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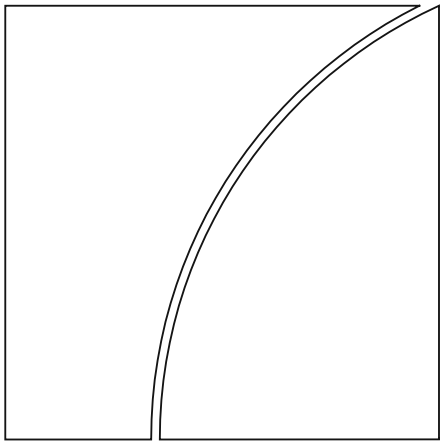

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Interest rate risk exposures of non-financial corporates and households

Implications for monetary policy transmission and financial stability

Report prepared by a CGFS Working Group chaired by Nicola Brink (South African Reserve Bank)

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Executive summary

The exposures of non-financial corporates (NFCs) and households to interest rate risk are of direct importance for the transmission of monetary policy to aggregate demand – an essential element of inflation control – and for financial stability. In the context of the non-financial private sector, interest rate risk is the risk that market interest rates affect financial incomes, asset prices and debt servicing burdens. In turn, these effects would translate into changes to investment and consumption – jointly "spending", a component of aggregate demand – and would have a bearing on NFCs' and households' creditworthiness. This report focuses on monetary policy rates as a source of interest rate risk – at its core are the *sensitivity of aggregate demand* and NFCs' and households' *financial resilience* to policy rate *hikes*.

The sensitivity of household and NFC spending to a rise in the monetary policy rate manifests itself through three main channels. First, the *interest rate channel* arises from the opportunity costs of spending, which reflect the return on savings and influence the hurdle rate of investment. Second, the *income/cash flow channel* reflects the impact of a policy rate hike on borrowers' and savers' net incomes. To the extent that households and NFCs spend out of income, the relative footprint of borrowers and savers determines the channel's net effect on aggregate demand. Third, the *wealth channel* arises from downward revisions to asset valuations that result from interest rate hikes and make households poorer, leading them to consume less, and reduce firms' net worth, disincentivising them to reinvest profits.

Financial resilience, in turn, refers to borrowers' ability to avoid default. It is higher when there are delays or mitigants to the impact of rate hikes on debt servicing costs. It also increases with borrowers' capacity to absorb such costs with liquidity buffers or cash flows. Conversely, the weaker borrowers' financial resilience, the more lenders raise risk premia when central banks tighten financial conditions. The resulting higher borrowing rates would not only further impair borrowers' creditworthiness but also fuel the income/cash flow channel. This would set in motion a self-reinforcing and potentially destabilising mechanism, known as the *financial accelerator* (Bernanke and Gertler (1989)), which might trigger defaults. Ultimately, the fallout of default-related losses could threaten financial stability.

The first set of findings is on general historical regularities with regard to the effects of monetary policy tightening on borrowing costs, aggregate demand and financial stress. The underlying data cover up to 23 advanced economies (AEs) and 26 emerging market economies (EMEs) from 1985 to 2016, and the specific tightening in focus is an exogenous 1 percentage point increase in the policy rate. A key finding is that the pass-through to the *average* borrowing rate on households' and NFCs' outstanding debt peaks four to five quarters after the start of the tightening, at 40–60% of the rate hike. In turn, real investment and gross domestic product (GDP) fall by 5% and 2%, respectively, reaching their troughs after 20 quarters. As signs of financial stress, non-performing loans start increasing eight quarters after a policy rate hike and peak after 12 quarters for households and 20 quarters for NFCs. And the probability of a financial crisis in the first eight quarters following a rate hike increases by 1–2 percentage points.

In addition, the report examines how macro-financial conditions influence the likelihood that taming inflation brings financial vulnerabilities to the fore. The main findings are as follows. Aggregate demand declines more and faster when the rate hikes take place during a joint credit and asset price boom – as it intensifies the income/cash flow and wealth channels. Thus, such a boom can lead to a short tightening cycle that does not affect the likelihood of a financial crisis. However, when the joint boom is combined with persistent and adverse supply shocks – more generally, with below-trend aggregate productivity, which intensify the interest rate channel *as well* – the rate hikes tend to also usher in financial stress. One reason is that an "unproductive boom" combines high indebtedness with low earnings, resulting in weak debt servicing capacity. It also generally induces persistent inflationary pressures that lead the central bank to keep the policy rate high for long in the presence of financial vulnerabilities.

Structural cross-country differences also affect the fallout of historical policy rate hikes. These notably include the debt structure prevailing in a given country (maturity and rate variability), borrowers'

balance sheet strength, households' interest rate risk exposure by income group (revealed by a novel data set from 13 countries) and the domestic regulatory environment. All else equal, a larger proportion of short-term variable rate debt would lead to a quicker and stronger transmission of policy rate increases, while holdings of liquid assets would act as a buffer and mitigate the impact of higher borrowing costs. Additionally, stricter borrower-level regulations, such as limits on the debt servicing burden, can dampen the overall transmission of policy rate increases to aggregate demand and financial instability.

The report also uses historical experience as a benchmark to assess the evolution of average borrowing rates, aggregate demand and non-performing loans at the early stage of the latest monetary policy tightening cycle. In the aggregate, across many of the countries included in the analysis, consumption and investment seem to have been –if anything– more resilient in the first six quarters of this cycle than the historical norm. This finding is consistent with some households and NFCs taking advantage of the long preceding period of low interest rates to secure long-term fixed rate debt, thus insulating, to an extent, average borrowing rates from the monetary tightening. More broadly, the private non-financial sector also benefited from pandemic-related fiscal support measures, which allowed households and NFCs to build liquidity buffers and generally strengthen their balance sheets. Such prepositioning likely contributed to non-performing loan ratios remaining contained at the early stage of the tightening cycle. That said, historical experience with lags in the effects of rate hikes indicates that, at the cut-off date of the analysis, it was still too early to draw definitive conclusions about the financial resilience of the household and corporate sectors.

Additional specificities of the macro-financial context at the onset of the latest tightening cycle shed further light on these findings. For instance, favourable labour market developments and resilient house prices – which weaken the income and wealth channels – were likely contributors to the resilience of consumption. By contrast, several pandemic-related and post-pandemic factors may have worked to intensify the interest rate and income channels for NFCs by hurting productivity and earnings. Notably, lingering supply chain disruptions, the drying up of trade credit, energy price increases and incentives to maintain high precautionary liquidity buffers seem to have weighed down on investment more in some countries than in others. And when it comes to non-financial private sector borrowers' financial resilience, successful and targeted prudential policies could have also played a role in some countries.

The report contributes in three ways to extant analyses of how interest rate risk exposure in the private non-financial sector influences the transmission of monetary policy and financial stability. First, it takes a unified approach to analysing the chain of monetary policy transmission – covering borrowing rates, consumption, investment and measures of financial stress. It largely confirms findings on historical regularities by previous studies that focus on parts of the chain and use a variety of empirical methods. Second, the report documents differences in the transmission of monetary policy across a broad range of advanced and emerging market economies and reviews potential drivers, partly on the basis of novel data sets. Third, the report proposes an early comparison between implications of the latest monetary policy tightening and the corresponding implications observed historically.

1. Introduction

When central banks raise their policy rate, they seek to offset macroeconomic overheating and inflationary pressures while preserving financial stability. Attaining this objective hinges on the *sensitivity* of aggregate demand to interest rate hikes. Financial *resilience* in the face of such hikes is also a prerequisite for success.

Following the post-Covid-19 monetary tightening, the Committee on the Global Financial System (CGFS) established a Working Group and tasked it with studying the above-mentioned sensitivity and resilience.

This Working Group had two concrete objectives. The first was to assess the exposures and vulnerability of non-financial corporates (NFCs) and households to interest rate risk – concretely, the risk that changes in monetary policy rates affect financial incomes, asset prices and debt servicing burdens. The second objective was to analyse how such exposures and vulnerability influence the transmission of policy rate hikes to aggregate demand as well as financial stability. Interest rate exposures of other institutional sectors (eg government and financial institutions) or the transmission channels of unconventional monetary policy remained out of scope.

This report – which presents the Working Group's analyses and findings – provides a partial analysis of the importance of interest rate risk exposures in the private non-financial sector for the transmission of monetary policy and financial stability. Due to data constraints, only the transmission through debt servicing costs and the attendant role of financial buffers are captured directly and systematically. Effects through financial incomes are captured only partially, while those due to asset prices and non-price factors – such as stricter credit standards or credit rationing – only to the extent that they manifest themselves in consumption, investment and measures of financial stress.

The report is organised in six sections. Section 2 reviews the main transmission channels of monetary policy and the attendant role of initial macro-financial conditions. Taking a historical perspective, Section 3 derives regularities with regard to the effects of a policy rate hike on consumption, investment and financial stability and the dependence of these effects on initial macro-financial conditions. Section 4 documents cross-country differences in the strength and speed of monetary policy transmission and reviews possible reasons. Section 5 compares the latest monetary policy tightening episode with historical norms. Section 6 concludes with a summary of the main takeaways.

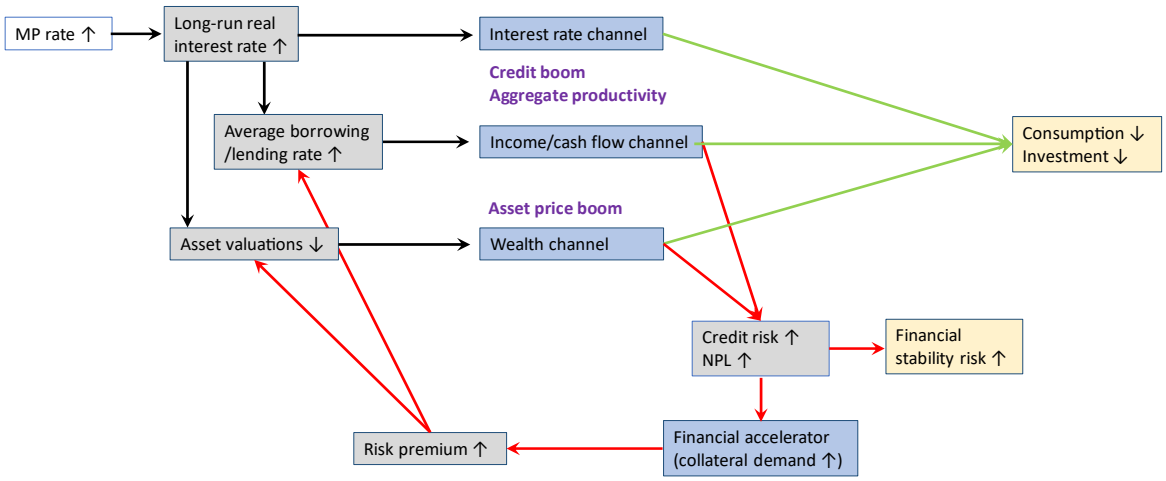
The report also contains seven boxes, summarising geographically focused analyses on: NFCs' debt structures (Box A); households' borrowing costs across income and credit-score groups (Boxes B and C); NFCs' use of interest rate derivatives (Box D); the effects of policy rate changes on loan delinquencies (Box E); large firms' exposure to interest rate risk through the supply of trade credit (Box F); and inflation and real earnings disparities after the Covid-19 pandemic (Box G).

2. Monetary policy transmission to aggregate demand and credit risk

A stylised framework will guide the empirical analysis of how firms' and households' interest rate risk exposures affect monetary policy transmission and financial stability. This framework features four transmission channels: the interest rate channel, the income and cash flow channel, the wealth channel, and the financial accelerator channel (Graph 1).

To focus on the effect of interest rate increases and households' and firms' exposures to those increases, the framework purposely abstracts from other monetary policy tightening measures (eg quantitative tightening), from second round and "general equilibrium" feedback effects (eg due to a decline in economic activity), as well as from broader transmission channels through exchange rates (Taylor (2001)) and banks' balance sheets (Bernanke and Blinder (1992), Drechsler et al (2017)).

Transmission channels of a policy rate hike[1] Graph 1



[1] Grey, blue and yellow rectangles correspond to symptoms of monetary policy actions, transmission channels and ultimate effects, respectively. Possible initial macro-financial conditions are in purple. The green and red arrows relate to the effects of the rate hike on aggregate demand and financial stability, respectively. NPL: Non-performing loans. MP: Monetary policy.

Source: CGFS Working Group.

2.1. Main monetary policy transmission channels

2.1.1. Interest rate channel

The interest rate channel captures how a policy rate hike – through its effect on the cost of *new or repriced* borrowing or the return on *new or repriced* savings – affects investment and consumption. The channel starts with a transmission from the short-term nominal interest rate to the long-term real interest rate. This transmission is stronger the stickier prices are and the stronger expectations are that the current rate hike will persist, ie that future short-term rates will increase. Given an increased long-term real interest rate, households perceive a higher cost of borrowing to consume. Symmetrically, they perceive a higher return on savings – ie a higher opportunity cost of current consumption. A similar mechanism in the NFC sector raises the "hurdle" (expected) rate of return, which needs to be surpassed by a productive capacity for a firm to invest in this capacity. Ultimately, the greater the extent to which spending needs to be financed with new borrowing or is crowded out by new savings, the greater the fall in aggregate demand through the interest rate channel.

2.1.2. Income/cash flow channel

Households and firms often consume and invest more when their current cash flow is higher. This cash flow depends, among other things, on the effect of policy rate changes on the cost of their *overall* borrowing (ie interest payments) and on the rate of return of their *overall* savings (ie interest income). Thus, the income/cash flow channel reflects the extent to which – on the back of a policy rate hike – the increase in long-term rates translates into an average borrowing rate and an average rate of return on savings, and ultimately weighs on households' and firms' net income/cash flow. In turn, this depends on the type of prevailing savings and borrowing instruments – their time to maturity and whether they are fixed or variable rate.

In the aggregate, the net effect of a policy rate hike through the income/cash flow channel on aggregate demand and financial stability varies with the relative footprint of savers and borrowers. While savers' higher income will lead them to consume or invest more, borrowers would do the opposite. Thus,

the effect on aggregate demand will depend on which of the two groups dominates as well as on the respective income elasticity of consumption and investment – the so-called marginal propensity to consume or invest.

And if borrowers are unwilling or unable to compensate fully for the net income loss with a reduction in investment or consumption, they may default on their debt. A wave of defaults can undermine financial stability if the attendant credit losses surpass lenders' provisions.

2.1.3. Wealth channel

Consumption and investment decisions also reflect expectations of *future* income and cash flows, ie they also depend on wealth. Monetary policy tightening – or expectations thereof – sets the wealth channel to work by lowering asset valuations. All else equal, when the market value of a firm falls, it must issue more equity or borrow more to make an investment in new productive capacity of a given size. This lowers the incentive to invest. Similarly, when the values of their homes or financial portfolios decrease, households would feel less financially secure, foreseeing potential capital losses should they need to liquidate their assets. In turn, this may induce them to accumulate precautionary savings and cut consumption. Ultimately, the wealth channel indicates that an increase in the policy rate can lower aggregate demand even in the absence of debt.

As with the income channel, the wealth channel could also give rise to defaults. For instance, when the assets pledged as collateral lose value, the extent to which a household or a NFC can borrow against them declines and the terms of borrowing worsen. This can tip a household or a NFC in need of refinancing over the edge.

2.1.4. Financial accelerator and risk to financial stability

When the income and wealth channels raise credit risk in the system, they may also set in motion a self-reinforcing and potentially destabilising mechanism, known as the financial accelerator. This mechanism thrives in the presence of financial frictions – such as an asymmetry of information between borrowers and lenders. When non-performing loans (NPLs) or other manifestations of credit risk mount, lenders' lack of information about borrower quality may lead them to put in place some "safeguards", which can take the form of higher risk premia, a reduction in the supply of credit, or asking for higher quality collateral and/or imposing greater haircuts on existing collateral. This may induce borrowers to deleverage and sell the pledged collateral. In turn, the rise in borrowing rates and reduction in asset valuations would further fuel the income/cash flow and wealth channels, ultimately closing the loop by adding to the rise in NPLs.

2.2. Initial macro-financial conditions influencing the channels

The sensitivity of aggregate demand to monetary policy tightening and the attendant financial stability implications depend on the macro-financial conditions in which the rate hikes take place. The literature identifies three macro-financial factors that influence households' and firms' exposure and vulnerability to interest rates: the volume of debt, the scope for asset valuation corrections and aggregate productivity (Borio and Lowe (2002), Borio and Drehmann (2009), Schularick and Taylor (2012), Gorton and Ordoñez (2020)). These factors are considered in turn (Graph 1 slots them into the framework).

2.2.1. Credit boom

Indebtedness is a key factor determining the impact of a monetary policy rate hike through the interest rate and income/cash flow channel. High and broad-based indebtedness as a result of a credit boom implies that a large share of consumption and investment is financed by and rests on borrowing. Hence, the transmission of monetary policy tends to be strong in a credit boom.

The financial stability implications of a credit boom depend not only on the size of the boom but also on its cause and length. The longer the credit boom lasts, the more likely it is to entail the

accumulation of surplus capital – or "capital overhang" – and funding misallocation (Gorton and Ordoñez (2020), Cette et al (2016), Dell'Ariccia et al (2016), Boissay et al (2022)). As productive investment opportunities are exhausted over time and marginal returns diminish, funding is channelled towards less creditworthy borrowers, eg lower-income ("subprime") households or less productive ("zombie") firms. Such borrowers are less likely to repay their debt when policy rates and borrowing costs increase, triggering defaults that may sometimes have systemic repercussions.

2.2.2. Asset price booms

The scope for sharp and pronounced valuation drops is higher on the back of asset price booms. Indeed, sharp rises in stock and house prices are often driven by overly optimistic expectations about future prices (eg Gennaioli et al (2012)), which a monetary policy hike would cool. Hence, the sharper the rise in asset prices before a policy hike, the more severe the price correction following the hike. For example, recent empirical analysis suggests that, following a tightening of policy rates by 1 percentage point, the fall in nominal house prices is 1.5 percentage points larger in countries that had experienced a house price boom relative to those that had not (IMF (2024)).

Since asset valuations are a central element of the wealth channel and underpin the financial accelerator channel, an asset price boom strengthens monetary policy transmission to aggregate demand but also amplifies the adverse financial stability implications of a tightening.

2.2.3. Productivity

Aggregate productivity supports the resilience of aggregate demand and contributes to buffers that may prevent financial instability. When productivity is higher, the expected return on investment is more likely to surpass the hurdle rate even after a policy rate hike, which dampens the interest rate channel in the transmission of monetary policy to aggregate demand. Likewise, higher productivity leads to higher operating profits, employment and wages that not only boost consumption but also ensure an important first line of defence against a rise in borrowing costs, thus dampening the income channel and reducing the default risk of NFCs and households.

3. Quantifying monetary policy transmission: historical analysis

This section analyses empirically the effects of an increase in the monetary policy rate on aggregate demand and the attendant implications for financial stability. The analysis proceeds in two stages, from the general to the more specific. The first stage delivers unconditional effects, "averaging" across initial macro-financial conditions and countries (subsection 3.1). The importance of macro-financial conditions at the start of a hiking cycle is studied second (subsection 3.2). Throughout this section, the focus is on the *causal* effects of an exogenous policy rate hike, identified using the so-called local projection trilemma instrumental variables (LP-TIV) econometric approach (Jordà (2005), Jordà et al (2020), Cloyne et al (2023), Goncalves et al (2024)). This approach is typically used in the context of a panel of countries that are open to cross-border capital flows and whose exchange rate is pegged to a base country.[1]

[1] The LP-TIV approach does not requires a "hard peg" but only the absence of a free-floating exchange rate regime. In effect, the LP-TIV uses the change in the base country's (eg the United States) monetary policy rate as the exogenous source of variation in the domestic country's (eg Canada) policy rate. One advantage of this approach is that it identifies *causal* effects. The flip side is that this identification rests on *specific* – foreign – policy rate changes that may have different effects from those of a *typical* exogenous change. For example, if the rate hikes in the base country induce capital outflows from the country in focus, the latter may experience a stronger than typical slowdown or financial stress. For more detail on the concrete econometric approach adopted for this report, see Annex B.

