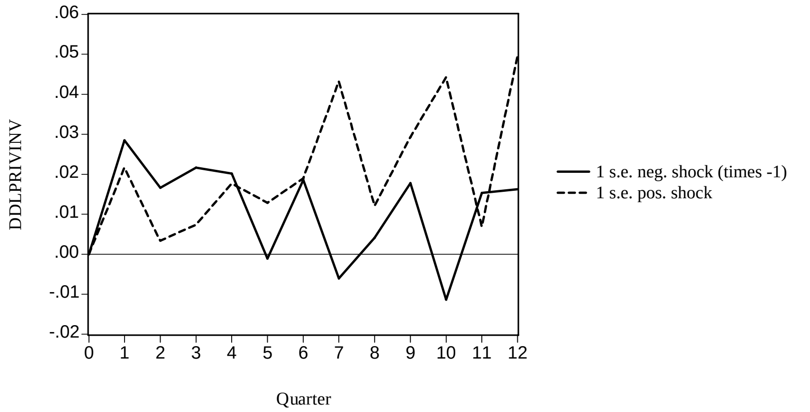


(c) Cumulative response of DLPRIVINV to DRIQ: Low credit regime

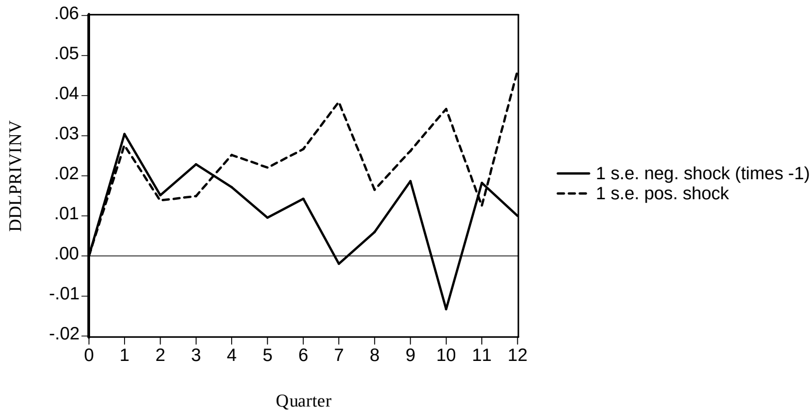
Figure 6.2

Venezuela: effects of one-standard-error negative and positive shocks to DDLCREDIT on DLPRIVINV

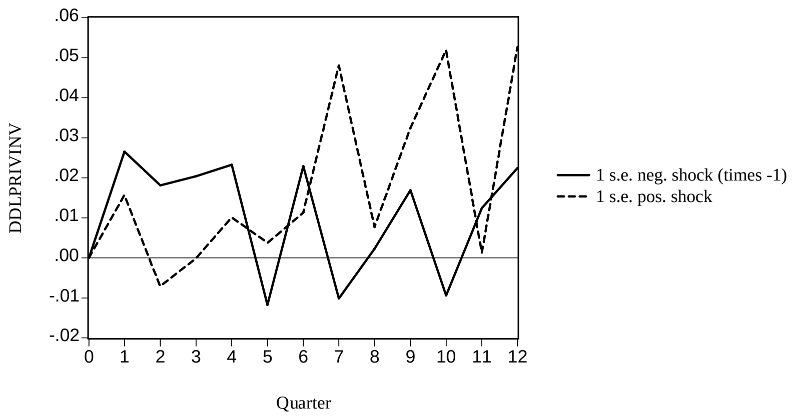
Total average and given the initial state of the economy



