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by Sandra Eickmeier and Boris Hofmann

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What drives inflation? Disentangling demand and supply factors *

Sandra Eickmeier[†] Boris Hofmann[‡]

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Abstract

We estimate indicators of aggregate demand and supply conditions based on a structural factor model using a large number of inflation and real activity measures for the United States. We identify demand and supply factors by imposing theoretically motivated sign restrictions on factor loadings. The results provide a narrative of the evolution of the stance of demand and supply over the past five decades. The most recent factor estimates indicate that the inflation surge since mid-2021 has been driven by a combination of extraordinarily expansionary demand conditions and tight supply conditions. We obtain similar results for the euro area, but with a somewhat greater role for tight supply consistent with the greater exposure of the euro area to recent adverse global energy price shocks. We further find that tighter monetary policy and financial conditions dampen both demand and supply conditions.

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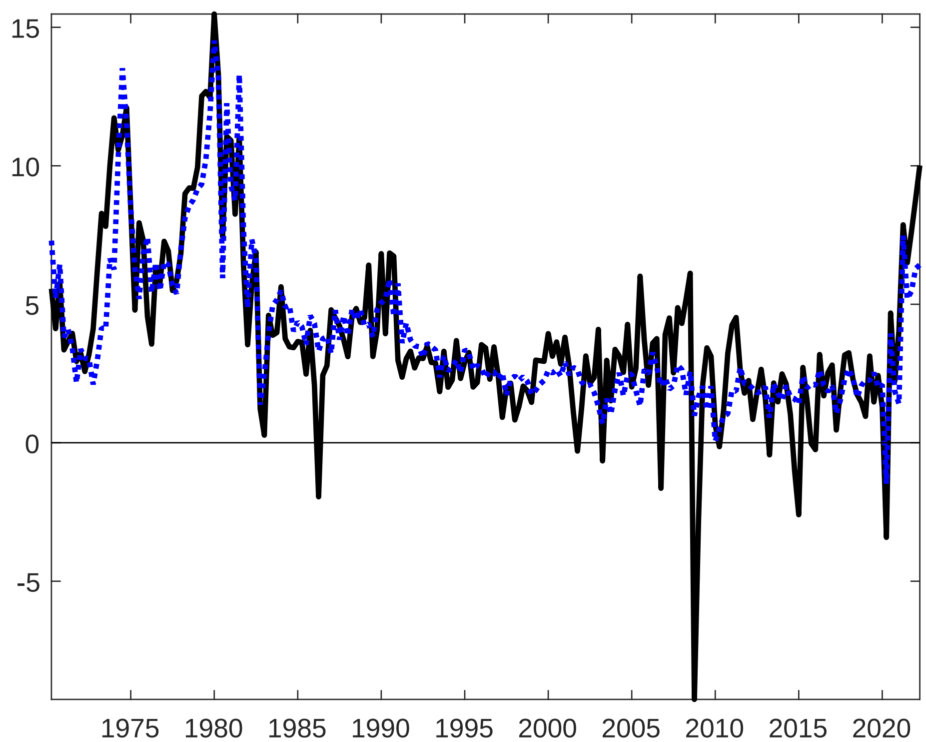
[†]Deutsche Bundesbank, CAMA, CEPR, sandra.eickmeier@bundesbank.de.

[‡]Bank for International Settlements, boris.hofmann@bis.org (corresponding author).

1 Introduction

Over the past year, inflation in the United States and many other countries has surged to its highest level since the 1970s (Figure 1). A key question is to which extent the surge is driven by demand or supply. The former would make the case for monetary and fiscal policy tightening, while the latter would be associated with tricky policy trade-offs. In the public debate, there is so far no consensus on the relative importance of supply and demand factors in the rise in inflation. While most contributions emphasise the role of adverse supply factors in the form of supply bottlenecks and higher energy prices (e.g. Budianto et al. 2021, some commentators point to excessive demand due to catch-up effects and massive monetary and fiscal stimulus in the wake of the Covid-19 pandemic (e.g. Summers (2021), Furman (2022)).[1]

Figure 1: **Inflation in the United States**



Notes: Consumer price index (CPI) inflation (black) and core CPI inflation (blue). Quarter-on-quarter, annualized, in %.