3.1. Strength and speed of monetary policy transmission

3.1.1 Effects on borrowing rates and aggregate demand

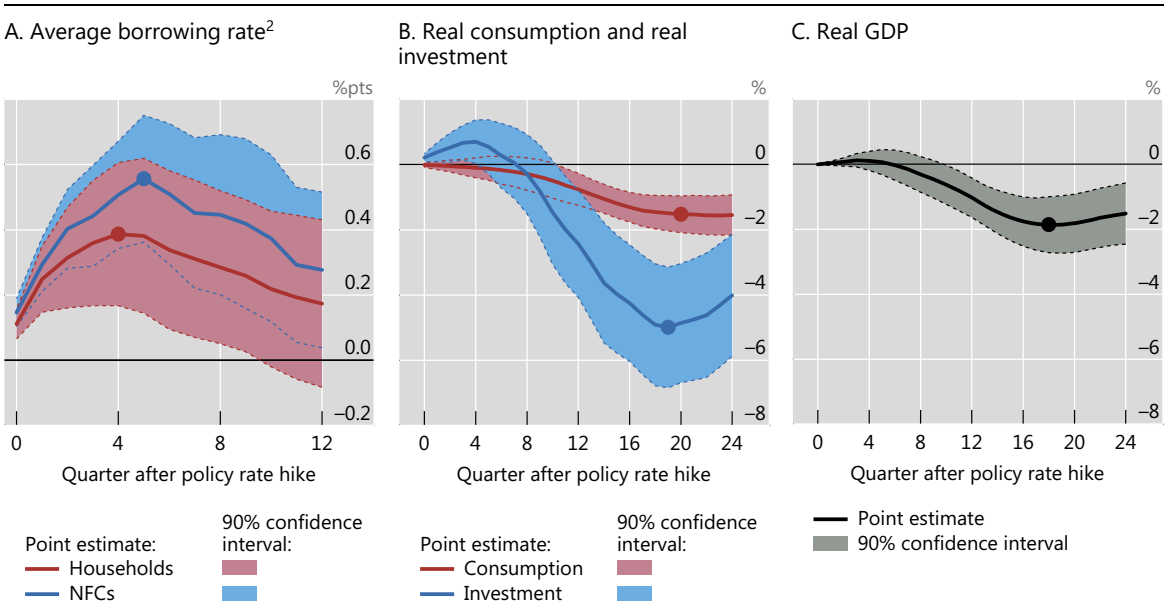
The first link in monetary policy's transmission chain (Graph 1) is the pass-through from the monetary policy rate to market interest rates.

The pass-through from policy rate to borrowing and deposit (as well as other savings) rates affects the interest rate as well as the income/cash flow channels. The former channel reflects changes in the rates on *new* loans, deposits or financial investments – it is these rates that affect the (opportunity) cost of new consumption and investment.[2] By contrast, the latter channel stems from the *average* rates on outstanding debt and financial investments.

The focus below is on the *average borrowing* rate – defined as the ratio of interest expenses to total debt. This choice is motivated partly by the greater availability and comparability of the underlying data for a broad set of countries. In addition, since the average borrowing rate accounts for borrowers' debt structure (eg maturity, rate variability and riskiness) and funding sources (eg domestic or foreign banks and non-banks), it is often seen as more informative about the income channel than, for example, banks' average or new lending rates.

Transmission of monetary policy tightening

Estimated effect of a 1 percentage point increase in the policy rate[1] Graph 2



[1] Based on linear panel regressions with country fixed effects and trilemma instrumental variables for a quarterly panel of AEs and EMEs between 1985 and 2016. The dots indicate the maximum effects. See annex B for technical details. [2] Average borrowing rate on the outstanding stock of debt, defined as the ratio of interest expenses to total debt.

Sources: Baron et al (2021); Bauer and Swanson (2023); Quinn et al (2011); J Shambaugh (2019); Global Financial Database; national data; CGFS Working Group.

[2] Existing empirical studies suggest that the interest rate pass-through on new loans is influenced by various factors such as bank characteristics and economic conditions, and its effectiveness can vary over time and across different countries. For example, Altavilla et al (2020) find that the median long-run pass-through is around 1 but varies significantly depending on banks' balance sheet characteristics (eg capitalisation and exposure to sovereign debt).

The analysis suggests that the pass-through from policy rates to average borrowing rates is somewhat stronger for NFCs than for households (Graph 2.A). Following a 1 percentage point increase in the policy rate, average borrowing rates initially surge in both sectors and peak in four to five quarters (dots), at 40% of the policy rate hike for households and 60% for NFCs.

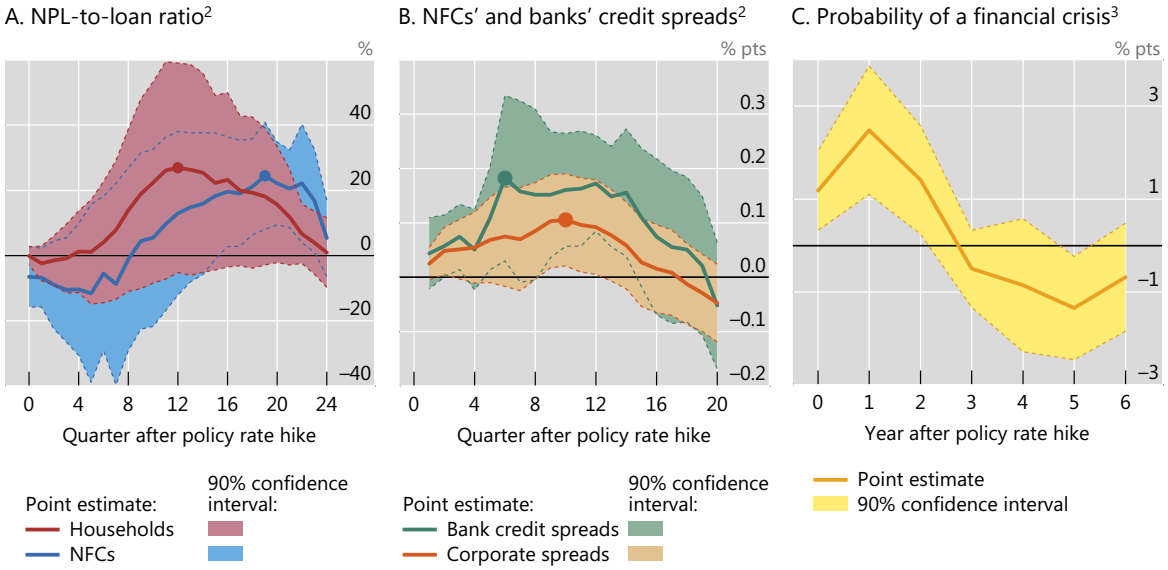
In comparison, monetary policy affects aggregate demand with longer lags (Graphs 2.B and 2.C). Following a 1 percentage point increase in the policy rate, household consumption "smoothing" surfaces as a gradual fall in consumption that bottoms out – at 2% below its initial value – only after five years (20 quarters). It takes roughly the same number of quarters for the higher policy rate to percolate through to NFCs' interest expenses and profits and then lead to a fall in investment, for a cumulative net decline of 5% after 19 quarters. GDP follows similar dynamics, falling by almost 2% in 19 quarters.[3]

3.1.2. Effects on default risk and financial stability

Following a rate hike, the rise in borrowing rates can bring to the fore pre-existing financial vulnerabilities and raise borrowers' default risk. A materialisation of this risk surfaces as an increase in NPL ratios, which historically peaked between 12 and 19 quarters after the hike (Graph 3.A). Up to that point, the NPL ratio rises by about 20% for NFCs and households alike. Corporate credit spreads also tend to increase as NPLs grow (Graph 3.B, orange line).

Households' and NFCs' default risks; spillovers to lenders

Estimated effect of a 1 percentage point increase in the policy rate[1] Graph 3



[1] Based on linear panel regressions with country fixed effects and trilemma instrumental variables. The dots indicate the maximum effects. See Annex B for technical details. [2] NPL ratio: percentage growth; credit spread: percentage point increase; quarterly panel of AEs and EMEs from 1985 to 2016. [3] Annual panel of AEs between 1945 and 2014.

Sources: Baron et al (2021); Bauer and Swanson (2023); Jordà et al (2017); Quinn et al (2011); Shambaugh (2019); Reserve Bank of Australia; Central Bank of Brazil; Bank of Italy; Bank of Korea; Bank of Spain; Board of Governors of the Federal Reserve System; OECD; LSEG Datastream; Global Financial Database; UK Finance; national data; CGFS Working Group.

[3] To interpret these estimates, note that the rate hike considered in the analysis is purely *exogenous* and should thus be expected to have a larger impact than an *observed* hike of the same size, as the latter responds to macroeconomic overheating. The results presented in Graphs 2, 3.C and 4.A are similar to those of other studies that also use the LP-TIV estimation approach (Durante et al (2020), Jiménez et al (2022), and Jordà et al (2023)).

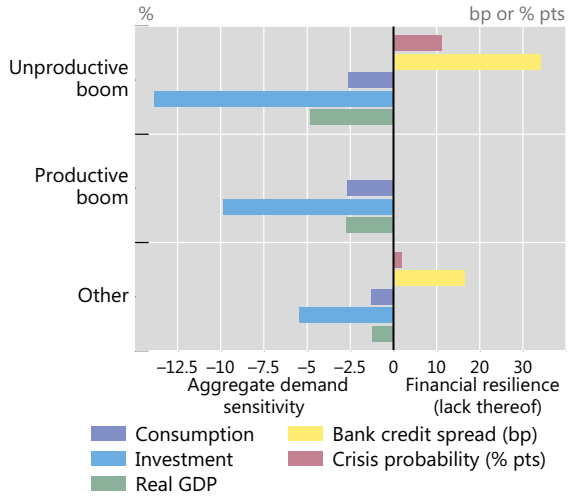
The higher credit risk in the private non-financial sector may have repercussions in the financial system, notably by worsening the quality of banks' loan portfolios and, in turn, raising their funding costs. The credit spreads charged to banks have indeed tended to jump up in the first year of a policy rate hike and to remain at an elevated level for two years (Graph 3.B, green line). This probably reflects valuation losses and market expectations of more loan defaults down the road (Graph 3.A), each weighing on banks' financial health. As confirmation that such developments may have systemic implications, the probability of a financial crisis occurring in the first or second year after a hike increases by 1–2 percentage points (Graph 3.C; see also Schularick et al (2021)).[4]

3.2. The role of initial macro-financial conditions

This section documents how the effect of a policy rate hike on aggregate demand and credit risk depends on the prevailing macro-financial conditions. It thus provides quantitative estimates to back the conceptual arguments in subsection 2.2.

Monetary policy transmission depends on initial macroeconomic conditions — Graph 4

A. Peak effects on aggregate demand and financial resilience[1]



B. Aggregate demand sensitivity and the materialisation of financial vulnerabilities[2]

Initial conditions	*Estimated impact of a rate hike on*	
	Aggregate demand	Financial stability risk
Unproductive boom	Strong	Strong
Productive boom	Medium	Weak
Other	Weak	Weak

[1] Estimated peak effect (over a four-year horizon) of a 1 percentage point increase in the policy rate. Only estimates statistically significant at the 10% level are reported. Based on linear panel regressions with country fixed effects and trilemma instrumental variables for a quarterly panel of up to 22 AEs and 23 EMEs between 1985 and 2016 (for GDP, investment, consumption, and bank credit spread) and an annual panel of 18 AEs between 1945 and 2014 (for the crisis probability). See annex B for technical details. [2] Subjective summary of the peak effect estimates reported in panel A.

Sources: Baron et al (2021); Bauer and Swanson (2023); Bergeaud et al (2015); Jordà et al (2017); Quinn et al (2011); J Shambaugh (2019); Global Financial Database; national data; CGFS Working Group.

The analysis considers three macro-financial conditions (Graph 4). The first one features booms of both credit and asset prices as well as above-trend productivity, henceforth referred to as a "*productive* boom".[5] The second one also features booms of credit and asset prices but during below-trend productivity, hence an "*unproductive* boom". Throughout, a boom is defined as a situation in which the variable considered (whether credit or asset prices) is above its one-sided (ie "real-time") trend. Likewise,

[4] The instantaneous response of the crisis probability to a rate hike (year "0" in Graph 3.C) could reflect a scenario in which the central bank follows the base country in raising the policy rate while the domestic economy is undergoing a crisis.

[5] Here, "credit" refers to the sum of real credit to NFCs and households; "asset prices" refer to real house and stock prices; and "productivity" refers to total factor productivity, measured by the so-called Solow residual, as in Bergeaud et al (2015).

"(un)productive" refers to productivity (below) above trend. Finally, "other" comprises all other macro-financial conditions.

Existing empirical studies motivate the choice of macro-financial conditions. Such studies have identified the combination of credit and asset price booms (rather than each type of boom separately) as relevant for the transmission of monetary policy (Borio and Lowe (2002), Schularick et al (2021)). Recent work further ascribes a critical role to productivity during credit booms, making a distinction between strong credit demand driven by productivity gains and high credit supply on the back of loose monetary policy (Gorton and Ordoñez (2020), Mueller and Verner (2023), Jiménez et al (2022), Boissay et al (2022)). In the sample considered, countries spend 20% of the time in a credit boom: 13% in a productive one, and 7% in an unproductive one.

Conditioning on one set of macro-financial conditions at a time refines the estimates of the effect of policy rate hikes on aggregate demand and financial stability. This is seen by comparing the peak effects (over a four-year horizon) on consumption, investment, GDP, bank credit spreads and probability of a financial crisis in Graph 4.A to the corresponding unconditional effects in Graphs 2.B, 2.C and 3.B (dots). One salient finding that emerges from this comparison is that an exogenous rate hike is particularly effective in lowering aggregate demand when it takes place during a boom.

Importantly, another finding is that such a hike is generally followed by financial instability only when this boom is unproductive. When productivity is above trend, labour market conditions and investment opportunities tend to be favourable, thus providing households and firms with a "natural hedge" against rate hikes – at least at the early stage of a tightening. In that case, there are few financial vulnerabilities that the tightening can bring to the fore. By contrast, the combination of high indebtedness and low earnings in an unproductive credit boom results in low interest coverage ratios, which raises the likelihood of a self-reinforcing loop between financial stress and the fall in aggregate demand.[6]

Stepping back to consider *endogenous* changes to policy rates allows for studying how the effect of monetary tightening on financial stability depends on the macroeconomic environment that the central bank responds to. When a central bank tightens monetary policy to tame inflation, it makes a difference whether inflation arises from demand- or supply-side developments (Bandera et al (2023), Boissay et al (2024)). If inflation is demand-driven, its high sensitivity to policy rate hikes implies that the hiking cycle is more likely to be short-lived. Nevertheless, it helps rein in a potential credit boom and prevent imbalances from building up, thus fostering financial stability in the medium term. By contrast, when inflation is the result of persistently low productivity (eg due to adverse supply shocks), it is more likely to become entrenched (eg through a wage-price spiral) thus inducing the central bank to maintain its policy rate "higher for longer" (BIS (2023), Borio et al (2023)). When such a tightening occurs on the back of a credit boom, it may bring financial vulnerabilities to the fore and culminate in a wave of defaults.

4. Cross-country differences in the transmission of monetary policy

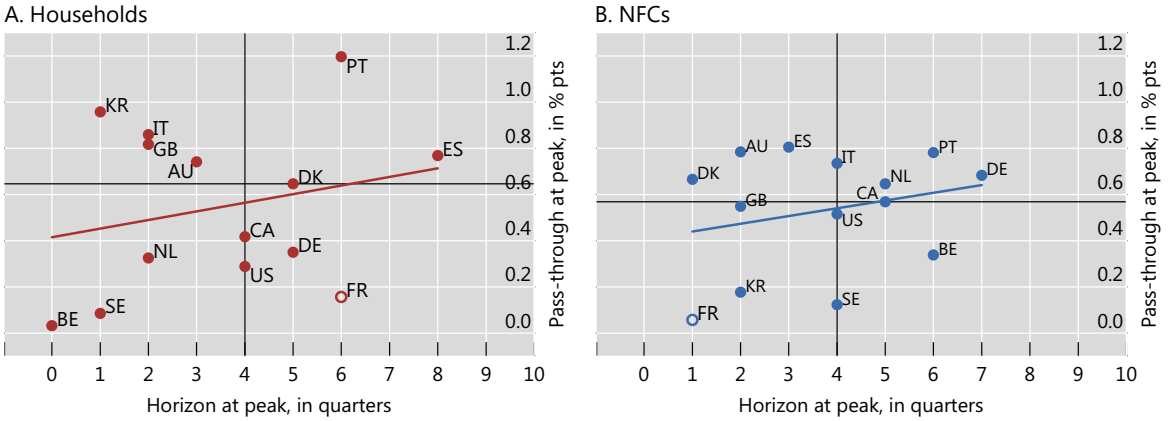
This section documents cross-country differences in the historical pass-throughs from policy rate rises to borrowing rates, consumption and investment. It first presents country-specific estimates of the effects of an overall rate hike – ie including both exogenous and endogenous components (subsection 4.1). It then moves on to discuss how the environment in which the monetary policy tightening takes place can explain cross-country differences in the findings (subsection 4.2).

[6] To the extent that a fall in productivity is an adverse inflationary supply shock, the above results dovetail with those in Boissay et al (2024). This paper finds that financial stress tends to increase after an *exogenous* policy rate hike when inflation is supply-driven but not when inflation is demand-driven.

4.1. Historical policy rate pass-throughs: a cross-country comparison

The *strength* and *speed* of the pass-through from a policy rate hike to the variable considered provide summary statistics of country-specific regularities. More concretely, these are measured by the maximum change of the variable and the horizon over which this change is reached, starting with the quarter of the hike.[7] For comparability, the pass-through is calculated for a 1 percentage point increase in the policy rate.

Historical pass-throughs to average borrowing rates: cross-country comparison[1] Graph 5



[1] A dot (circle) corresponds to a statistically significant (insignificant) change in the borrowing rate following a 1 percentage point increase in the monetary policy rate; the black lines indicate corresponding medians. See annex B for technical details.

Sources: National data; CGFS Working Group.

Consider first the pass-through to average borrowing rates (Graph 5). Over the sample period, Belgium, France and Sweden saw less than 40% of the overall rate hikes pass through to households' or NFCs' average borrowing rates. The corresponding pass-through was more than 60% in Australia, Italy, Portugal and Spain. In most countries, the pass-through reaches its peak between the second and sixth quarter after the hike. But the transmission lag tends to be longer in countries with a stronger pass-through (as indicated by the upward-sloping fitted lines).

The pass-through from the (short-term) policy rate on (longer-term) borrowing rates has two distinct components. The first one is the change in the risk-free long-term rate, eg a steepening of the yield curve when lenders expect further increases in the short-term policy rate. The second element is the rise in default risk premia (or credit spreads), eg as lenders require compensation for the risk of rising NPLs and for the perception that this risk worsens lenders' own creditworthiness.

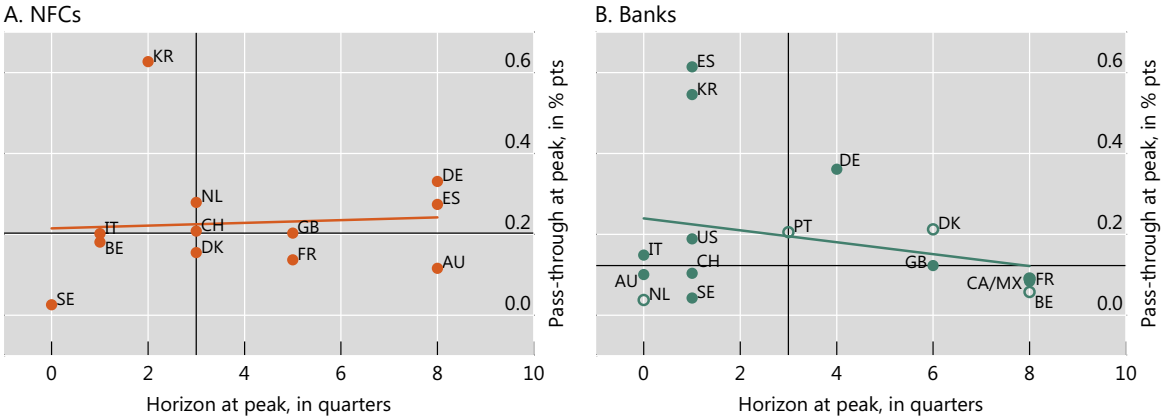
A comparison between Graphs 5.B and 6.A sheds light on the magnitude of the two components.[8] In several countries, the rise in credit spreads is material and can explain a sizeable part of the increase in borrowing rates. For example, of the 0.7–0.8 percentage point increase in German and Spanish NFCs' average borrowing rate (Graph 5.B), 0.3 percentage points can be attributed to the rise in NFCs' credit spread (Graph 6.A) – and the rest to that in the risk-free rate.

[7] The underlying analysis relies on country-level linear regressions and data from Q1 1985 to Q4 2016. In contrast to the previous section, country-level data do not allow for identifying the causal effects of an exogenous rate hike. Accordingly, the historical pass-through should be interpreted more as a long-run correlation rather than as reflecting a causal effect.

[8] While useful to get a sense of the magnitude of the effects, this comparison can only be suggestive, insofar as Graphs 5.B and 6.A are based on different types of data (average borrowing rate on outstanding debt versus credit spreads on new loans) from different sources and on different sample periods (the latter depending on the country considered). Due to the lack of historical data at the country level, a similar comparison could not be done for households' credit spreads, NPLs and financial crises.