(a) Cumulative response of DLPRIVINV to DDLCREDIT: Total average



(b) Cumulative response of DLPRIVINV to DDLCREDIT: High credit regime

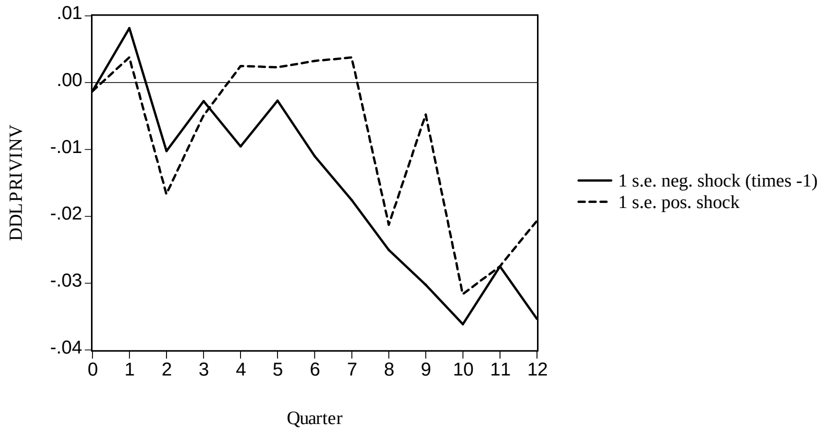


(c) Cumulative response of DLPRIVINV to DDLCREDIT: Low credit regime

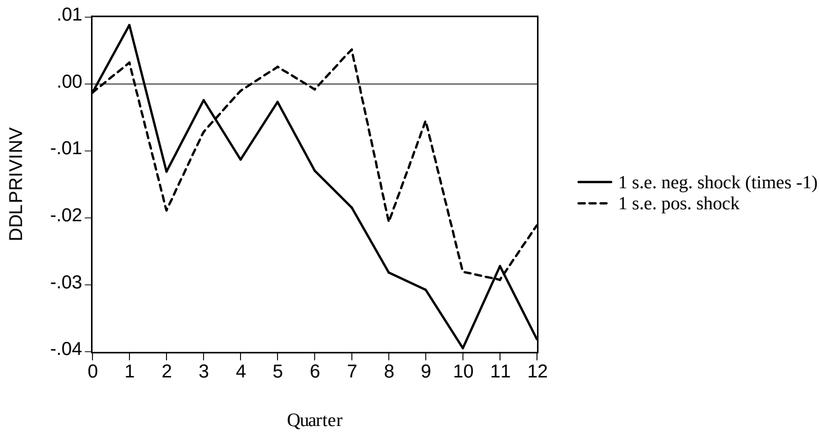
Figure 6.3

Venezuela: effects of one-standard-error positive and negative shocks to DLPUBINV on DLPRIVINV

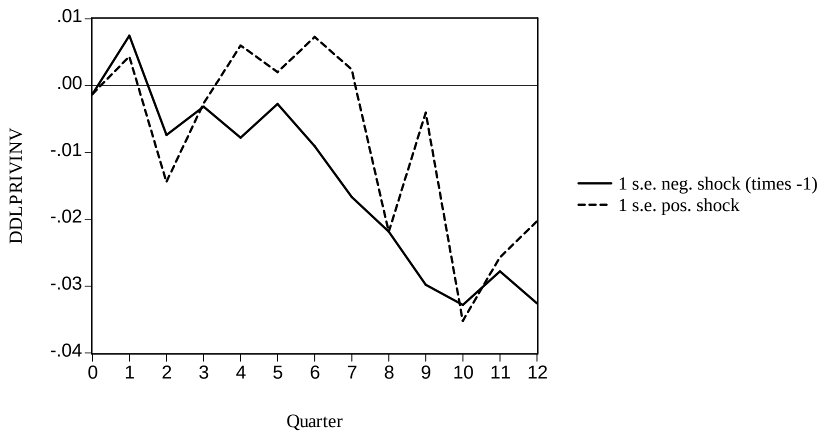
Total average and given the initial state of the economy



(a) Cumulative response of DLPRIVINV to DLPUBINV: Total average



(b) Cumulative response of DLPRIVINV to DLPUBINV: High credit regime



(c) Cumulative response of DLPRIVINV to DLPUBINV: Low credit regime

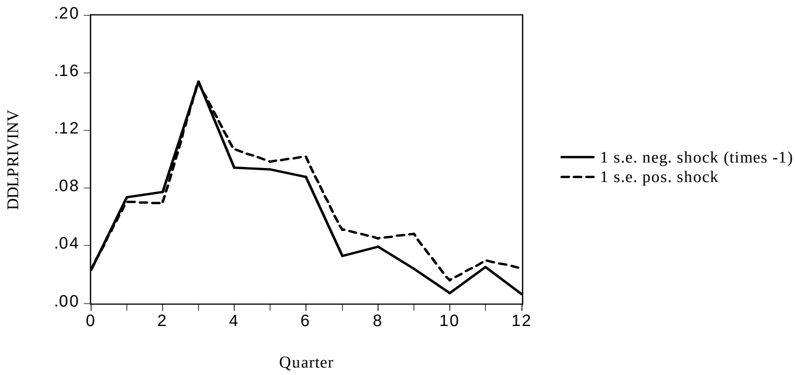
6.4 Responses of DLPRIVINV to shocks to DLPRIVGDP and DLPRIVINV

Even when private investment causes private GDP in the long run without causality observed in the opposite direction, impulse response functions of DLPRIVINV to shocks to DLPRIVGDP reveal this variable to be the most important determinant of private investment in the short run. A standard error shock to DLPRIVGDP causes a cumulative response in DLPRIVINV of 16% by the third period. After that period, this effect starts to decrease, achieving values near zero by the 12th period (Figure 6.4). Furthermore, DLPRIVINV has an important immediate response of the same sign to its own shocks. This, however, vanishes as time passes and reaches near zero by the 12th period (Figure 6.5). In both cases, responses are symmetric and independent of the initial state of the economy.