Historical pass-throughs to credit spreads: cross-country comparison[1]

Graph 6



[1] A dot (circle) corresponds to a statistically significant (insignificant) change in the credit spread following a 1 percentage point increase in the monetary policy rate; the black lines indicate corresponding medians. See annex B for technical details.

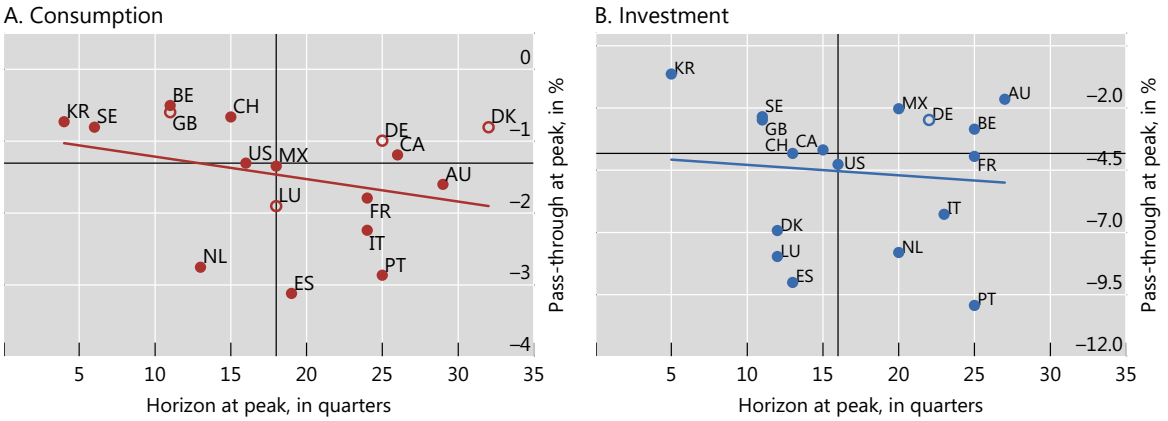
Sources: Baron et al (2021); national data; CGFS Working Group.

A sizeable rise in corporate credit spreads could stem from a financial accelerator mechanism. Indeed, Graph 6 suggests that, following a rate hike, countries where *corporate* spreads increase the most (panel A) are also those with the strongest increase in *bank* spreads (panel B). This pattern is consistent with a scenario whereby the rise in NPLs induces investors to raise banks' funding costs, in turn prompting banks to charge NFCs yet higher credit spreads and further raising NFCs' default risk.

Turning next to the transmission from policy rates to aggregate demand. A stronger pass-through to consumption in a given country is generally associated with a stronger pass-through to investment in that country as well (Graphs 7.A and 7.B). But here too there are differences across countries. For instance, following a rate hike, the fall in both consumption and investment seem more muted in Sweden and South Korea than in the Netherlands, Portugal or Spain.

Historical pass-throughs to aggregate demand: cross-country comparison[1]

Graph 7



[1] A dot (circle) corresponds to a statistically significant (insignificant) change in aggregate consumption and investment following a 1 percentage point increase in the monetary policy rate; the black lines indicate corresponding medians. See annex B for technical details.

Sources: National data; CGFS Working Group.

Putting the findings in Graphs 5 and 7 together leads to the conclusion that the effects of a rate hike can be uneven along the transmission chain (Table 1). Granted, a strong (weak) increase in households and NFCs' borrowing rates is generally associated with an eventually strong (weak) fall in aggregate consumption and investment (white cells). However, there are exceptions. In South Korea and the United Kingdom, for example, aggregate consumption decreases by less than 1% after a rate hike (Graph 7.A) – a particularly low historical pass-through among the countries in the sample – even though households in these countries stand out as having relatively high and fast pass-through to borrowing rates (Graph 5.A). The general finding is consistent with earlier studies reporting a significant cross-country heterogeneity in the transmission of monetary policy (eg Georgiadis (2014), Deb et al (2023)).

The pass-through can be uneven along the transmission chain[1]

Number of countries — Table 1

A. Historical pass-through to consumption

		Weak	Strong
Pass-through to households' borrowing rates	Weak	5	3
	Strong	3	4

B. Historical pass-through to investment

		Weak	Strong
Pass-through to NFCs' borrowing rates	Weak	5	2
	Strong	2	5

[1] Number of countries in the sample with a weak or strong pass-through, based on whether a country is below the corresponding median, as shown in Graphs 5 and 7.

Source: CGFS Working Group.

4.2. Factors explaining cross-country differences in historical pass-through

Country specificities in the transmission of monetary policy can stem from differences in households' and NFCs' exposures to interest rate risk as well as in the buffers available to them to weather the rise in borrowing costs. The factors affecting exposures essentially relate to debt characteristics, ie rate variability, maturity and lender safeguards. In turn, buffers relate to borrowers' cash holdings, the availability of alternative sources of external funding and the regulatory environment. This section reviews these factors and the attendant cross-country differences in turn.

4.2.1. Debt characteristics as drivers of interest rate risk exposures

The *characteristics* of debt – that is, lending rate adjustability, time to maturity and the presence of any lender safeguards – play a role in monetary policy transmission above and beyond that of the *level* of debt discussed earlier. Consider the various characteristics of debt sequentially.

Lending rate adjustability and time to maturity

All else equal, average borrowing rates rise faster – and thus the income/cash flow channel of monetary policy is stronger – when the share of short-term variable rate debt is higher.[9] In the NFC sector, listed firms in the Asia-Pacific region have historically had on average the largest share of both short-term and variable rate debt (Graph 8). At the other end of the spectrum are firms in North America, possibly a result of their greater reliance on corporate bond markets for funding.

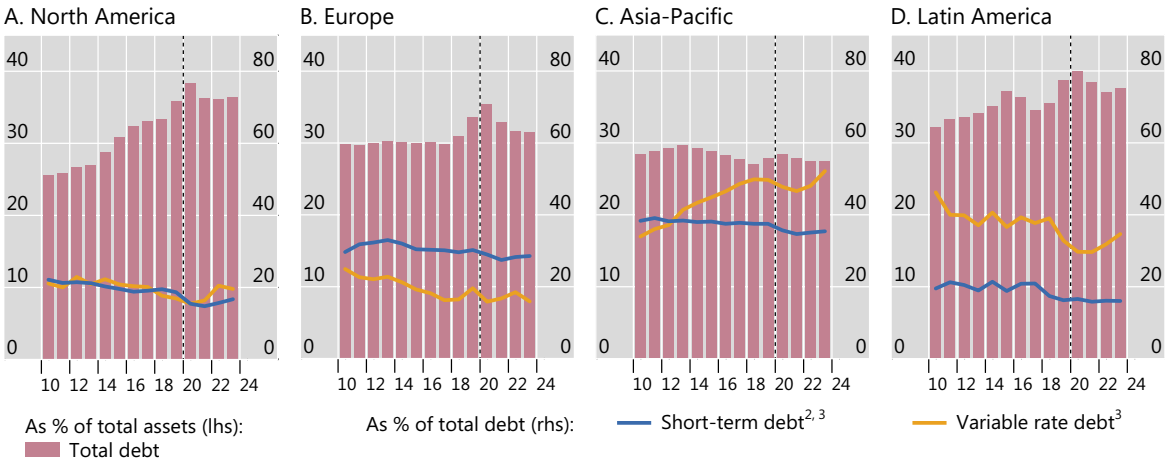
[9] Recent empirical analysis indicates that the transmission of monetary policy to consumption is weaker in countries with a higher share of fixed rate mortgages; see IMF (2024).

The structure of corporate debt also differs across countries within the same region. Within the euro area, French and German NFCs are among those with the highest share of fixed rate debt (Box A). Their debt also has a relatively longer maturity – of three and a half to four years for the median firm – than that of Italian and Spanish NFCs (Gueuder and Ray (2022)). These differences could be one possible explanation of the relatively strong interest rate pass-through in Italy and Spain compared with France (Graph 5.B).

Similar cross-country differences describe the household sector. For example, fixed rate mortgages are rare in Portugal, Spain and South Korea but are the majority of mortgages in Belgium, Germany and the United Kingdom (Graph 9.A). Unsurprisingly, the latter countries exhibit a relatively weaker or slower pass-through of policy rates to households' average borrowing rate (Graph 5.A).

Corporate debt structure: cross-country differences[1]

Listed firms, in per cent — Graph 8



[1] Weighted average over a sample of firms for which balance sheet information is available for 2021-23. Dotted line = Covid-19 outbreak. See annex B for technical details. [2] Debt with maturity less than 1 year. [3] The two categories of debt are not mutually exclusive.

Sources: S&P Capital IQ.

Lender safeguards

Debt instruments may differ starkly in terms of features that impose constraints on borrowers in order to protect lenders from default risk (ie lender safeguards).

The presence of such safeguards can underpin a financial accelerator. Lenders benefit from safeguards when they can use borrowers' assets in order to mitigate credit losses. This is the case for mortgage loans – which are secured with real estate – or recourse loans, which offer claims on assets beyond those pledged as collateral. In these cases, the pricing of the loan is typically inversely related to the value of the relevant assets. If a mortgage loan needs refinancing when the attendant real estate value has declined on the back of a policy rate hike, the increased riskiness from the lender's perspective would raise the risk premium. A higher risk premium would translate into higher refinancing costs and raise credit risk further, thus setting in motion the financial accelerator. Graph 9.B shows that, if anything, countries where a larger proportion of households have a mortgage also tend to be those where variable rate mortgages dominate. All else equal, the wealth channel and the financial accelerator could be particularly strong in these countries.

Box A

NFCs' debt structure and sensitivity to interest rate risk in the euro area

The structure of NFC debt – its maturity and interest rate variability – differs significantly across countries. Such differences have persisted even in the euro area, despite the monetary union and owing to the economic sector of borrowing firms, the structure of the financial system and the history of inflation. These differences influence the pass-through of policy rates to interest costs.

Considering individual countries in the euro area reveals the following. French and German NFCs are among those with the highest share of fixed rate debt, at around 80% of outstanding bank loans and debt securities (Table A1). Their debt also has a relatively long maturity, with 50% of the total exceeding three and a half years. Italian and Spanish NFCs have a much lower share of fixed rate debt, at 43% and 59% respectively, with shorter maturities. Consistent with this, the average cost of debt increased by 160 basis points more for Italian than for French firms between end-2021 and June 2023.

Corporate debt structure is only one among several factors that affect the pass-through of policy rates to firms' average funding costs. Notably, ample cash reserves can also help firms repay their outstanding debt and limit refinancing at higher interest rates.

Rate and maturity structure of euro area NFC debt[1]

Table A1

Maturing debt, as a percentage of total debt outstanding at end-2022

	France		Germany		Italy		Spain	
	Total	Fixed rate	Total	Fixed rate	Total	Fixed rate	Total	Fixed rate
End-2022	100	79	100	79	100	43	100	59
Maturing within 1 year	21	12	22	15	31	14	28	16
Maturing within 2 years	33	22	35	24	48	20	42	24
Maturing within 5 years	63	46	61	35	81	34	75	44

[1] Debt comprises bank loans granted by euro area banks to NFCs and debt securities issued by NFCs. Depending on the country, the sample covers between 49% and 65% of outstanding corporate debt, as estimated in national accounts.

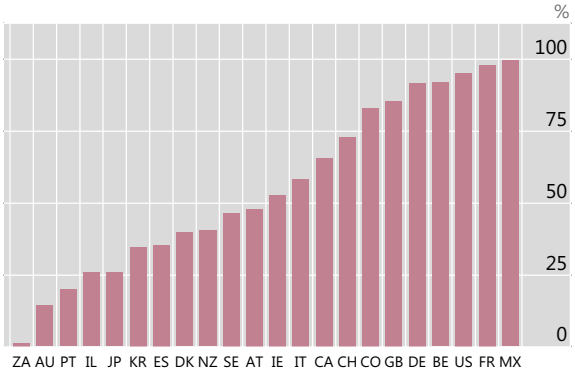
Source: Gueuder and Ray (2022).

"Flexible use" debt may give rise to similar dynamics when interest rates rise. In this category are unsecured debt contracts, such as credit card loans, corporate credit lines or student loans. The lack of constraints on how funds must be spent introduces more uncertainty, not least because it opens the door to an adverse selection of borrowers, whereby the latter demand a loan precisely when they are in dire straits (Edelberg (2004)). When monetary tightening induces a deterioration of economic conditions, the proportion of financially vulnerable loan applicants may increase and the uncertainty as to where vulnerabilities reside may induce lenders to charge higher risk premia to *all* borrowers.[10] Again, a destabilising financial accelerator would be at work.

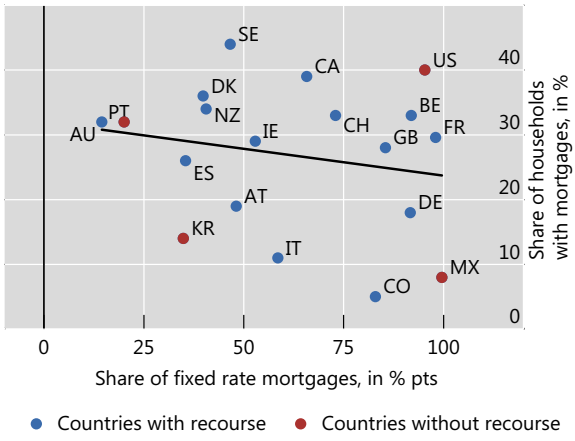
[10] Empirical studies on the sensitivity of consumer loan rates are scant and, if anything, emphasise the important role of borrower heterogeneity (Cespedes (2023)). In some specific cases, eg when loan rates are close to credit rationing levels, lenders may be reluctant to increase their lending rates for fear of triggering defaults, as this would make such increases unprofitable (see Boxes B and C). In those cases, the loan rates charged to the riskiest borrowers could be less (not more) sensitive to rate hikes.

Cross-country differences in terms of households' debt structure and risk Graph 9

A. Share of fixed rate mortgages



B. Prevalence of mortgages and the possibility of recourse[1]



[1] See annex B for technical details.

Sources: IMF April 2024 WEO; CGFS Working Group.

4.2.2. Borrowers' financial buffers and vulnerability to rate hikes

Borrowers' vulnerability to higher borrowing costs depends to a large extent on their liquidity buffers. The latter comprise short-term or liquid assets that can be used to repay debt without having to refinance it at a higher cost. To gauge the adequacy of a borrower's liquidity buffers, one must therefore take into consideration both assets and liabilities.

Relatedly, if the rate hikes are passed through to financial assets, the resulting rise in interest income might also partly compensate for the rise in interest expenses.[11] In that case, financial assets may act not only as a buffer but also as a source of income. While a potential contributor to the income channel, this mechanism could not be studied in detail due to a lack of granular historical data at the level of individual balance sheets (but see below for a related discussion in the context of households).

NFCs' buffers and vulnerability

Differences in NFCs' potential vulnerability to interest rate risk transpire both across regions and firm sizes.

First, consider differences across geographical locations. Firms in the Asia-Pacific region tend to hold more financial assets, and – all else equal – would have larger buffers to weather the impact of rate hikes on their liabilities than firms in other regions (Graph 10, red bars). At the same time, however, these assets tend to be of longer maturity on average (blue line) – and hence more exposed to valuation effects – and to be associated with more variable rate debt (Graph 8, yellow line). The net effect of a rate hike on Asia-Pacific firms' repayment capacity is therefore a priori ambiguous. By contrast, North American firms, which tend to hold short-term financial assets and finance themselves with long-term fixed rate debt seem less exposed to an increase in borrowing rates. In turn, this could be one explanation for the relative resilience of Canadian and US firms' levels of investment to a rate hike (Graph 7.B).

[11] In principle, interest rate exposures may also be mitigated off-balance sheet, eg by using interest rate derivatives. In practice, however, the use of such derivatives by NFCs is limited and unlikely to affect the transmission of monetary policy in the aggregate (see Box D).

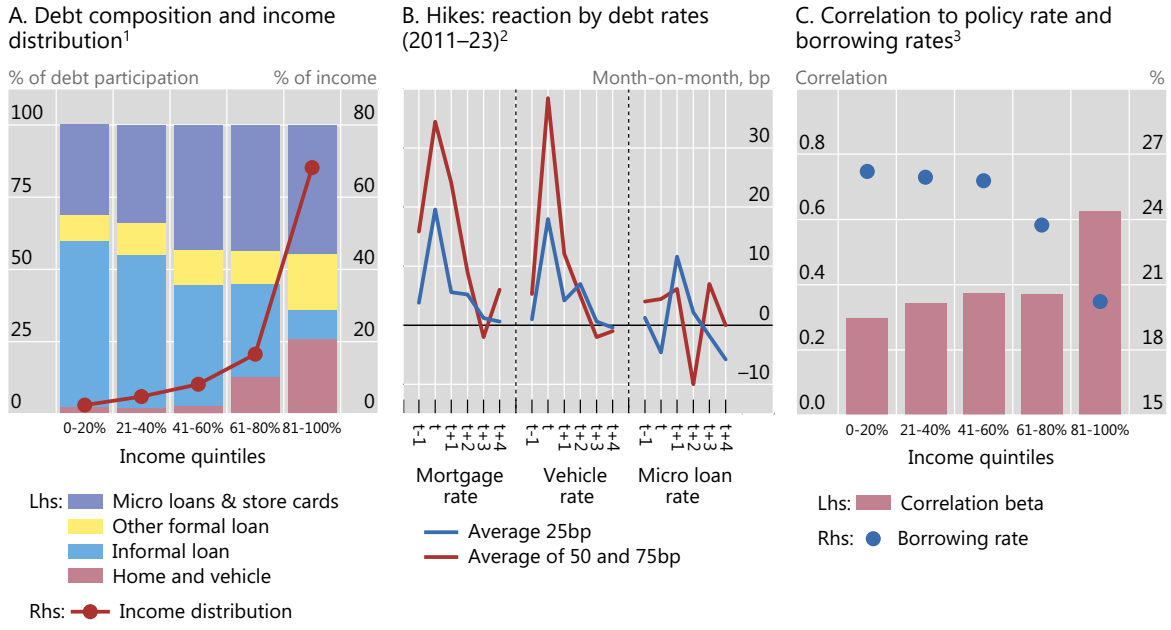
Box B

Borrowing costs by income group – the case of South Africa

This box focuses on differences in the pass-through of the monetary policy rate to borrowing rates across South African households. The pass-through varies across income groups, as these differ in terms of their debt composition (Graph B1.A). The share of mortgages and car loans is material only to the debt of higher-income groups. Lending rates on such loans have been most responsive to the policy rate since 2011 (Graph B1.B) and, accordingly, the average borrowing costs of higher-income households have been most responsive (Graph B1.C, red bars). By contrast, the borrowing costs of lower-income households have been less responsive because the underlying debt comprises micro and informal loans. That said, the *level* of lower-income households' borrowing costs is higher (blue dots), reflecting higher credit risk.①

Pass-through varies across income groups and debt composition

Graph B1



[1] Debt composition based on average 2011–15. Income distribution based on 2014 data. [2] t refers to the month of the policy rate hike. t+1 is the month-on-month change in the specific debt interest rate. [3] See Annex B for technical details.

Sources: South African Reserve Bank; World Bank Poverty and Equity Data Base; South African Social Attitudes Survey.

These results illustrate that the policy rate has an uneven effect on borrowing costs across household income groups. The effect is strongest for the highest-income households. Poorer South Africans are less affected, not because this group avoids debt but because their debt instruments are not as closely tied to the central bank rate.

① A limitation of the analysis is that interest rates on microloans are used as a proxy for high-interest debt, including informal loans, whose rates are likely to be higher and even less responsive to the policy rate than those of microloans. Considering that informal loans represent on average more than one third of poor households' debt, the results probably overstate the effect of policy rate changes on these households' borrowing costs.

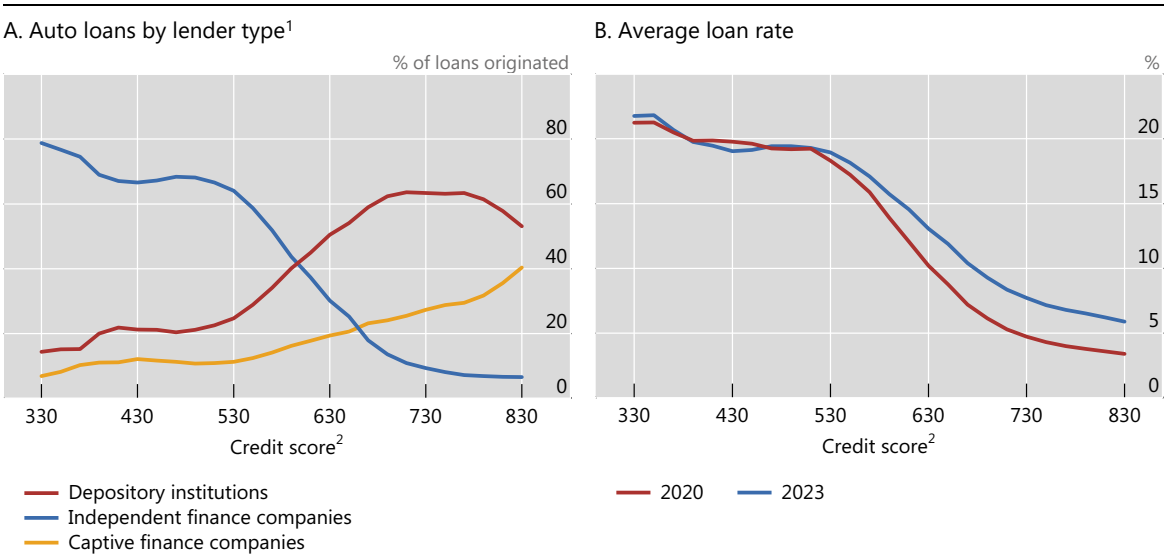
Box C

Borrowing rate pass-through, by credit score group – the case of the United States

Auto lending is an important segment of the US non-mortgage household credit market. It amounted to over $1.5 trillion in outstanding amounts at end-2023, or more than one third of total household non-mortgage debt. Because vehicles are a significant component of household durable goods purchases, which in turn are an important component of GDP, dynamics in the auto loan market tend to have important implications for monetary policy transmission and the aggregate economy. This box documents that, while auto loan interest rates rose broadly during the latest monetary policy tightening cycle, those charged to the borrowers with lower (ie worse) credit scores increased less. It also offers an explanation of this difference in borrowing rate pass-through across credit score groups.

Riskier borrowers' auto loan rates increased by less during the latest tightening

Graph C1



[1] Auto loan originations in 2023. [2] Average of 20-point credit score bins.

Source: Experian.

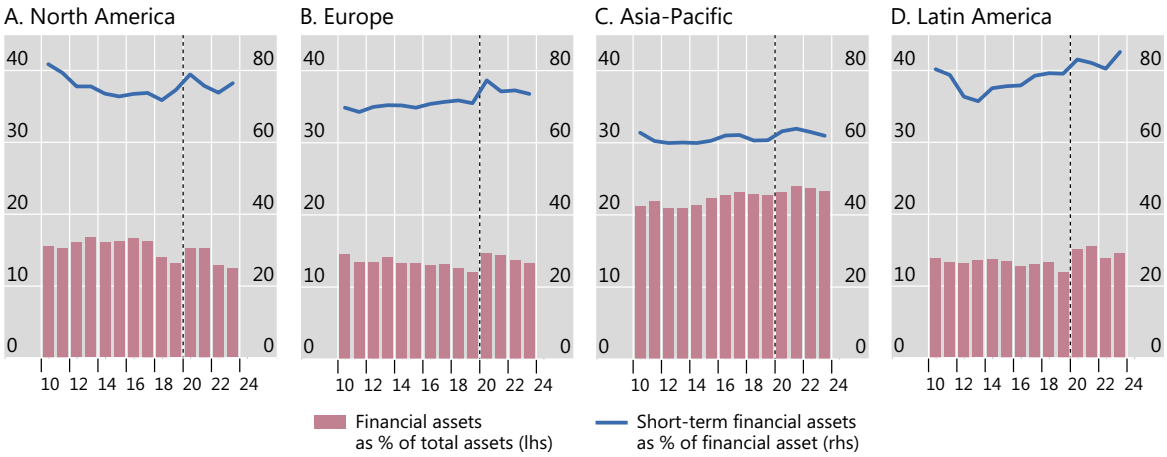
Several types of lender are active in the US auto loan market. Important ones are depository institutions, such as banks and credit unions. Other relevant lenders include the financing subsidiaries of major auto makers – so-called captive finance companies – and independent finance companies. Unlike depository institutions, the latter fund themselves with bank loans, on the securitisation market, with commercial paper and with parent company loans. Lender types differ in terms of the credit scores of consumer groups that they focus on. As shown in Graph C1.A, independent finance companies are the main lenders to borrowers with low credit scores (subprime borrowers), while depositories and captive finance companies extend credit mainly to borrowers with higher credit scores (prime borrowers).

The response of average loan rates to the latest policy rate hikes varied significantly across borrowers. Unlike average rates charged to subprime borrowers, which hardly changed, those charged to prime borrowers increased significantly, by around 200–300 basis points (Graph C1.B). This increase amounted to about 60% of the increase in the federal funds rate.

Several factors might explain the low pass-through to subprime borrowing rates. For one, the cost of market-based funding for independent finance companies may have been less sensitive to changes in the federal funds rate. In addition, when interest rates for subprime borrowers were close to credit rationing levels, lenders may have been reluctant to further increase these rates for fear of inducing defaults that would make such increases unprofitable.

Corporate liquidity buffers: cross-country differences[1]

Listed firms, in per cent — Graph 10



[1] Weighted average over a sample of firms for which balance sheet information is available for 2021-23. See annex B for technical details.

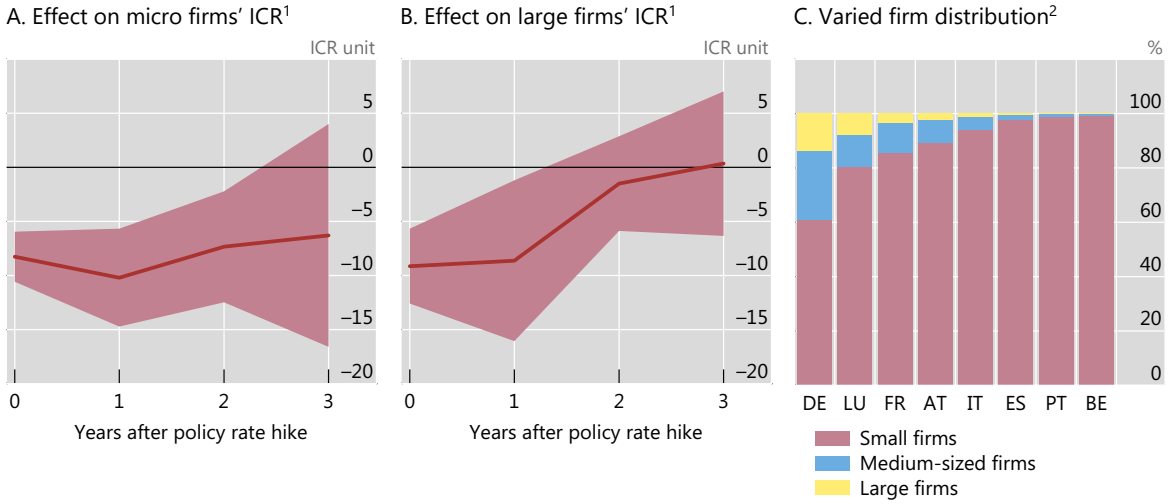
Sources: S&P Capital IQ; CGFS Working Group.

The vulnerability to interest rate risk also seems to depend on the size of firms. The capacity to raise sizeable amounts of fixed rate debt is generally limited to large firms with credit ratings, while small firms are more reliant on bank debt. As the latter tends to be variable rate, small firms are in general more vulnerable to rate hikes.

An empirical exercise – based on data for 300,000 European NFCs between 2002 and 2019 – suggests that large firms' greater capacity to mitigate the income/cash flow channel also plays a role. The exercise consists in estimating the effects of a rate hike on firms' financial strength for sub-groups of small and large firms. As a measure of financial strength, the exercise uses the interest coverage ratio (ICR), defined as operating profits divided by interest payments. The results indicate that, in the year following the hike, the ICR falls by around 10 units on average for both small and large firms (Graphs 11.A and 11.B). This fall is economically large, considering that the sample median of the ICR ranges from 8 in 2002 to 23 in 2019 and that firms with an ICR between 1 one and two and a half are usually regarded as being on the brink of default. Importantly, the ICR of large firms recovers to its pre-hike level in a little over a year, whereas the recovery of small firms takes twice as long. These findings dovetail with the notion that large firms can not only optimise their funding sources but also have more stable or diversified cash flows and greater ability to absorb shocks.

Firms' size distribution thus likely influences the effect of a rate hike on aggregate spending. For example, a relatively lower share of micro and small firms (Graph 11.C) might be one reason why the pass-through to aggregate investment has historically been more muted in Germany than in other European countries, such as Italy, Spain or Portugal (Graph 7.B).

Heterogeneity of corporate vulnerabilities following monetary tightening Graph 11



[1] ICR: Interest coverage ratio. Estimated effect of a 1 percentage point increase in the policy rate. See Annex B for technical details. [2] 2020 data for LU; 2021 for AT, BE, DE; 2022 for ES, FR, IT and PT. Small firms: turnover < EUR 10 million. Medium-sized firms: EUR 10 million ≤ turnover < EUR 50 million. Large firms: turnover ≥ EUR 50 million.

Sources: BACH; Orbis; CGFS Working Group.

Households' buffers and vulnerability

One useful summary measure of households' vulnerability to interest rate risk is the so-called unhedged risk exposure (URE), defined as the difference between a household's assets and liabilities that mature within one year (Auclert (2019) and Tzamourani (2021)). The lower the URE, the more *net* interest expenses increase in response to a rate hike. Among the countries in the data sample, Australia and South Korea stand out with deeply negative UREs (Graph 12.A), which suggests that – all else equal – households there would be particularly sensitive to interest rate risk.

A household's vulnerability to rising interest rates also depends on its income level. On the one hand, all else equal, an indebted low-income household may lack financial buffers to cope with a rate hike (Box E). On the other hand, the higher its income, the more likely a household is to have a mortgage and the higher the share of such borrowing is in its overall debt (Graphs 12.B and 12.C). In countries where mortgages have a shorter maturity and are more likely to be granted a variable rate, higher-income households may be relatively more exposed to a change in policy rates than lower-income ones.[12]

Households with illiquid assets – which they pledge to obtain financing – and low revenues are particularly exposed to the income and wealth channels of monetary policy. These are the so-called illiquid/indebted hand-to-mouth (HtM) households.[13] Unlike non-HtM households, they do not have spare revenues or liquidity buffers to weather income losses and smooth their consumption through additional borrowing. And unlike other HtM households, with low wealth and debt, they suffer income and wealth shocks from a rise in interest rates.

[12] Of course, one cannot rule out that, over time, higher-income households in these countries become accustomed to managing the interest rate risk associated with a high share of variable rate debt, which would eventually mitigate the impact of a rate hike.

[13] These households are also referred to as "wealthy HtM" households (Kaplan et al (2014)).

Box D

Interest rate derivatives

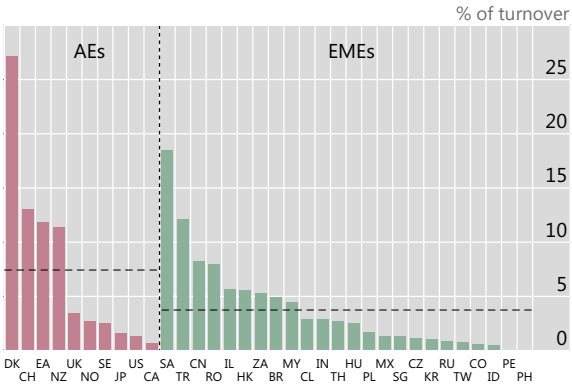
NFCs can use interest rate derivatives (IRDs) to mitigate the effect of higher monetary policy rates on their average cost of debt. In practice, however, this use remains limited and essentially concentrated among large firms. In April 2022, NFCs accounted for only 7.6% of IRD turnover in advanced economies and 3.9% in emerging market economies (Graph D1.A). While firms with more variable rate debt are also more likely to hedge against interest rate risk by using derivatives, a significant share of such firms do not hedge (Graph D1.B).

Moreover, the use of derivatives can at times be guided more by the earnings performance of hedging instruments than by interest rate risk exposure. Several studies suggest that large firms use interest rate swaps to speculate rather than hedge, especially when their executives' compensation depends on earnings (Faulkender (2005), Chernenko and Faulkender (2011)). In such instances, the use of derivatives may increase – rather than reduce – the volatility of corporate earnings.

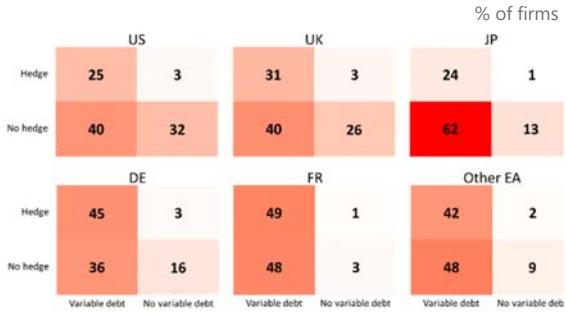
NFCs' limited use of IRDs is unlikely to cushion the impact of rate hikes

Graph D1

A. NFCs' limited footprint in IRD markets[1]



B. Who hedges – firms with or without variable rates?[2]



[1] Share of NFCs in OTC derivatives turnover as of April 2022. Horizontal lines: group averages. [2] 2019–21 averages.

Source: Banerjee et al (2023); BIS Triennial Central Bank Survey; CGFS Working Group.

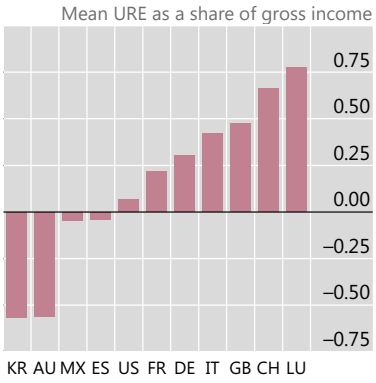
In EMEs, IRD markets remain small. Even though these markets have gained depth in recent years, the outstanding notional amount of IRDs is still less than one quarter that of foreign exchange derivatives. In comparison to AEs, the relatively small scale of IRD activity in EMEs can be explained by several factors. Less developed bond markets and tighter capital controls limit the availability of hedging instruments and increase their cost.

In the face of a rate hike, the main way in which illiquid/indebted HtM households can service their debt is by cutting consumption. This explains why the sensitivity of these households' consumption to policy rate changes tends to be higher than that of other households' consumption (Graph 13.A). It is also consistent with the finding that the relatively low footprint of illiquid/indebted HtM households in eg Belgium, Germany and Switzerland (Graph 13.B) goes hand in hand with a limited fall in consumption following a rate hike (Graph 7.A).

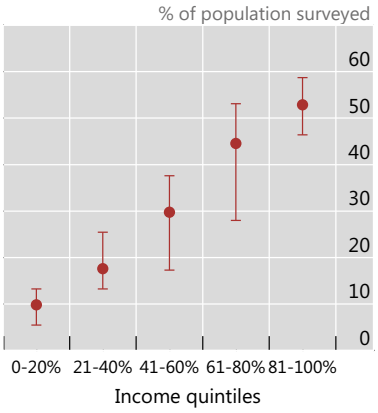
Households' exposure to interest rate risk: differences across income groups

Graph 12

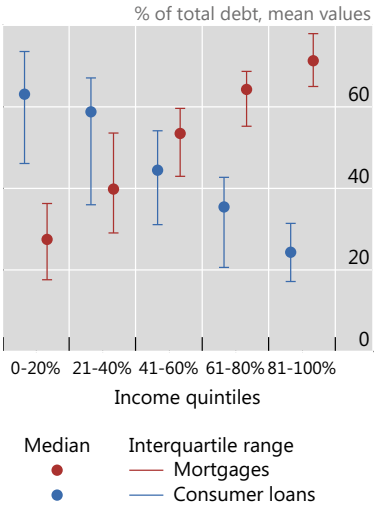
A. Net exposures[1]



B. Mortgages are concentrated in higher income groups[2, 3]



C. The higher the income, the larger the debt share of mortgages[2]



[1] See annex B for technical details. [2] Over a sample of 13 countries. Household survey dates: AU 2022, CH 2021, EA countries 2020/21, GB Q3 2023, KR 2022, MX 2019, US 2022. [3] Share of the population surveyed having mortgages, in %.

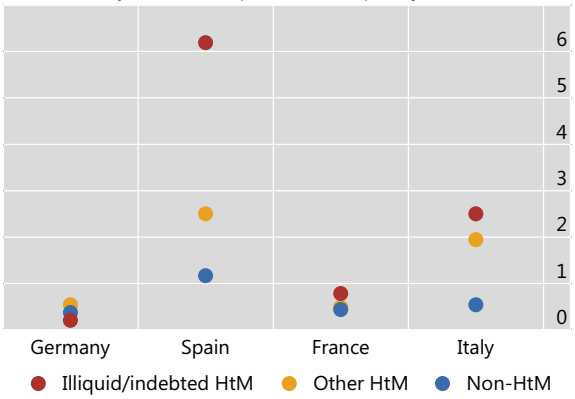
Sources: ECB; AU: Household, Income and Labour Dynamics (HILDA Survey Release 22.0 - disclaimer); CH: individual tax data of the Canton of Berne; EA: Household Finance and Consumption Survey (HFCS); GB: Bank of England / NMG Survey of Household Finances; KR: Survey of Household Finances and Living Conditions (SFLC); MX: National Survey of Household Finances (ENFIH); US: Survey of Consumer Finances (SCF); European Mortgage Federation; OECD; LSEG Datastream; CGFS Working Group.

The footprint of hand-to-mouth households can affect the transmission of a rate hike[1]

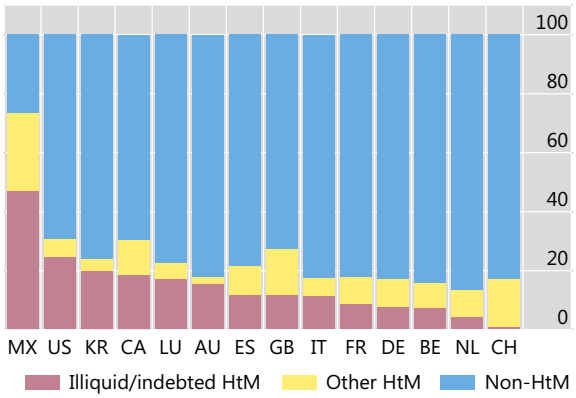
In per cent

Graph 13

A. Sensitivity of consumption to the policy rate[2]



B. Distribution of households



[1] See annex B for technical details. [2] Effect of a 1 percentage point *decrease* in the monetary policy rate on aggregate consumption, as reported in Slacalek et al (2020).

Sources: Slacalek et al (2020); AU: Household, Income and Labour Dynamics (HILDA Survey Release 22.0 - disclaimer); CA: Survey of Financial Security (SFS); CH: individual tax data of the Canton of Berne; EA: Household Finance and Consumption Survey (HFCS); GB: Wealth and Assets Survey (WAS); KR: Survey of Household Finances and Living Conditions (SFLC); MX: National Survey of Household Finances (ENFIH); US: Survey of Consumer Finances (SCF); CGFS Working Group.

Box E

Effects of policy rate changes on default risk – the case of US student loans

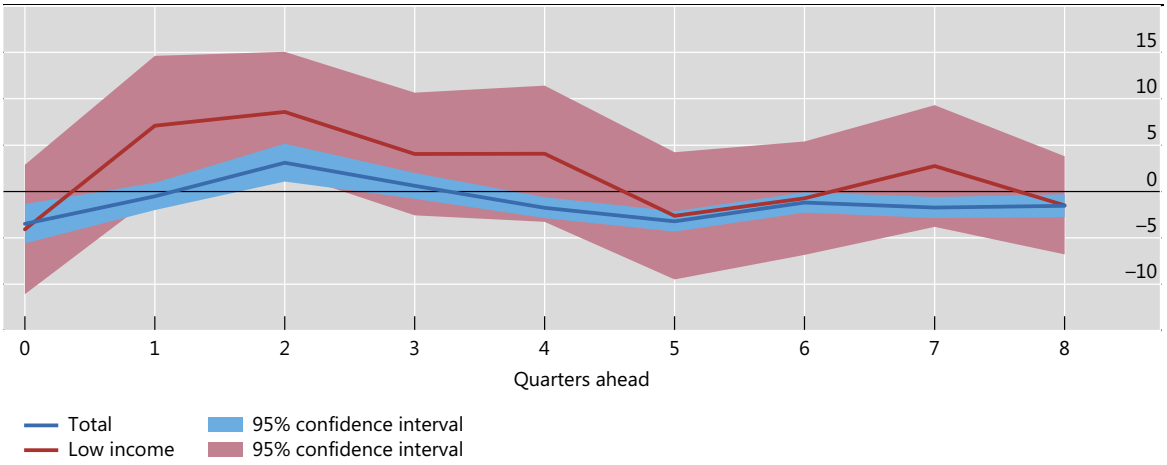
This box studies the effects of an increase in the federal funds rate on student loan delinquencies. It differentiates across households with respect to their initial leverage – ie debt-to-income ratio – and income level. Focusing on student loans helps to identify the effects of a change in the policy rate (Mankiw (1986)) because these loans have simpler contractual terms than, for instance, mortgage or auto loans, which often involve collateral and other covenants.①

The econometric analysis consists of comparing the effect of a 1 percentage point rate hike in geographical areas (US counties) where households (including students) have relatively high leverage and low income versus counties where households are less leveraged and have a higher income. The analysis covers the period 2003–19.②

Low-income households experience more difficulties servicing loans when financial conditions tighten, especially when they are highly leveraged to begin with (Graph E1). Following the hike, delinquencies grow on average much faster in more leveraged areas (both the blue and red lines are above zero). This effect is even more pronounced when households have a relatively low income (the red line is above the blue line).