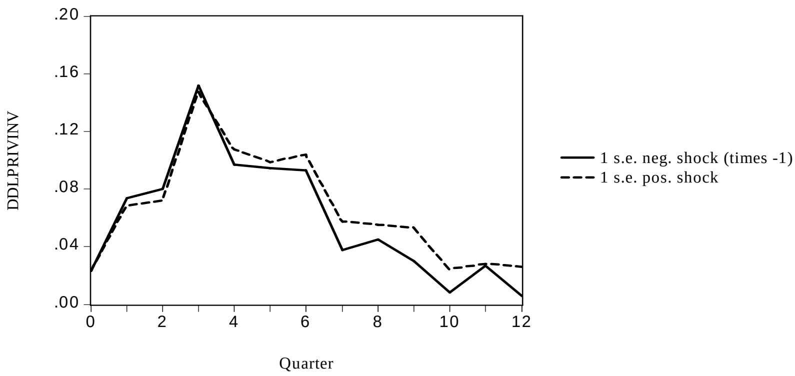
Figure 6.4

Venezuela: effects of one-standard-error positive and negative shocks to DLPRIVGDP on DLPRIVINV

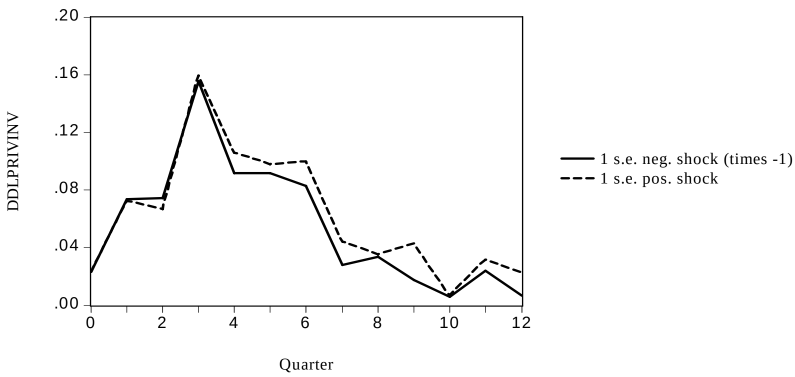
Total average and given the initial state of the economy



(a) Cumulative response of DLPRIVINV to DLPRIVGDP: Total average



(b) Cumulative response of DLPRIVINV to DLPRIVGDP: High credit

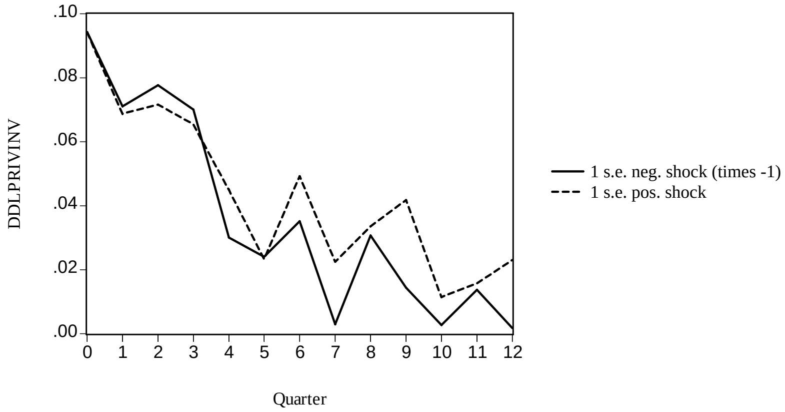


(c) Cumulative response of DLPRIVINV to DLPRIVGDP: Low credit

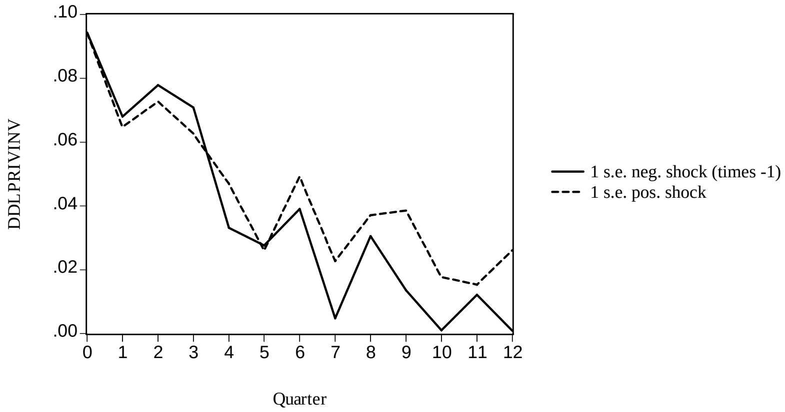
Figure 6.5

Venezuela: effects of one-standard-error positive and negative shocks to DLPRIVINV on DLPRIVINV