Excess share of student loans in delinquencies[1]

In percentage points — Graph E1



[1] Each line shows the difference in the share of student loans in delinquencies between high- and low-leveraged regions after a 1 percentage point rate hike.

Source: New York Fed Consumer Credit Panel.

① Some unique features of the US student debt market during our period of analysis are the possibilities of forbearance, income-based repayment plans and loan consolidations. ② The sample period is limited to 2019 as the US implemented student debt (and other) pandemic relief policies in the wake of the 2020 Covid-19 pandemic. Over the sample period, the average borrower lived in a county with a delinquency rate of 10% of student loan balances, while that number was 14% for an average borrower residing in a low-income county.

4.2.3. Other relevant country-specific factors

Country-specific institutional arrangements may influence vulnerabilities in the private non-financial sector to rate hikes and thus the transmission of monetary policy. This section focuses on two of them: the availability of multiple and substitutable sources of funding and the regulatory environment.

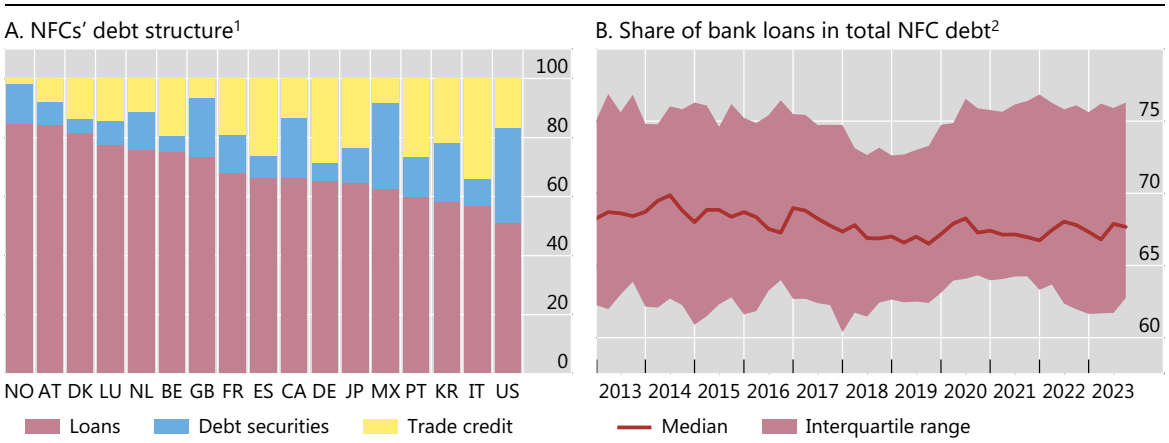
Availability of multiple sources of funding

The availability of multiple sources of funding can help cushion the pass-through from policy rates to average borrowing rates, and thus weaken the income/cash flow channel of monetary policy. In particular, the pass-through may be relatively fast in countries where domestic banks are the only source of external finance, especially if banks rapidly pass on increases in the policy rate – which raises their own cost of funding – to their lending rates. In contrast, the pass-through would tend to be slower in countries where borrowers can optimise the composition of their funding mix. For firms, alternative funding sources may include foreign currency loans, commercial paper, corporate bonds or interfirm trade credit (see Box F).[14] Households too may have different alternatives to bank financing, such as loans from friends and family.

Multiple sources of external finance

In per cent

Graph 14



[1] Q4 2023, except for JP, KR and MX: Q3 2023. [2] Total debt is defined as the sum of loans, debt securities, and trade credit and advances.

Sources: OECD; CGFS Working Group.

The availability of these substitutes varies across countries. Commercial paper and corporate bond issuances are more prevalent in countries where financial markets are more developed. Even there, this source of funding is mostly available only to the largest NFCs. Trade credit is also an important alternative source of funding for small and medium-sized enterprises (SMEs) in many countries, AEs and EMEs alike (Graph 14).

Empirical studies reveal that availability of multiple and substitutable sources of funding can hinder monetary policy transmission. During a period of monetary tightening, credit-constrained NFCs may replace bank loans with commercial paper issuance or new trade credit (Kashyap et al (1993)).[15] For these firms, commercial paper and trade credit lines act as a "spare tire" that weakens the pass-through from the policy rate to corporate borrowing costs. All else equal, one would therefore expect this pass-through to be weaker in countries where financial markets are more developed (eg the United States) or the use of other alternative funding sources such as trade credit are widespread (eg Italy and Portugal).

[14] Trade credit is a contractual or oral agreement in which a seller allows a buyer to pay its purchases several (usually one to three) months after delivery. Trade credit is distinct from "trade finance", which refers to the financing of international trade through bank loans. In many countries, it commonly amounts to more than 20% of a firm's annual sales. For suppliers, allowing credit-constrained customers to pay invoices late helps to maintain customer-supplier relationships through the business cycle. Suppliers that sell customised goods and cannot easily replace their constrained customers, in particular, may have greater incentives to offer financial relief.

[15] For an empirical analysis of the substitution of bank loans for commercial paper during monetary policy tightening episodes, see Kashyap et al (1993). Similar substitution effects of bank loans for trade credit were shown by Nilsen (2002) and Levine et al (2018).

For example, the use of multiple sources of funding in South Korea (Graph 14.A) could be yet one more potential explanation for the limited pass-through there of rate hikes to NFCs' borrowing rates (Graph 5.B).

In some cases, credit markets may also react to rising borrowing costs by engineering new products or stimulating the entry of new firms. Fintech firms, notably, may offer alternative forms of financing that have lower explicit borrowing costs and may be more appealing to constrained and financially fragile borrowers. One example is "buy now, pay later" (BNPL) schemes, which allow consumers to divide their spending into interest-free instalments and rapidly increased in popularity on the back of the recent surge in inflation (Cornelli et al (2023)). Such schemes are particularly attractive to, and have been used disproportionally by, consumers with rejected applications for bank credit.

While finance from fintechs may help some households to smooth consumption in the short term, this may pose risks to financial stability over the longer term. Indeed, households that cannot obtain additional loans from traditional financial intermediaries tend to have lower credit scores and to be financially fragile. If a poor understanding of fintech funding terms leads to over-indebtedness and impairs borrowers' ability to repay other debts, a further rise in this type of funding in the household sector could induce defaults on traditional bank loans (Aidala et al (2023)).

Box F

Financial intermediation through NFCs: the case of Mexico

Trade credit is an important source of external funding for small and medium-sized enterprises in Mexico. Indeed, according to the country's national survey on firm financing conditions, the three main sources are commercial banks, suppliers (ie trade credit) and family/friends. This box discusses the role that large NFCs play in channelling international funding in Mexico (Caballero et al (2016)) – as they simultaneously issue debt in US dollars and lend in domestic currency.

The practice of borrowing in foreign currency and extending trade receivables to customers is common in countries where capital controls are in place. But it is widespread even in emerging market economies that do not have significant capital controls, such as Mexico. A recent study finds that each dollar of large Mexican firms' foreign currency liabilities is linked to more than 30 cents of short-term assets – mostly trade credit (Hardy and Saffie (2024)).

NFCs' motives for engaging in this type of "financial intermediation" are manifold. In some cases, firms may seek to generate interest income by borrowing at a low cost abroad and investing in short-term interest-bearing assets at home – which can be in the form either of trade credit or bank deposits. In other cases, large firms may seek to offer financial support to their customers. During the 2007–09 financial crisis, for example, firms that built up large foreign exchange exposures through the carry trade continued to supply trade credit, despite the fall in their profits due to the significant depreciation of the Mexican peso. Relatedly, Mexico's national survey on firm financing conditions indicates that, during the Covid-19 pandemic, one third of Mexican firms delayed payments to their suppliers as a buffer against the fall in cash flows. These observations suggest that firms place a high value on interfirm credit and business relationships.

One implication of the growing carry trade by large corporates is that the latter have become a conduit through which international financial conditions affect domestic liquidity and credit growth. During favourable carry trade periods, these firms tend to accumulate currency mismatch, increasing not only their own exposure but also – indirectly – their business partners' exposure to currency risk. That said, in Mexico only a small share of firms (less than 5%, mainly the largest ones) finance themselves with foreign currency-denominated debt.

Regulatory and institutional context

Another possible explanation of the cross-country differences in the transmission of monetary policy is the domestic regulatory and institutional context.

In seeking to foster financial stability, prudential measures may affect the transmission of monetary policy. For example, many national banking systems face loan-to-value (LTV) limits and

constraints on the debt servicing burden for new borrowers. Such constraints support borrower resilience by reducing leverage and limiting the ability of lower income and less wealthy households to borrow for property purchases. In many countries there are also measures in place to require or encourage amortisation, as faster amortisation contributes further to borrower resilience.[16]

Recent empirical analysis suggests that, in countries where LTV limits are below 100%, households' greater resilience surfaces as private consumption responding less forcefully to changes in monetary policy rates (IMF (2024)). In other words, LTV limits weaken the income and wealth channels. A case in point is South Korea, where a particularly low LTV limit may be an additional reason why consumption hardly falls following a rate hike (Graph 7.A) despite the relatively strong interest rate pass-through to the average borrowing rate (Graph 5.A).

Institutional arrangements could also shape borrowers' exposure to interest rate risk. For example, the existence of interest rate caps would moderate the pass-through of large policy rate changes. In another example, households' periodic mortgage loan payments could be fixed, with the maturity date adjusting in response to a change in the variable lending rate (eg Germany).

5. Early stage of the post-pandemic monetary tightening: was this time different?

This section focuses on the early stage (ie the first six quarters) of the latest monetary tightening episode. It first compares it with historical experience and reports salient differences (subsection 5.1). It then reviews specific elements of the macro-financial and policy context of this episode that may explain observed deviations from historical norms (subsection 5.2).

5.1. Comparison with historical experience

The comparison between historical and the latest monetary tightening episodes follows the transmission chain of monetary policy described in Graph 1. It focuses first on the pass-through of rate hikes to average borrowing rates over the first six quarters into monetary tightening, then on the transmission to consumption and investment. A final subsection discusses implications for credit risk.

The main finding is that the evolution of borrowing rates and aggregate demand during the recent period was by and large in line with that observed historically. If anything, aggregate consumption was relatively strong and households relatively resilient this time round, across most countries. In comparison, the evolution of investment was more uneven across countries.

In assessing the latest rise in borrowing rates, this report compares it with what it would have been had the pass-through from policy rates been the same as the historical norm. The motivation for this approach stems from the observation that, even though households' and NFCs' borrowing rates have tended to increase by much more during the latest cycle than historically (Graphs 15.B and 15.C), the rise in policy rates themselves has also been stronger (Graph 15.A).

Counterfactual borrowing rates are constructed by applying country-specific historical pass-through estimates (recall Graph 5) to the latest policy rate hikes. Subtracting the average quarterly increase in counterfactual borrowing rates over the first six quarters after the initial hike from the corresponding increase in actual borrowing rates delivers an "interest rate gap". A positive (negative) gap means that borrowing rates increased by more (less) this time round compared with the usual historical relationship. To facilitate the comparison across countries, each interest rate gap is standardised using the country-

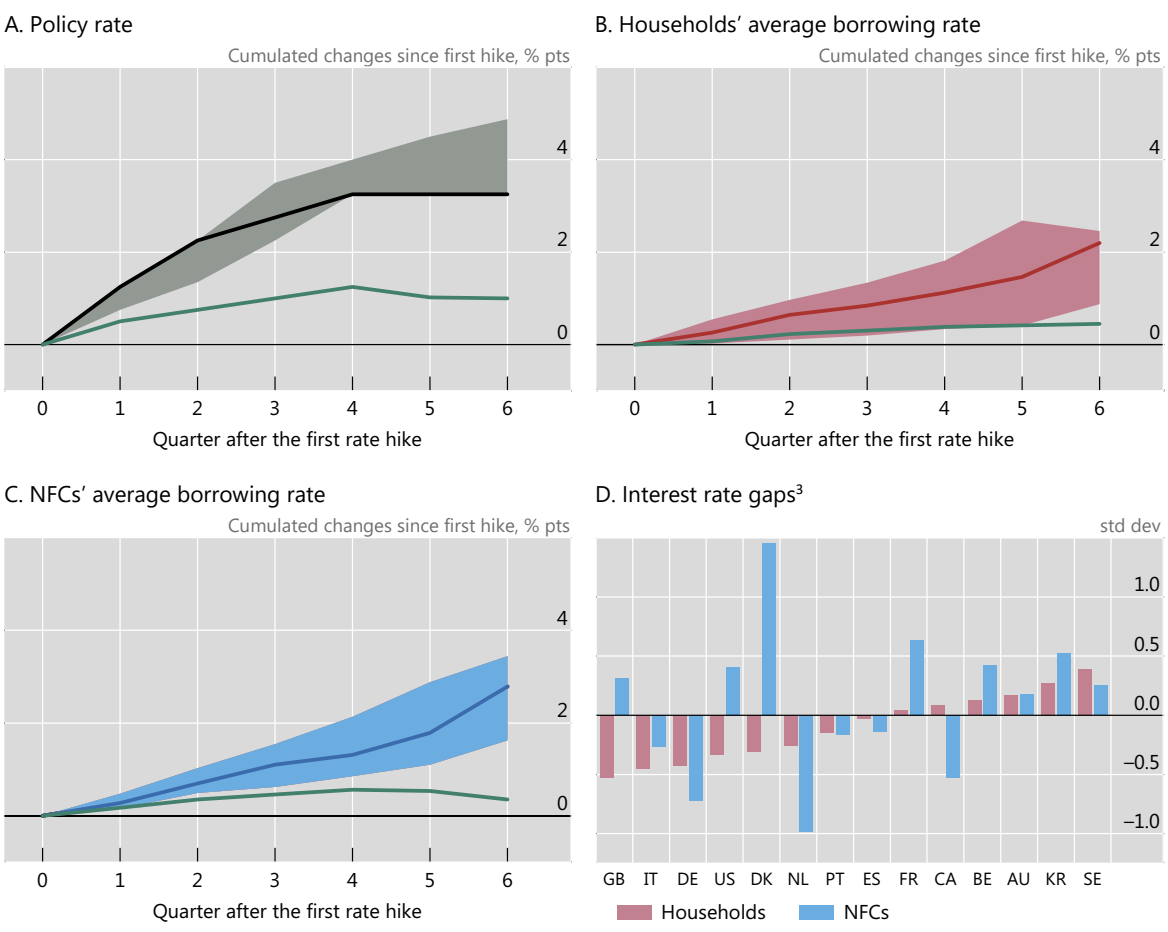
[16] See Annex A for country-specific details as well as CGFS (2023).

specific standard deviation of the corresponding borrowing rate over the period Q1 1985–Q4 2016. An exceptionally wide gap would exceed two standard deviations.

Over the first six quarters after the start of the latest tightening cycle, the private non-financial sector witnessed changes in borrowing rates that were largely in line with the historical norm (Graph 15.D). For households, the gap is negative for a (small) majority of countries in the sample but its absolute value is of little economic significance; ie it is invariably smaller than one half of the standard deviation of the corresponding borrowing rate (red bars). The picture is largely similar for NFCs, even though the economic significance of the interest rate gap is greater for some countries (blue bars).

Evolution of interest rates during latest versus past tightening episodes

Graph 15



[1] Median over a sample of more than 74 past monetary tightening episodes. [2] Median over a sample of 15 post-pandemic monetary tightening episodes. [3] A negative (positive) gap indicates a slower (faster) pass-through by historical standards. See Annex B for technical details.

Sources: National data; CGFS Working Group.

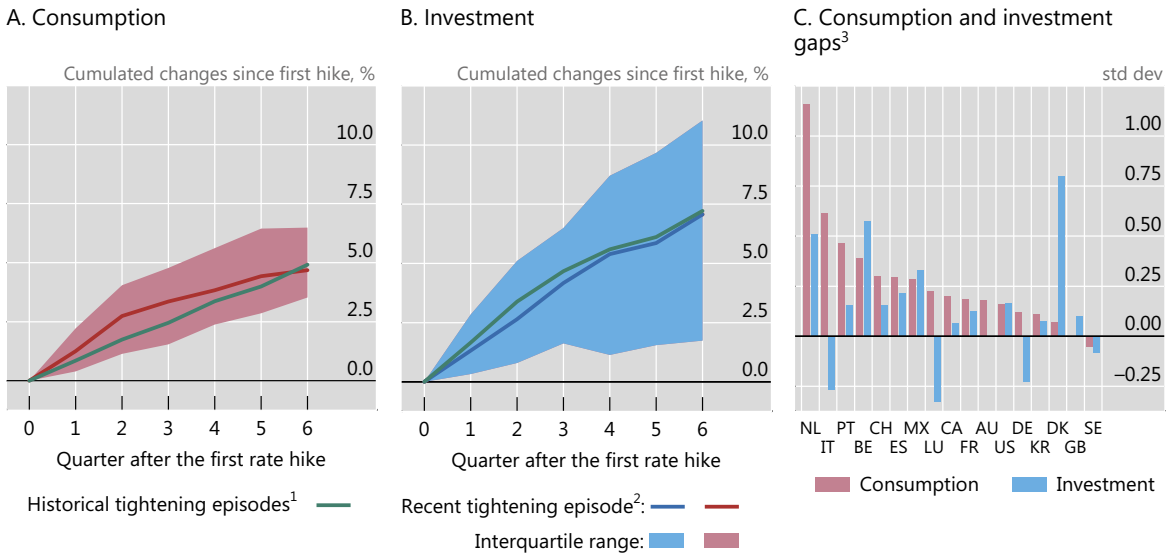
It is necessary to acknowledge that this assessment of monetary policy pass-through has important limitations and should be viewed as tentative. First, focusing only on the first six quarters after the start of a hiking cycle – a reflection of data availability – cannot do justice to the long and variable lags of monetary policy transmission. Second, policy rate hikes *alone* may not capture the full extent of

monetary policy tightening. Early changes (or announcements thereof) in some central banks' asset purchase programmes – or more generally in unconventional monetary policies – may have tightened financial conditions ahead of the policy rate hikes, notably via the long end of the yield curve (Rostagno et al (2021)).[17] The effects of such changes are an important omission of the analysis.

A similar comparison indicates that, relative to the historical norm, households' consumption and NFCs' investment largely held up during the first six quarters of the latest tightening cycle (Graph 16).[18] For one, a direct comparison reveals hardly any difference across episodes in terms of both aggregate consumption and investment (Graphs 16.A and 16.B, lines effectively coinciding). Moreover, since the recent evolution of consumption and investment arose from much more forceful increases in policy rates compared with past tightening episodes (Graph 15.A), the contractionary effect of a *given* hike size on each type of spending must have been weaker this time round. In particular, consumption was relatively resilient in almost all of the countries covered by the analysis, as indicated by the positive consumption gaps (Graph 16.C). In comparison, the evolution of investment was more uneven across countries, with four countries exhibiting a negative investment gap.

Evolution of aggregate demand during latest versus past tightening episodes

Graph 16



[1] Median over a sample of 151 past monetary tightening episodes. [2] Median over a sample of 55 post-pandemic monetary tightening episodes. [3] A negative (positive) gap indicates a faster (slower) pass-through by historical standards. See annex B for technical details.

Sources: National data, CGFS Working Group.

Financial vulnerabilities in the household and NFC sectors seemed muted in the first stage of the latest tightening, even though some signs of stress appeared for early hikers. Over the five quarters after the first hike – for which data on loan quality are available consistently across countries – NFCs' and households' NPLs remained on average below but close to their pre-hike levels (Graph 17). For countries that had started hiking earlier – Brazil, Mexico, the United Kingdom and the United States – data from one

[17] For example, the ECB announced that it would lower the pace of its pandemic emergency purchase programme on 16 December 2021, ie more than eight months before raising its policy rate in July 2022. As a result, long-term rates started to increase in December 2021, driving up mortgage rates before the hiking cycle started. Accordingly, the analysis presented here may underestimate the effects of the latest monetary tightening on borrowing rates.