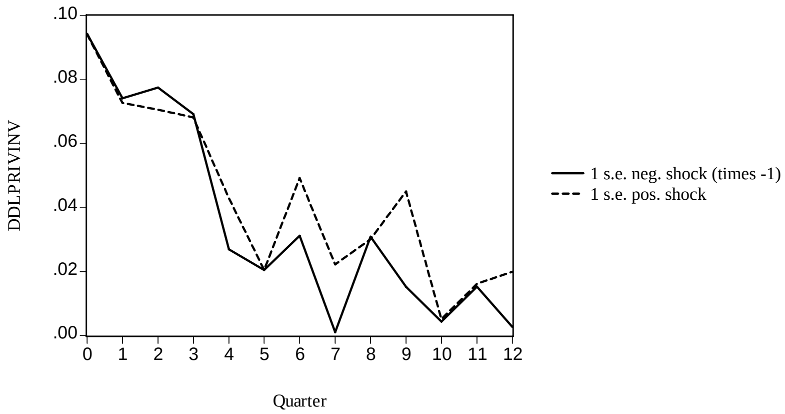
Total average and given the initial state of the economy



(a) Cumulative response of DLPRIVINV to DLPRIVINV: Total average



(b) Cumulative response of DLPRIVINV to DLPRIVINV: High credit regime



(c) Cumulative response of DLPRIVINV to DLPRIVINV: Low credit regime

7. Conclusions

Venezuela is a developing country that had very low average real interest rates in the past. Part of the period of study, 1983:1–1988:4, was characterized by administrative controls on nominal interest rates. Since 1989, more flexible interest rate policies have been adopted. According to the financial liberalization theory, we should expect that in those economies with very low or negative real interest rates, a positive shock to interest rates would cause a positive effect on private investment while the same effect is negative, according to the traditional theory, at higher rates. This theory suggests a nonlinear relationship between private investment and real interest rates with real interest rates describing the states of the economy. However, from the Venezuelan data we did not find evidence for using the real interest rate as a transition variable in a smooth transition logistic vector error correction (LSTVEC) model. Evidence was in favor of using lagged values of DLCREDIT as a transition variable. Under such a specification with two regimes – low credit and high credit – we have estimated the effects of shocks to changes in real interest rates, DRIQ, on the growth rate of private investment, DLPRIVINV. We should expect that in periods of credit contraction, a positive shock to real interest rates will have a positive effect on private investment. However, we did not find evidence for such an effect using Venezuelan data. In both regimes positive shocks to DRIQ have negative effects on DLPRIVINV, and this accumulated effect is more negative in the lower regime. Furthermore, the effect of positive shocks to DRIQ on DLPRIVINV is lower in absolute values than the response to negative shocks. Negative shocks to DRIQ on DLPRIVINV have a stronger cumulative effect when they start in the low regime.

Despite the fact that we have found evidence for asymmetric effects between positive and negative shocks to DRIQ on DLPRIVINV, those results do not support McKinnon's argument of positive shocks on DRIQ causing a rise in DLPRIVINV, even in periods of credit contraction.

In addition, the Venezuelan data provides evidence for an asymmetric response of DLPRIVINV to shocks in DDLCREDIT for immediate periods after a negative shock to credit when the economy is already facing credit contractions, as was expected. On the other hand, the cumulative response of DLPRIVINV to positive shocks to DDLCREDIT becomes bigger in later periods when the high credit regime prevails. Why investment is more responsive to negative shocks to interest rates when facing credit contraction and more responsive to positive shocks to DDLCREDIT when facing credit expansion is difficult to explain.

While the responses of the rate of growth of private investment to shocks to the rate of growth of private GDP and to its own shocks are symmetric, they emerge as the most important forces driving investment spending in the short run.

Furthermore, the fact that the cointegrating vector does not enter into the private investment equation tells us that the opposite effect on DLPRIVINV of shocks to DLPUBINV is temporal. This is evidence that public investment acts as a substitute for private investment in the Venezuelan economy. Public investment has a negative effect on private investment when the government competes with the private sector to obtain the resources to finance investment projects or when it provides goods that can be produced by the private sector. Shocks to DLPUBINV of opposite effect on DLPRIVINV invite us to study the effects of public investment policy in more detail using disaggregate data on public investment spending.

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