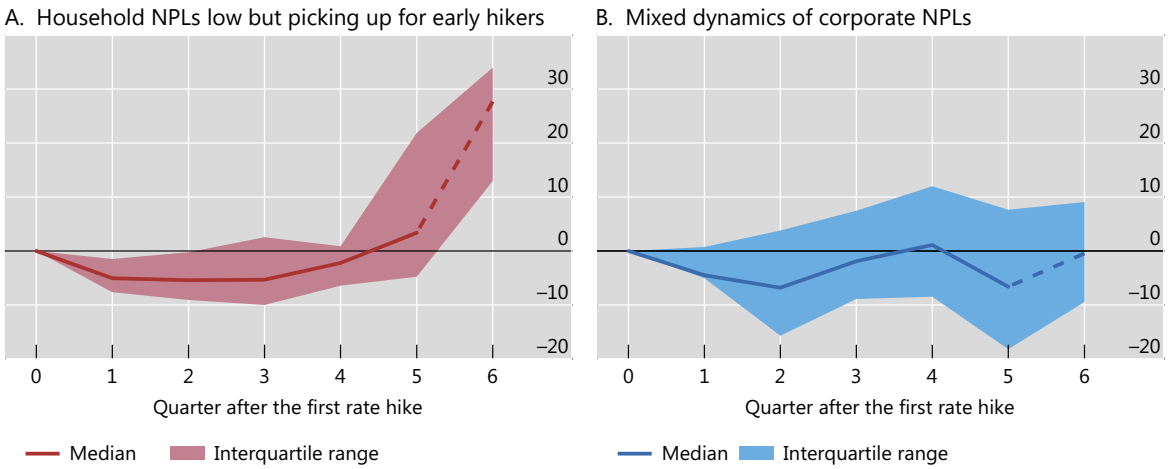
[18] In some countries, the resilience of *aggregate* consumption may have masked sectoral disparities. In the case of the euro area, for example, ECB (2023) contrasts the resilience of consumption in contact-sensitive services and in sectors in which supply bottlenecks were subsiding (eg electric cars) after the Covid-19 pandemic with the relative weakness of consumption of non-durable goods.

additional quarter revealed a rapid increase (by 25%) in households' NPL ratio. A back-of-the-envelope calculation based on Graph 3.A suggests that such an increase is roughly in line with that seen at the same stage in previous tightening episodes.[19] Indeed, historical experience offers a reminder that the effects on NPLs take longer to unfold, with NPLs starting to increase at around four quarters and peaking at around 12 quarters after the initial rate hike.

Evolution of NPLs during the post-pandemic tightening episode[1]

In per cent

Graph 17



[1] Cumulative growth rate of NPL-to-loan ratio since first rate hike. Dashed line: statistics for early hikers: BR, GB, MX, US. See annex B for technical details.

Sources: Reserve Bank of Australia; Central Bank of Brazil; Bank of Italy; Bank of Spain; Board of Governors of the Federal Reserve System; LSEG Datastream; UK Finance; CGFS Working Group.

5.2. Tentative explanations for deviations from historical norms

The evolution of average borrowing rates, consumption, investment and NPLs in the early stage of the latest tightening episode reflects not only the response of these variables to rate hikes but also (and possibly to a great extent) the specific post-pandemic macro-financial and policy context.

Consider the macro-financial conditions at the outset of the latest monetary tightening episode. For one, they reflected the aftermath of a global pandemic that had led countries to implement containment measures. Once lifted, the artificial suppression of activity gave way to a strong rebound in aggregate demand, also fuelled by outsize policy support. Meanwhile, the war in Ukraine and lingering pandemic-related disruptions to supply chains weighed on aggregate supply. This global sequence of shocks likely contributed to the remarkably similar macro-financial conditions across countries. In particular, all countries included in this report lacked a credit and asset price boom (as defined in section 2). In such circumstances, the effects of a rate hike on aggregate demand and financial performance in the private non-financial sector have been modest historically (Graph 4). This could partly explain the general resilience of consumption and, to a lesser extent, investment this time round.

That said, such a comparison with historical experience misses certain post-pandemic conditions that are of potential relevance. Country-specific factors extending beyond credit and asset price booms and productivity are likely to have also shaped the evolution of borrowing rates, consumption and

[19] See Annex B for details.

investment as well as households' and firms' financial resilience. The rest of this section reviews these elements of the context.

5.2.1. Factors that may have bolstered consumption

Several factors specific to the post-pandemic period may shed light on the relative resilience of aggregate consumption.

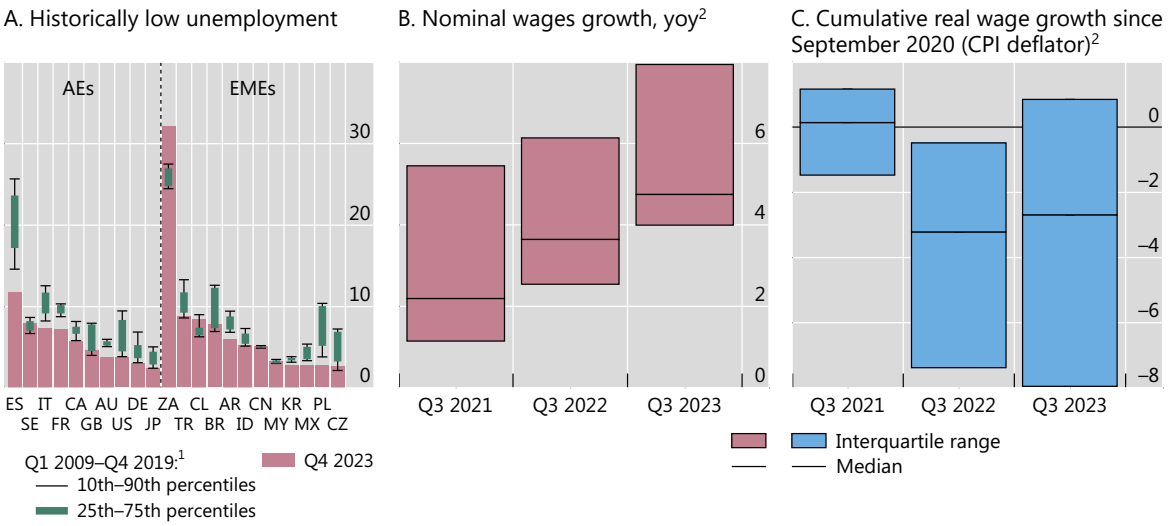
Favourable labour market developments

The latest tightening took place against tight labour markets, with a few exceptions. This favourable backdrop likely supported households' income, mitigating the transmission of rate hikes through the income channel.

Quite generally across countries, unemployment rates plummeted and stayed low after the pandemic. In all major AEs as well as in several EMEs, unemployment rates fell close to the troughs seen over the decade starting with the Great Financial Crisis (Graph 18.A). The persistence of this labour market tightness included sectors that typically rely on low-wage – and possibly financially vulnerable – workers, such as construction and hospitality.[20] This stands in contrast to past tightening episodes, in which unemployment tended to rise.

Labour market developments

In per cent — Graph 18



[1] BR: Q2 2012–Q4 2019; CN:, Q1 2017–Q4 2019. [2] See annex B for technical details.

Sources: ILO; OECD; LSEG Datastream; national data; CGFS Working Group.

The picture is less clear-cut in terms of real wage growth. Wage growth picked up in nominal terms but still fell short of inflation in the early stage of the tightening (Graphs 18.B and 18.C).[21] That said, the minimum wage increased relatively fast in some countries. Indeed, the minimum-to-median wage ratio increased by 0.6 percentage points on average between 2021 and 2022 among OECD countries (ranging

[20] The labour market is said to be "tight" when the imbalance between labour supply and labour demand manifests itself in an abundance of job opportunities along with a scarcity of workers available and willing to take those jobs. See Van Doornik et al (2023).

[21] One reason is that inflation increased unexpectedly and rapidly, making it harder for wage inflation to catch up after a long period of stability; see BIS (2022).

from –1.68 percentage points in the United States to +6.35 in Mexico). Higher minimum wages may have helped cushion the impact of monetary tightening for lower-income households. To the extent that these households have the highest marginal propensity to consume out of changes in their income (see subsection 4.2.2), they may also have contributed to consumption's resilience.

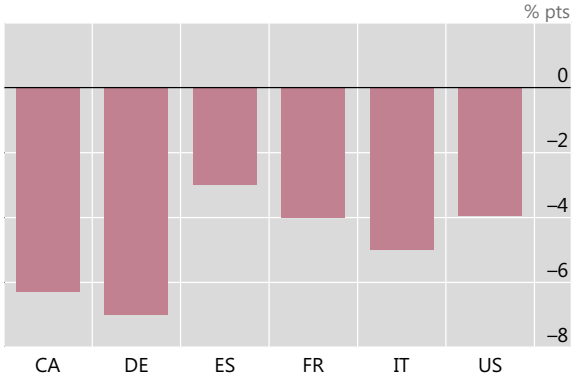
Reduced drag on consumption from specific household groups

The macroeconomic and policy context benefited to a larger extent households that have a high propensity to consume out of current income.

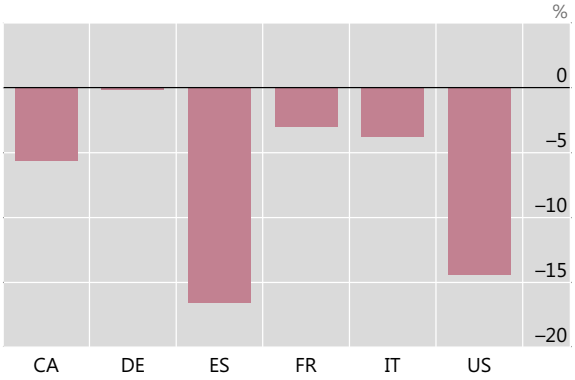
The inflation rates across consumption items in the first six quarters of the tightening seem to have carried relative benefits for lower-income households. Recent evidence suggests that, in some countries, the earnings of such households increased in real terms relatively more than those of middle-income households (Box G). The reason is that the former households tend to spend a higher share of their income on housing and food, where inflation was relatively subdued, than on transportation, where inflation was initially strong. Ultimately, considering that lower-income households tend to have a higher marginal propensity to consume out of real income, the way in which relative price dynamics affected these households' consumption baskets would have supported aggregate consumption in the early stage of the tightening cycle.

Share of hand-to-mouth households and the income channel — Graph 19

A. The share of hand-to-mouth households has declined



B. Impact of the lower share of hand-to-mouth households on the elasticity of consumption[1]



[1] Percentage change in the absolute value of the elasticity of aggregate consumption to the monetary policy rate. A negative bar indicates a lower (absolute) elasticity. Based on the methodology developed by Alves and Acharaya (2024). See annex B for technical details.

Sources: CA: Survey of Financial Security 2019 and model simulations; EA: Household Finance and Consumption Survey (HFCS); US: Survey of Consumer Finances (SCF); CGFS Working Group.

In addition, many governments supported households with extraordinary transfers during the pandemic, reducing the footprint of HtM households. Together with the inability to spend due to pandemic restrictions, such assistance contributed to higher savings, even for households that held very little or no liquid assets prior to the pandemic. As a result, the share of HtM households declined across all countries in the sample during the pandemic (Graph 19.A). Since these households have a higher propensity to consume out of current income, their smaller footprint would have weakened the income channel of monetary policy.[22] Rough estimates suggest that the decline in the share of HtM households

[22] A fall in the proportion of HtM households may a priori have two opposite effects on monetary policy transmission. On the one hand, a lower share of HtM households means that more households save. The larger footprint of savers, in turn, tends to strengthen the interest channel. On the other hand, a lower share of HtM households dampens the income channel because

reduced the (absolute value of the) elasticity of aggregate consumption to policy rates by about 15% in the United States and Spain (Graph 19.B).

Box G

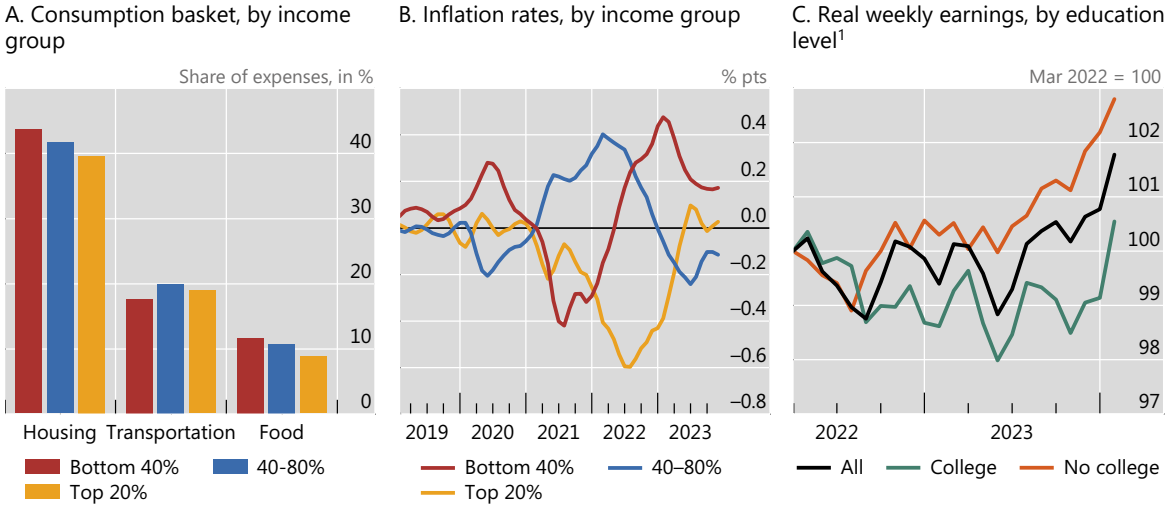
Inflation and real earnings disparities following the Covid-19 pandemic – the case of the United States

This box estimates heterogeneous effects of the recent surge in inflation on real earnings across US household income groups. The underlying inflation data are at the level of goods categories, the weight of which differ in consumption baskets depending on household incomes. The key finding is that real earnings of low-income households have been particularly resilient during the latest tightening cycle.

The first step of the analysis is to identify income group-specific consumption baskets and compute the corresponding inflation rates. The computation is based on granular inflation rates for 30 different goods categories (eg food away from home, used cars). Middle-income households, which have the largest transportation budget (Graph G1.A) as a percentage of their total expenses, experienced the most severe inflation between 2021 and 2022 (Graph G1.B, blue line). The inflation differential with other income groups converged to zero by end-2022, as inflation fell and became more broad-based.

Heterogeneous exposure to inflation affects real income

Graph G1



[1] Nominal earnings deflated by the consumption basket inflation of the considered group.

Sources: Federal Reserve Bank of New York Equitable Growth Indicators; US Current Population Survey; US Consumer Expenditure Survey.

The second step is to estimate the evolution of households' real earnings, taking into consideration the heterogeneity of inflation across income groups. Due to data constraints, education is used as a proxy for income, based on the positive correlation between the two. Graph B7.C shows that the real earnings of more educated (higher-income) households decreased during the monetary tightening and returned to their pre-tightening level only recently. In contrast, real earnings of households with no college degree (and lower income) were stable or increasing throughout, standing most recently at 3% above their level before the first rate hike. This resilience of the earnings of the low-education workers may be a result of tighter labour markets, of lower labour force participation among these workers or of greater resilience in industries that employ them.

(i) the consumption of these households tends to be more sensitive to changes in their income (compared with other households) and (ii) their income tends to be highly sensitive to changes in the policy rate. On net, the dampening of the income channel is usually seen as more than offsetting the strengthening of the interest rate channel.

Resilient house prices

Resilient house prices may have contributed to weakening the wealth channel of monetary policy. Indeed, another specificity of the latest tightening cycle is that, despite the rise in policy rates, house prices have remained elevated in many countries in the first two years of the tightening. The few exceptions are countries where house prices had risen the most in the wake of the Covid-19 pandemic (eg Germany and Sweden). Several factors may have contributed to propping up house prices. High inflationary pressures on raw materials triggered a surge in construction costs that cooled building activity in most countries, depressing housing supply. Meanwhile, elevated rates on new mortgages contributed to a drying up of house sales, especially in countries where homeowners were reluctant to sell in order not to forfeit the low fixed rates that they had locked in on their existing mortgages (Fonseca and Lui (2023)).

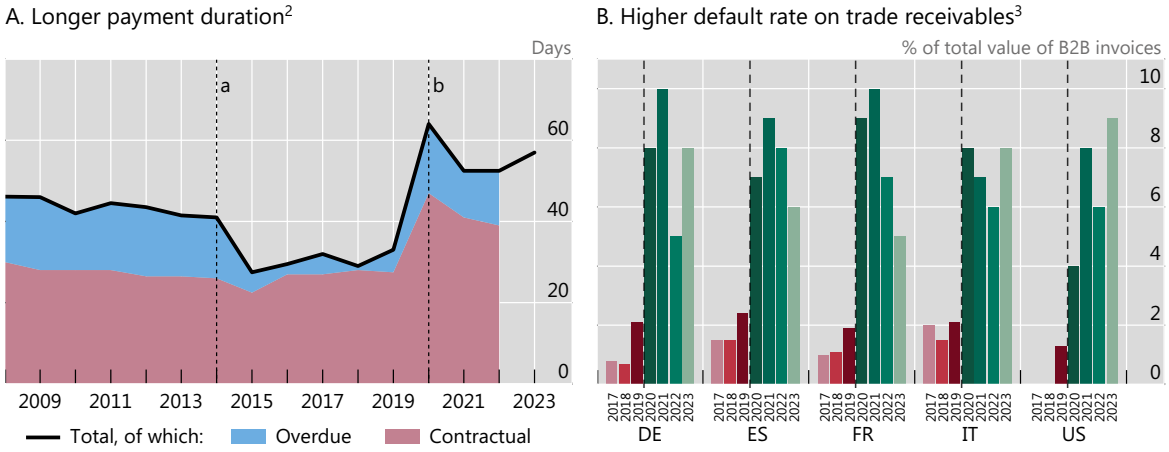
Migration-driven population growth

Rapid post-pandemic population growth is another factor independent of monetary policy that may have supported aggregate consumption. In most of the countries in focus, population growth from 2022 onwards has been higher than in previous years. In countries where the population grew the fastest (eg Australia and Canada), this growth was mainly due to strong immigration, which de facto resulted in a rapid increase in the number of consumers and aggregate consumption. Aggregate consumption indeed grew significantly in these countries, even though monetary tightening may have reduced consumption per capita.

5.2.2. Factors that may have affected aggregate investment differently across countries

While countries faced a broadly similar sequence of adverse shocks prior to implementing monetary policy tightening, their vulnerability to these shocks may have been different. All else equal, protracted supply chain disruptions and higher energy prices may have affected investment more strongly in countries where firms rely relatively more on trade credit or cannot reduce their energy consumption easily.

Financial strains in supply chains[1] Graph 20



[1] See Annex B for technical details. [2] Median maturity of trade payables over a sample of 22 European countries. Dotted line (a): year of transposition of the 2011 EU Late Payment Directive into domestic law in most of the countries in the sample; dotted line (b): Covid-19 pandemic outbreak. [3] Share of the total value of business-to-business (B2B) invoices written off.

Sources: Boissay et al (2024); Intrum Justitia; Atradius; CGFS Working Group.

Reduced role of trade credit

A "buffer" that has historically helped firms cope with rising funding costs is trade credit. Often interest-free, such credit represents an important alternative source of external funding for SMEs (Graph 14.A). During a period of monetary tightening, credit-constrained SMEs often replace bank loans with trade credit from unconstrained suppliers as a way to ease financial strains.

In the latest monetary tightening episode, however, trade credit may not have played its usual role as a buffer. This tightening took place against the overhang of unprecedented pandemic-related disruptions to supply chains, which generated a backlog of unpaid trade credit claims. In Europe, this backlog has led to an increase in the effective maturity of trade receivables by about 30 days (Graph 20.A) and to a share of trade credit in default around 5 percentage points above that in 2019 (Graph 20.B). To the extent that firms had already used up their trade credit lines to cushion the impact of supply chain bottlenecks, they may have had little left to cushion the effects of rising interest rates.

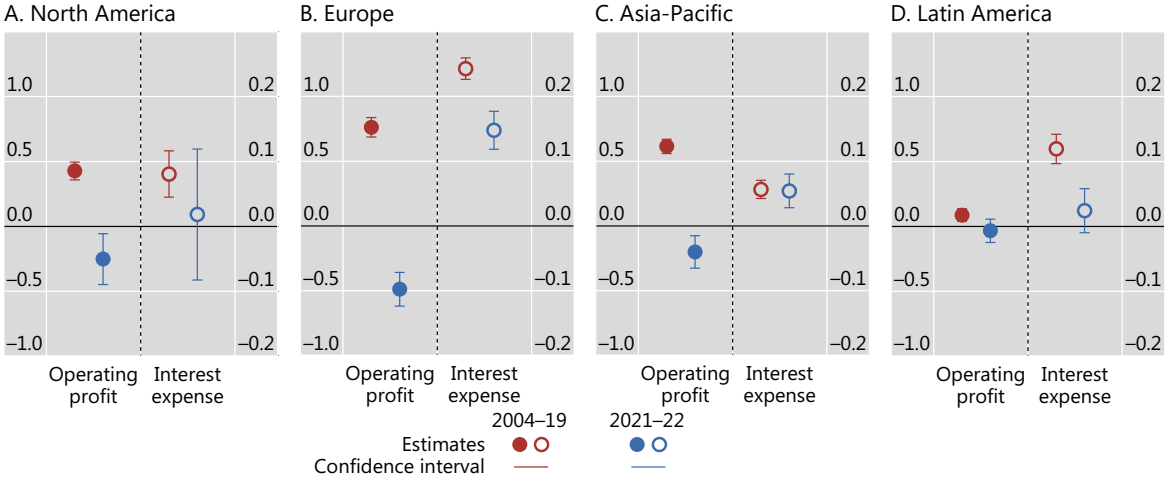
The buffering effect of corporate profits has been weaker

NFC investment is more likely to be resilient when underpinned by financial strength, which in turn depends on the type of inflation that policy rate hikes seek to tame.

When inflation is demand-driven, the rise in policy rates takes place against the backdrop of strong aggregate economic growth. In such an environment, profits are buoyant – at least in the early phase of the monetary tightening – thus providing firms with a "natural hedge". The presence of such a hedge transpires in the contemporaneous correlation between changes in the policy rate and profits: the so-called cash flow beta. During past tightening cycles, cash flow betas tended to be positive in most regions (Graph 21, red dots) and comparable to interest expense betas (red dots vs red circles), except in Latin America. This is a sign of a weak cash flow channel that would support the resilience of NFC investment despite monetary policy tightening.

Cashflow betas were low at the onset of the latest monetary tightening cycle[1]

% of total assets — Graph 21



[1] Correlations between the change in NFCs' cashflows (in per cent of lagged total assets) and the change in the monetary policy rate ("cashflow betas"). Reading note: in Europe, a 1 percentage point increase in the monetary policy rate was associated with a 0.5 (0.8) percentage point decrease (increase) in NFCs' EBITDA/Asset ratio in 2021–22 (2014-2019). See annex B for technical details.

Sources: S&P Capital IQ; CGFS Working Group.

By contrast, the cash flow betas were negative and below interest expense betas in 2021–22, notably in Europe. A possible reason is that the latest tightening responded to both demand- and supply-

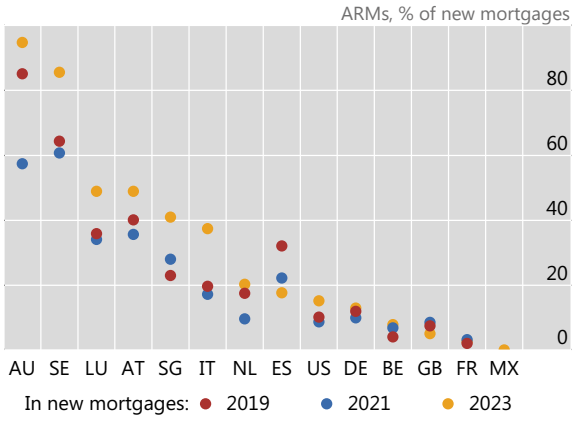
driven inflationary pressures (Shapiro (2022), Boissay et al (2024)). Persistent supply chain bottlenecks and high energy prices not only spurred inflation but may also have weighed on operating cash flows and profits. With the latter's role as a hedge undermined, the cash flow channel may thus have been relatively strong this time round.[23]

5.2.3. Factors that may have contributed to financial resilience

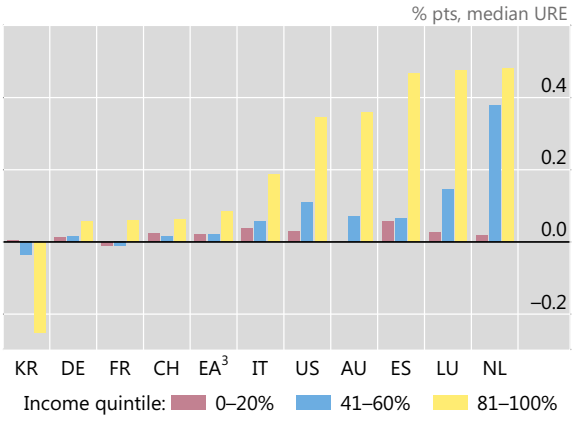
Even though the historical norm suggests that the peak effect on NPLs may still come (Graph 3.A), NFCs and households proved financially resilient in the first stage of the latest tightening episode. Their resilience was consistent with them taking advantage of the preceding period of low interest rates and benefiting from pandemic-related assistance packages. It could also have been a reflection of successful prudential policies.

Households strengthened their balance sheets during the pandemic — Graph 22

A. New mortgages: share of ARMs[1]



B. Changes in UREs during the pandemic[2]



[1] ARM: Adjustable rate mortgage. End of year values. [2] URE: Unhedged risk exposure. Post-Covid-19 minus pre-Covid-19 median URE, standardised by mean gross income; population of indebted households. Pre-Covid-19 survey dates: AU 2018, CH 2019, EA countries 2017/18, KR 2019 and US 2019. Post-Covid-19 survey dates: AU 2022, CH 2021, EA countries 2020/21, KR 2022 and US 2022. [3] Euro area aggregate.

Sources: AU: Household, Income and Labour Dynamics (HILDA Survey Release 22.0 - disclaimer); CH: individual tax data of the Canton of Berne; EA: Household Finance and Consumption Survey (HFCS); KR: Survey of Household Finances and Living Conditions (SFLC); MX: National Survey of Household Finances (ENFIH); US: Survey of Consumer Finances (SCF); ECB; OECD; LSEG Datastream; European Mortgage Federation; CGFS Working Group.

NFCs' and households' debt pre-positioning

Borrowers' pre-positioning in the run-up to the monetary tightening cycle provided an effective shield against rate hikes. The post-pandemic tightening followed an extended period of low interest rates that prompted many NFCs and households to take on more fixed rate debt at long maturities. As a result, the share of adjustable rate mortgages (ARMs) in new mortgages decreased in most countries in the wake of the pandemic (Graph 22.A, blue versus red dots).[24] This likely helped to reduce households' net exposure

[23] The size of demand and supply shocks varied across countries. In Australia, relatively strong demand enabled NFCs to pass on their higher costs to clients, which has raised the median operating profit margin since the start of the monetary tightening.

[24] More recently, with mortgage rates already at elevated levels, the share of ARMs bounced back to stand above even its pre-pandemic levels (Graph 22.A, yellow versus blue dots). This is consistent with households expecting mortgage rates to ease in the near term.

to interest rate risk (Graph 22.B),[25] which would explain why households' average borrowing rates adjusted relatively slowly in some countries in the early stage of the tightening (Graph 15.D).

Pandemic-related government support

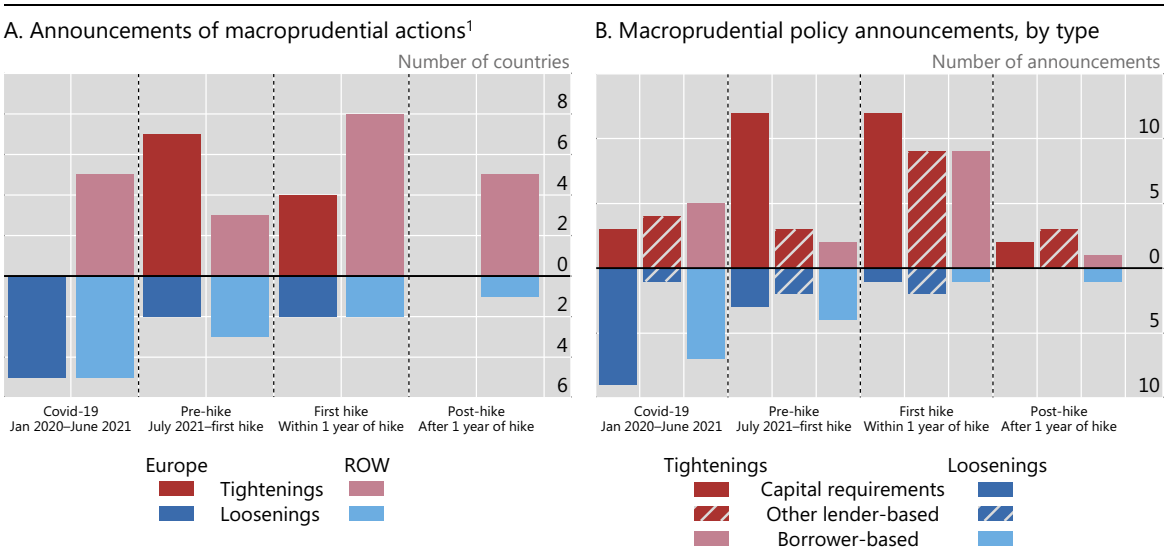
The fiscal programmes that preceded the latest tightening cycle helped NFCs and households strengthen their balance sheets, thus reducing the risk that they would default. Government support – eg public loan guarantee schemes – helped NFCs secure funding on favourable terms and build hefty liquidity buffers (Graph 10).[26] As regards households, cost of living assistance, extra unemployment benefits and, most notably, the lack of spending opportunities during pandemic-related lockdowns led to extra savings. This, in turn, reduced households' interest rate exposures during the pandemic, as the rise in UREs suggests (Graph 22.B).

Prudential policies before and during the tightening

Prudential authorities in many countries tightened their policy ahead of and during the latest monetary tightening episodes (Graph 23).

Evolution and heterogeneity of macroprudential actions

Period January 2020 – July 2023 Graph 23



[1] Europe: BE, CH, DE, FR, IT, NL, SE and UK. Rest of the world: AR, AU, CA, HK, IN, KR, MX, SG, TH and US.

Sources: National data; CGFS Working Group.

The tightening was reportedly motivated by three main objectives, whose relative importance varied across countries. First, authorities unwound loosening measures taken during the Covid-19 pandemic. Second, they sought to address financial imbalances that had built up further during the Covid-19 crisis, notably where housing markets showed signs of overheating. Third, they also sought to reduce borrowers' exposures to rising rates. In pursuit of the third objective, some countries imposed ceilings on

[25] The comparability of the changes in UREs across countries is imperfect because of differences in the periods between pre- and post-Covid survey dates.

[26] In the case of Mexico, for example, about half of the firms could be considered highly indebted in 2021, but almost 85% had fixed rate debt. Furthermore, among the 15% of firms with adjustable rate debt, two thirds reported having liquid or short maturity assets. Thus, Mexican firms' exposure to interest rate hikes was rather low at the outset of the monetary tightening.

new borrowers' debt servicing costs and/or required that these limits be met under the assumption of a "stressed interest rate" above the contractual mortgage rate (see Annex A). While gauging the impact of these prudential measures is difficult, there are some tentative conclusions that they supported financial stability. In particular, recent empirical work suggests that prudential policy tightening – whether ahead of or during a monetary tightening – may have helped to reduce the likelihood of financial stress (Boissay et al (2023)).

6. Key takeaways and omissions

This report analyses the impact of policy rate hikes on NFCs and households across a number of advanced and emerging market economies. The analysis reviewed historical regularities and compared them with experience during the latest tightening episode. This section summarises the more salient findings and points to related themes in the private non-financial sector that were out of scope for the report but also deserve attention.

Historical regularities

1. **After the start of monetary policy rate hikes, borrowing rates rise quickly while declines in aggregate demand and signs of financial stress take longer to materialise**.
   - The pass-through to the average borrowing rate on households' and NFCs' outstanding debt peaks at 40–60% of the policy rate hike, with a delay of four to five quarters.
   - By contrast, consumption, real investment and GDP reach their troughs after 16–20 quarters.
   - Non-performing loans start increasing eight quarters after the policy rate hikes and peak after 12 quarters in the case of households and 20 quarters in the case of NFCs.
2. **The strength of monetary policy transmission depends on the prevailing macro-financial conditions as well as on the structure of debt and the availability of financial buffers. Vulnerabilities to interest rate hikes vary within the corporate and household sectors.**
   - Against the backdrop of a joint credit and asset price boom, rate hikes are particularly effective in reducing aggregate demand. They also tend to usher in financial stress if, in addition, aggregate productivity is below trend.
   - Prudential measures can help mitigate financial stress by addressing financial vulnerabilities ahead of a monetary tightening cycle.
   - Depending on the channel considered, the transmission strengthens with the share of variable rate or short-term debt, the holdings of long-term assets and borrowers' funding needs, and weakens with the size of borrowers' liquidity buffers and the availability of alternative funding sources.
   - Illiquid/indebted households and small firms seem to be particularly vulnerable to interest rate hikes. Their vulnerability amplifies the impact of monetary policy tightening on aggregate demand but also raises the likelihood of financial stress.

Early stage of the latest monetary tightening

1. Accounting for the pace and extent of policy rate increases, **the evolution of borrowing rates in the first six quarters of the latest monetary tightening was broadly in line with the historical norm**. Over the same period, financial vulnerabilities in the private non-financial sector appeared muted, with signs of rising default rates roughly in line with past experience and not

suggesting generalised stress. That said, definitive conclusions about the resilience of the private non-financial sector could not be drawn because of the long monetary policy transmission lags.

2. **In parallel, the evolution of aggregate consumption was more resilient than had been the case historically for most of the countries covered by the report.** Probable supporting factors were the absence of a prior credit boom in the household sector and favourable labour markets. In addition, households had taken advantage of the low-for-long era to lock in low debt service costs and of fiscal support during the pandemic to strengthen their balance sheets.

3. **Relative to the historical norm, NFCs' investment evolved more unevenly across countries.** Overall, the favourable underlying conditions were similar to those in the household sector. However, NFCs particularly reliant on trade credit and energy consumption experienced relatively stronger headwinds from supply chain disruptions and higher energy prices. An unusually strong cash flow channel of monetary policy may have also weighed down on NFCs in some geographic regions.

Out-of-scope issues deserving attention

1. **Policy rate hikes alone and their effects on households and NFCs through borrowing costs may not capture the full extent of a monetary policy tightening.**

   - In some countries, scaling down asset purchase programmes and forward guidance or other central bank communication before the start of the latest hiking cycle may have raised borrowing costs ahead of the actual tightening. The report abstracts from such mechanisms as it focuses on the impact of policy rate hikes only.
   - Monetary tightening may also affect households' and NFCs' financing conditions through non-price factors, such as stricter credit standards or credit rationing by banks and other financial intermediaries. The report captures such effects only indirectly, to the extent that they surface in consumption and investment.

2. **Potentially important channels of monetary policy transmission are omitted or covered only indirectly.**

   - The exchange rate channel is captured only to the extent that it enters borrowing costs and manifests itself in observed consumption and investment.
   - The report does account for the capacity of NFCs' and households' assets to serve as a buffer when interest rate risk materialises. However, the analysis only partially incorporates (in the context of households) the effect of monetary tightening on *net* interest income.

3. **Focusing on households and NFCs, the report cannot provide a system-wide account of interest rate risk**.

   - Such an account also requires covering the public and financial sectors.
   - Ultimately, financial stability hinges on the loss-absorbing capacity of financial intermediaries that hold the debt of borrowers with interest rate risk exposure.

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Annex A: Structural resilience factors – a cross-country comparison

This annex reports country-specific institutional factors and recent support measures that may have helped households cope with higher borrowing costs since the beginning of the latest monetary tightening episode. It is based on a survey within the Working Group.

	Structural or institutional factors	Recent/temporary support measures to bolster household resilience	Macroprudential measures to bolster household resilience
AU	▪ Strong incentives to prepay loans and build loan-offsetting savings: ○ "Redraw facilities": allow borrowers to draw immediately on any repayments made above the required minimum. ○ "Offset account": everyday deposit account linked to the mortgage that allows the borrower to pay interest only on the mortgage net of the deposits on the offset account. There is no income tax on the interest income from offset accounts. ▪ Full recourse for most mortgages.	▪ Banks offer payment holidays and other hardship arrangements for borrowers in arrears. ▪ Government support in the form of various cost of living relief measures, including energy bill relief, cheaper healthcare and childcare subsidies.	▪ Strong lending standards enforced via – among other things – an additional margin (currently 300 basis points (bp)) applied above the initial interest rate when testing borrowers' serviceability. ▪ Borrowers with a loan-to-value (LTV) ratio above 80% are required to obtain mortgage insurance.
CA	▪ Most mortgages are fixed rate. ▪ Homeowners with an origination LTV ratio below 80% (65% for new mortgages as of 2024) can tap their home equity through lines of credit. ▪ Full recourse for around 90% of mortgages, although bankruptcy law shields income and retirement assets for almost all borrowers.	▪ Borrowers facing financial hardship have the possibility to temporarily lower their principal payments.	▪ For mortgages with an LTV above 80%: ○ government mortgage insurance is required; and ○ there is a stress test for mortgage qualification based on a minimum qualifying mortgage rate equal to 5.25% or to a 200 bp add-on above the contracted mortgage rate.
CH	▪ No requirement to directly amortise (repay principal on) the mortgage. Homeowners often opt for a tax-deductible indirect repayment via contributions to a tied pension scheme, which they pledge to the bank as collateral. ▪ Consumer and car loans typically have a fixed rate over the entire term. ▪ Interest rates on credit cards and overdrafts capped at 12 percentage points above a (non-negative) reference rate based on the Swiss Average Rate Overnight (SARON). ▪ Full recourse for most mortgages.		▪ Households are required to reduce their mortgage loan's LTV down to at least 66.7% over the course of 15 years (from LTV at origination, which typically does not exceed 80%). ▪ The supervisory authority acts to ensure reasonable debt service coverage is maintained. A common practice is that costs for debt service and maintaining the property should not exceed one third of the sustainable income. A prudent imputed interest rate (eg a long-term average, currently approximately 4–5%) should be assumed for the interest payable.
DE	▪ Most mortgages are annuity loans, ie involve time-to-maturity changes that keep periodic payments fixed (when possible). ▪ There is no legal interest rate cap but the German Civil Code prohibits usury. ▪ Full recourse for most mortgages.	▪ Temporary public support measures to dampen the impact of higher energy costs and the cost of living on households (eg tax reliefs and lump sum payments).	▪ Supervisory communication to lenders on the importance of prudent lending standards.

ES		▪ Borrower relief (2022–23) measures for eligible borrowers with mortgage loans: ○ offer borrowers to pay interest only; or benefit from a borrowing rate cap, a payment holiday, or a maturity extension up to seven years; ○ facilitate the conversion of floating into fixed rate mortgage loans; or ○ suspend early repayment fees for variable rate mortgage loans.	
FR	▪ Almost all housing loans have fixed interest rates over their entire duration (98% of outstanding loans as of December 2023). ▪ Nearly all housing loans are secured by credit protection (97% of outstanding loans as of December 2023). This mainly takes the form of a third-party guarantee that covers the losses banks face when borrowers default (64% of outstanding loans as of December 2023). The use of mortgages, whereby the house is used as collateral, is limited. ▪ Possibility of debt restructuring to limit defaults. ▪ Interest rate cap (usury rate), set quarterly. ▪ Full recourse for most mortgages.	▪ Measures to help households with rising energy costs and cost of living increases (2022–24).	▪ Borrower-based limits for new housing loans (limits for the debt service-to-income (DSTI) ratio and for maturity).
GB		▪ Government scheme that offers eligible borrowers the possibility to pay interest only or to obtain a maturity extension. ▪ Measures to help households with rising energy costs and cost of living increases (since 2022).	▪ Limits on the share of new mortgages with loan to income (LTI) ratios of 4.5 or higher.
IT	▪ Household mortgages are mostly fixed rate (around two thirds) and have long maturities. ▪ About one fifth of the residual share of floating rate loans are subject to an interest rate cap. ▪ Consumer loans are predominantly fixed rate and with low DSTI ratio requirements.	▪ Until 2023, a government scheme offered eligible borrowers the possibility to convert floating into fixed rate mortgage loans. ▪ Measures to help households with rising energy costs and cost of living increases (since 2022).	
KR		▪	▪ As of 2024, implementation of a "stressed debt service ratio" (SDSR). ○ SDSR imposes an additional stress rate of 1.5 to 3.0 percentage points when calculating a borrower's DSR for all variable rate loans.
LU	▪ Possibility of debt restructuring to limit defaults. ▪ Income tax deductibility of interest rate payments for mortgages and consumer loans. ▪ Full recourse for most mortgages.	▪ Measures to help households with rising energy costs and cost of living increases (since 2022).	▪ Banks are required to assess households' creditworthiness with a 200 bp interest rate stress test before granting a mortgage.

MX	▪ Interpersonal (eg family) loans and payroll advances to cope with adverse liquidity shocks. ▪ Availability of tools to compare bank offers, educational campaigns to increase the population's financial skills. ▪ Cap on banks' loan fees.	▪ Temporary relaxation of mandatory pension funds' rules in order to allow cash withdrawals. ▪ Loans without collateral requirements for micro family-owned businesses or female entrepreneurs (2020–23). ▪ In some cases, possibility to convert variable loan repayments into fixed repayments (since 2023). ▪ Measures to help households with rising energy costs and cost of living increases (since 2022), including expansion of poverty alleviation programmes.	
SG	▪ Mortgages are fully amortised over maturity, and interest-only loans are prohibited.		▪ The total debt servicing ratio limits the entire monthly debt payment obligation (including mortgages) at 55% of borrowers' monthly income.
US	▪ The vast majority of residential mortgages are 30-year fixed and were originated or refinanced prior to the beginning of the current tightening cycle. ▪ Homeowners can tap their home equity through home equity loans or lines of credit. ▪ Essentially all auto loans and student loans are fixed rate. Most auto loans have maturities of 72 months or longer, and student loans have even longer repayment durations.	▪ Various fiscal (eg the so-called economic impact payments to lower-income households, tax rebates) and credit support during the pandemic outbreak helped households build relatively strong balance sheets.	▪ Rules regulating mortgage securitisation and mortgage sales to government sponsored enterprises have limits on mortgage debt service-to-income ratio, putting a soft cap on the mortgage debt service burden that a borrower can take.

Annex B: Technical annex

Graph 2.A: This graph reports point estimates of coefficient β^k (see below) obtained from instrumental variable regressions on a quarterly panel of countries c (AU, BE, CA, DE, DK, ES, FI, FR, GB, IT, JP, KR, NL, PT, SE and US) between Q1 1985 and Q4 2016, for $k = 0, \dots, 12$. The unit of analysis is a country in a quarter. The dependent variable is the change of the average borrowing rate on households/NFCs' outstanding stock of debt ($Rate_{c,t+k} - Rate_{c,t-1}$) over the next k quarters, ie between $t-1$ and $t+k$. The econometric approach follows the two-stage least squares instrumental variable approach of Jordà et al (2020). The estimated model is the following:

$$Rate_{c,t+k} - Rate_{c,t-1} = \beta^k \Delta^4 \widehat{mpr}_{c,t} + \phi^k \left(\Delta^4 mpr_{c,t} - \Delta^4 \widehat{mpr}_{c,t} \right) + \sum_{h=1}^{h=4} \theta_h^k Rate_{c,t-h} + \sum_{h=1}^{h=4} \zeta_h^k mpr_{c,t-h} + \sum_{h=0}^{h=4} \eta_h^k \Delta^4 log(gdp_{c,t-h}) + \sum_{h=0}^{h=4} \mu_h^k \Delta^4 log(cpi_{c,t-h}) + \epsilon_c + u_{c,t+k}$$

where $\Delta^4 \widehat{mpr}_{c,t} = \hat{\gamma}\, SOFTPEG_{c,t} \times CAPITALOPENESS_{c,t} \times \Delta^4 mpr_{base(c),t}$ is the result of the first stage least square regression that consists in regression the change of country c's domestic nominal monetary policy rate $\Delta^4 mpr_{c,t}$ on a composite variable $SOFTPEG_{c,t} \times CAPITALOPENESS_{c,t} \times \Delta^4 mpr_{base(c),t}$, where $\Delta^4 mpr_{base(c),t}$ is the change of the nominal monetary policy rate of country c's base country (eg of the euro area for Denmark). In this compositive variable, $SOFTPEG_{c,t}$ is a dummy variable equal to 0 if country c's exchange rate is fully floating and to 1 otherwise; $base(c)$ refers to the country to which country c's exchange rate is pegged; and $CAPITALOPENESS_{c,t}$ is an indicator of capital account openness that takes values from 0 to 100%. The exchange rate regime classification and base country identification are taken from Shambaugh (2019). The measure of financial openness is taken from Quinn et al (2011).

The estimate of coefficient β^k can be seen as the *causal* effect of a 1 percentage point rate hike in country c's base country $base(c)$ on country c's borrowing rates after k quarters. In the specific case of the United States, the analysis uses the monetary policy surprises derived by Bauer and Swanson (2023) as the exogenous source of variation and instrument. In the above econometric model, the main explanatory variable is the instrumented year-on-year change of country c's nominal monetary policy rate, $\Delta^4 \widehat{mpr}_{c,t}$. The control variables include four lags of the dependent variable ($Rate_{c,t-h}$), of the domestic nominal monetary policy rate ($mpr_{c,t-h}$), of year-on-year GDP growth ($\Delta^4 \log(gdp_{c,t-h})$) and of year-on-year consumer price index (CPI) inflation ($\Delta^4 \log(cpi_{c,t-h})$), country fixed effects (ϵ_c), the contemporaneous year-on-year GDP growth rate and year-on-year CPI inflation and the difference between the year-on-year change in the domestic monetary policy rate and that of the instrument ($\Delta^4 mpr_{c,t} - \Delta^4 \widehat{mpr}_{c,t}$) – the latter capturing the endogenous part of the contemporaneous variation in the monetary policy rate and potential feedback effects from the domestic monetary policy onto the base country's monetary policy. The average borrowing rate on outstanding debt ($Rate_{c,t}$) is calculated as the ratio of total interest expenses to total debt from aggregate financial accounts, except for AU and KR, where the average lending rate on outstanding mortgage loans was used as a proxy for households' average borrowing rate.

Graphs 2.B and 2.C: These graphs report point estimates β^k $(k = 0, \dots, 24)$ obtained from instrumental variable regressions on a quarterly panel of countries (AR, AT, AU, BE, BG, BR, CA, CH, CL, CN, CO, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HK, HR, HU, ID, IE, IL, IN, IS, IT, JP, KR, LT, LU, LV, MT, MX, MY, NL, NZ, PE, PH, PL, PT, RO, RU, SA, SE, SG, SI, SK, TH, TR, US and ZA) between Q1 1985 and Q4 2016. The econometric specification is the same as for Graph 2.A, except that the dependent variables are the changes in the logarithms of real consumption, real investment and real GDP.

Graph 3.A: This graph reports point estimates β^k $(k = 0, \dots, 24)$ obtained from instrumental variable regressions on a quarterly panel of countries (AU, BR, CH, DE, ES, GB, IT, KR, MX and US) between Q1 1985 and Q4 2016. The econometric specification is the same as for Graph 2.A, except that the dependent variable is the change in the logarithm of the ratio of non-performing loans to total loans. Data for CH are only available for households' non-performing loans. The definition of non-performing loans varies across countries.

Graphs 3.B: This graph reports point estimates β^k $(k = 0, \dots, 24)$ obtained from instrumental variable regressions on a quarterly panel of countries (for the bank credit spread: AR, AT, AU, BE, BR, CA, CH, CL, CO, CZ, DE, DK, ES, FI, FR, GB, GR, HK, HU, ID, IE, IL, IN, IS, IT, JP, KR, LU, MX, MY, NL, NZ, PE, PH, PT, SE, SG, TH, TR, US and ZA; for the corporate spread: AT, AU, BE, CA, CH, DE, DK, ES, FR, GB, IN, IT, JP, KR, NL, SE, US and ZA) between Q1 1985 and Q4 2016. The econometric specification is the same as for Graph 2.A, except that the dependent variable is the change in the bank corporate credit spreads. Credit spreads are taken from Baron et al (2021).

Graph 3.C: This graph reports peak point estimates of β^k $(k = 0, \dots, 6)$ obtained from instrumental variable regressions based on an annual panel of 18 countries (AU, BE, CA, CH, DE, DK, ES, FI, FR, GB, IE, IT, JP, NL, NO, PT, SE and US) between 1945 and 2014. The econometric specification is the same as for Graph 2.A, except that the dependent variable is a dummy variable equal to one in the first year of a financial crisis and to zero otherwise, as defined in Jordà et al (2017).

Graph 4.A: This graph reports peak estimates of coefficients β_{PB}^k, β_{UB}^k, and β_O^k (see below) over a 16 quarter horizon $(k = 0, \dots, 16)$. The sample and econometric model is the same as that used for Graphs 2.A, 3.B, and 3.C, except that the effect is differentiated based on country *c*'s initial macro-financial situation at the time of the rate hike. In the case of investment, the regression reads:

$$\begin{aligned}\ln(inv_{c,t+k}) - \ln(inv_{c,t-1}) = \quad & \beta_{PB}^k \Delta^4 \widehat{mpr}_{c,t} \times PB_{c,t} + \beta_{UB}^k \Delta^4 \widehat{mpr}_{c,t} \times UB_{c,t} + \beta_O^k \Delta^4 \widehat{mpr}_{c,t} \times O_{c,t} \\ & + \gamma_{PB}^k PB_{c,t} + \gamma_{UB}^k UB_{c,t} \\ & + \gamma\phi^k \left(\Delta^4 mpr_{c,t} - \Delta^4 \widehat{mpr}_{c,t} \right) + \sum_{h=1}^{h=4} \theta_h^k \log(inv_{c,t-h}) + \sum_{h=1}^{h=4} \zeta_h^k mpr_{c,t-h} \\ & + \sum_{h=0}^{h=4} \eta_h^k \Delta^4 log(gdp_{c,t-h}) + \sum_{h=0}^{h=4} \mu_h^k \Delta^4 log(cpi_{c,t-h}) + \epsilon_c + u_{c,t+k}\end{aligned}$$

In the above specification, $PB_{c,t}$ is a dummy that is equal to one when country *c* is in a "productive boom" in quarter *t*, defined as a situation where total credit to the private non-financial sector, house prices and stock prices, and total factor productivity are all above their respective one-sided Hodrick-Prescott trend. Similarly, $UB_{c,t}$ is a dummy that is equal to one when country *c* is in an "unproductive boom" in quarter *t*, defined as a situation where total credit to the private non-financial sector, house prices and stock prices are above their one-sided Hodrick-Prescott trend while total factor productivity is below its one-sided trend. The dummy $O_{c,t}$ is defined as a non-boom situation: $O_{c,t} = 1 - PB_{c,t} - UB_{c,t}$. Total factor productivity is taken from Bergeaud et al (2015).

Graphs 5.A, 5.B, 6.A, 6.B, 7.A, 7.B: These graphs show the highest value of the estimate of coefficient β_c^k (see below) over a 32 quarter horizon $(k = 0, \dots, 32)$. This value corresponds to the maximum change in the borrowing rates, consumption, investment, and credit spreads observed after a 1 percentage point increase in the domestic monetary policy rate. The estimates of β_c^k are obtained from ordinary least square regressions on quarterly data between Q1 1985 and Q4 2016, and for each country *c* separately:

$$\begin{aligned}y_{c,t+k} = \quad & \beta_c^k mpr_{c,t} + \sum_{h=1}^{h=4} \theta_h^{k,c} y_{c,t-h} + \sum_{h=1}^{h=4} \zeta_h^{k,c} mpr_{c,t-h} \\ & + \sum_{h=0}^{h=4} \eta_h^{k,c} \Delta^4 log(gdp_{c,t-h}) + \sum_{h=0}^{h=4} \mu_h^{k,c} \Delta^4 log(cpi_{c,t-h}) + \epsilon_c + u_{c,t+k}\end{aligned}$$

where the dependent variable $y_{c,t+k}$ is the average borrowing rate on households or NFCs' outstanding stock of debt (Graph 5), the logarithm of aggregate consumption or investment (Graph 7), or banks' and NFCs' credit spreads (Graph 6) in country *c* at a *k* quarter horizon. Throughout, the variable of interest is country *c*'s nominal monetary policy rate $mpr_{c,t}$. The control variables include four lags of the dependent variable $(y_{c,t-h})$, of the domestic monetary policy rate $(mpr_{c,t-h})$, of year-on-year GDP growth $(\Delta^4 \log(gdp_{c,t-h}))$ and of year-on-year CPI inflation $(\Delta^4 \log(cpi_{c,t-h}))$, country fixed effects (ϵ_c), and the contemporaneous year-on-year GDP growth rate and year-on-year CPI inflation. For each country-specific regression, a minimum of 50 observations is required. In Graph 5, the average borrowing rate on outstanding debt is calculated as the ratio of total interest expenses to total debt from aggregate financial

accounts, except for AU and KR, where the average lending rate on outstanding mortgage loans was used as a proxy for households' average borrowing rate.

Graph 8: North America: US and CA; Europe: BE, DE, DK, ES, FI, FR, GB, IE, IT, NL, NO, PT and SE; Asia-Pacific: AU, CN, HK, IN, JP, KR, MY, NZ, SG and TH. Latin America: AR, BR, CL and MX.

Graph 9.B: The recourse data are taken from Cerutti et al (2017) and date back from 2015. For France: the figure on the y-axis (29.6%) corresponds to the share of households with housing loans (including non-mortgage loans); mortgages represent only one quarter of total housing loans in France.

Graph 10: North America: US and CA; Europe: BE, DE, DK, ES, FI, FR, GB, IE, IT, NL, NO, PT and SE; Asia-Pacific: AU, CN, HK, IN, JP, KR, MY, NZ, SG and TH. Latin America: AR, BR, CL and MX.

Graph 11A, 11.B: These graphs show the estimates of coefficients β_M^k and β_L^k (see below) over a three-year horizon ($k = 0, 1, 2, 3$). These estimates are obtained from ordinary least square regressions on an annual panel of about 300,000 French, German, Italian and Spanish firms between 2002 and 2019. The unit of analysis is a firm in a year. The dependent variable is the change of firm i's interest coverage ratio, defined as the ratio of operating profits over interest payments ($ICR_{i,t+k} - ICR_{i,t-1}$) over the next k quarters, ie between $t-1$ and $t+k$. The estimated model is the following:

$$\begin{aligned} ICR_{i,t+k} - ICR_{i,t-1} = \quad & \beta_M^k \, \Delta mpr_t \times MICRO_{i,t} + \beta_S^k \Delta mpr_t \times SME_{i,t} + \beta_L^k \, \Delta mpr_t \times LARGE_{i,t} \\ & + \gamma_S^k SME_{i,t} + \gamma_L^k LARGE_{i,t} \\ & + \sum_{h=0}^{h=4} \eta_h^k \, \Delta \, log(gdp_{c(i),t-h}) + \sum_{h=0}^{h=4} \mu_h^k \, \Delta \, log(cpi_{c(i),t-h}) + \epsilon_i + u_{i,t+k} \end{aligned}$$

where Δmpr_t is the change in the euro area monetary policy rate between $t-1$ and t, $\Delta \, log(gdp_{c(i),t-h})$ and $\Delta \, log(cpi_{c(i),t-h})$ is GDP growth and rates in firm i's country, $MICRO_{i,t}$ ($LARGE_{i,t}$) is a dummy variable that is equal to 1 if firm i has less (more) than EUR 2 million (EUR 43 million) of assets in year t, $SME_{i,t} = 1 - MICRO_{i,t} - \mathrm{LARGE}_{i,t}$, and ϵ_i is a firm fixed effect. Firm-level balance sheet data are taken from the Orbis database.

Graph 12.A: UREs are computed using granular household survey data. The main component of maturing assets consists of bank deposits, and the largest component of maturing liabilities consists of adjustable rate mortgages. To facilitate the comparison across countries, households' UREs are normalised using their respective country's mean gross income and thus computed according to the following – simplified – formulae:

$$Standardised\ URE = \frac{\begin{array}{c} Sight\ deposits + 0.8 \times Saving\ deposits + 0.15 \times Bonds \\ -Adjustable\ rate\ mortgage\ debt - Non\ mortgage\ debt \end{array}}{Country's\ mean\ gross\ income}$$

Graph 13: Following Slacalek et al (2020), a household is considered "hand-to-mouth" (HtM) if at least one of the following two conditions is met:

- Its net liquid wealth is positive but below its biweekly net income.
- Its net liquid wealth is negative and the sum of its net liquid wealth and credit limit is below its biweekly net income.

Among HtM households, some may hold illiquid assets (eg a house). To the extent that such households tend to be indebted (otherwise, they could pledge their illiquid assets to obtain funding and would not be HtM), they are referred to as "illiquid/indebted HtM" households.

Graph 15.D: The interest rate gap is defined as the average (quarterly) difference between the borrowing rate observed in the first six quarters after the initial rate hike in the latest monetary tightening and the corresponding counterfactual value over the same period. The latter value is obtained by applying estimates of the historical country-specific interest rate pass-through (Graph 5) to the actual increases in policy rate over the latest tightening cycle (Graph 15.A). The reported gap is standardised, ie divided by the country-specific standard deviation of the borrowing rate over the period 1985–2016. A negative

(positive) gap indicates a slower (faster) pass-through by historical standards. A gap that is less than two standard deviations can be considered in line with the historical norm.

Graph 16.C: The consumption (investment) gap is defined as the average (quarterly) difference between the logarithm of aggregate consumption (investment) observed in the first six quarters after the initial rate hike in the latest monetary tightening and the corresponding counterfactual value over the same period. The latter value is obtained by applying estimates of the historical country-specific interest rate pass-through (Graph 7) to the actual increases in policy rate over the latest tightening cycle (Graph 15.A). The reported gap is standardised, ie divided by the country-specific standard deviation of the logarithm of consumption (investment) over the period 1985–2016.

Graph 17: This graph shows the median and inter-quartile range of the change in the NPL-to-loan ratio between the quarter of the first hike (quarter 0) and the kth quarter after the first hike (quarter k = 0,…,6). Country sample: AU, BR, CH, DE, ES, FR, GB, IT, KR, MX and US.

Graph 18.B and 18.C: Country sample: AU, BR, CA, CH, CL, CZ, DE, ES, FR, GB, IT, JP, KR, MX, NL, PL, SE and US.

Graph 19.B: Back-of-the-envelope calculation based on Alves and Acharya (2024) and estimates of HtM elasticities of income to GDP of 1.02 in Germany, 1.43 in Canada, France and Italy, 1.95 in the United States and 2.69 in Spain.

Graph 20.A: Based on the responses of more than 10,000 firms to the questions "*What payment terms do you allow your customers, on average?*" (contractual) and "*What is the average time actually taken by customers to pay*" (effective maturity) in Intrum Justitia's "European Payment" annual survey. Overdue: difference between the effective and contractual maturity. Intrum Justitia's surveys are run from January to March.

Graph 20.B: Based on Atradius's "Payment Practices Barometer" survey over a (small) sample of 200 companies per country. Atradius's surveys are run from January to June. A firm may occasionally write off unpaid (or partially paid) invoices after attempting to collect payment for a certain period (eg beyond 90 days past the due date). From the point of view of a creditor, an invoice write-off is counted as a business expense that reduces taxable income. Invoice write-offs are not classified as non-performing loans and are not necessarily associated with the trade debtor's insolvency.

Graph 21: Contemporaneous correlation obtained from linear regression analysis. The unit of analysis is a (listed) firm in a year. The dependent variable is the annual change in NFCs' nominal gross operating profit (EBITDA) or gross interest expenses, in per cent of the one-year lag of total assets. The explanatory variable is the contemporaneous annual change in the nominal monetary policy rate, in percentage points. The control variable is the one-year lag of the gross operating profit (EBITDA) or gross interest expenses, in per cent of lagged total assets, and firm fixed effects. Countries where monetary policy was not tightened in 2021–22 are excluded from the sample; country-years where monetary policy was loosened are excluded from the subsample 2004–19. North America: US and CA; Europe: BE, DE, DK, ES, FI, FR, GB, IE, IT, NL, NO, PT and SE; Asia-Pacific: AU, HK, IN, KR, MY, NZ and TH; Latin America: AR, BR, CL and MX.

Graph B1.C: Correlation analysis excludes the structural break between M5 2016 and M10 2017 – when new regulations capped loan rates at various spreads over the policy rate. Microloan rate adjusted significantly by 2 percentage points, unrelated to the policy rate. Calculations based on Singh and Fowkes (2020).

Footnote 19: Comparison of Graphs 3.A and 17. Graph 3.A shows that, following a 1 percentage point rate hike, households' NPL ratios start rising after four quarters by up to 14% (upper bound of the red confidence interval). Graph 15.A further shows that the initial rate hikes in the first two quarters of the tightening hovered around 3 percentage points in most of the countries that hiked their policy rates early (BR, GB, MX and US). Therefore, one would expect households' NPL ratios to start rising by at most 14 x 3=42% in these countries in the sixth quarter after the first hike. The 25% increase reported in Graph 17.A is lower than this upper bound (dashed red line), and therefore within the historical norm. In addition,

Graph 3.A also shows that, in the case of NFCs, NPLs start rising with a relatively long lag, after eight quarters (blue line). The muted effect of the rate hikes on corporate NPLs observed in the first six quarters of the latest tightening cycle (Graph 17.B) is therefore also in line with that observed in the first stages of past tightening episodes.

Annex C: Members of the Working Group

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Reserve Bank of Australia	**David Wakeling**, Senior Manager, Domestic Markets Department
Bank of Canada	**Martin Kuncl**, Principal Researcher, Canadian Economic Analysis
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