[1] See BIS (2022) for a detailed discussion of the various factors at work in the recent inflation surge.

The challenge of disentangling demand and supply factors behind observable inflation dynamics is, of course, not new. Over the decades, the relative weight assigned to underlying demand or supply factors has often played a key role in policy debates and decisions. For instance, the Great Inflation of the 1970s was attributed to misguided perceptions of primarily supply-side origins of inflation leading to an excessively loose monetary policy stance (Nelson, 2022). Another example is the debate about the missing disinflation after the Great Financial Crisis (GFC) which was ascribed to tightening supply conditions emanating from higher energy prices (Coibion and Gorodnichenko 2015) and negative financial shocks (Gilchrist et al. 2017). A third example is the period of persistent low inflation during the recovery from the GFC, which was linked to inadequate demand (Summers, 2014) as well as to disinflationary supply-side factors emanating from globalisation and technological advances (Borio et al. 2018).

This paper takes a novel approach to disentangle aggregate supply and demand. Based on a structural factor model comprising more than 140 quarterly time series measures of inflation and real activity in the United States going back to 1970, we identify aggregate demand and supply factors. That way, we obtain indicators of aggregate demand and supply conditions and can assess their role in the dynamics of inflation and real activity.

We estimate factors based on a principal component analysis and then rotate them to identify supply and demand using sign restrictions imposed on factor loadings. Specifically, we propose a set of theoretically motivated sign restrictions on the factor loadings of inflation and economic activity indicators to separate supply and demand. These restrictions are based on the standard supply and demand framework, where changes in supply move inflation and output in opposite directions, while changes in demand move both variables in the same direction. We thus identify supply as a factor that loads negatively on inflation and positively on economic activity, and demand as a factor that loads positively on both inflation and economic activity.

Our analysis has points of contact with several strands of literature. Or structural factor analysis is methodologically related to factor models using zero or sign restrictions on factor loadings to analyse the impact of monetary policy on the yield curve (Gürkaynak et al. 2005, Swanson (2021) and Andrade and Ferroni (2021)), international business cycles (Kose et al. 2003) and global financial conditions (Eickmeier et al. (2014)). We add to this literature by proposing a structural factor model that disentangles aggregate demand and supply based on sign restriction imposed on factor loadings.

The sign restriction we use to identify demand and supply factors are similar to those used in the literature on structural vector autoregressions to identify aggregate demand and supply shocks (Canova and de Nicoló 2003, Peersman 2005). Shapiro (2022*a*) has recently used similar restrictions to split the PCE basket into demand- and supply-driven groups based on the sign of unexpected changes in prices and quantities. In our analysis, we go beyond shocks and extract indicators of demand and supply conditions from the data.

By providing indicators of the stance of aggregate demand and supply, our analysis also contributes to the literature on business cycle indicators. This literature, which was pioneered by Stock and Watson (1998), Stock and Watson (2002*b*) and Stock and Watson (2010), uses factor models estimated on large macroeconomic datasets to derive indicators of the state of the business cycle. Prominent examples of such business cycle indicators are the Conference Board and the Eurocoin indicators. Our analysis disentangles business cycle conditions further into underlying demand and supply conditions. Moreover, based on our analytical framework, we can also perform historical decompositions, backing out the contribution of supply and demand factors to the evolution of inflation and economic activity measures over time. This allows us to assess, for instance, to which extent CPI inflation in a given point in time was driven by demand or supply conditions.

Our structural factors offer a narrative of the evolution of demand and supply conditions and of their role in inflation dynamics in the United States over the past five decades. In particular, for the recent period since 2021, our analysis indicates a combination of very strong demand conditions at levels not seen since the 1970s and tight supply. Historical decompositions suggest that recent inflation dynamics have been driven in particular by strong demand, and to a lesser extent also by tight supply. Also for other important historical episodes there are a number of findings worth highlighting. We find that a combination of occasionally tight supply and persistently expansionary demand conditions was driving the Great Inflation. The missing disinflation after the GFC was attributable to tight supply counteracting the disinflationary effects of weak demand according to our estimates. And for the period between the GFC and the pandemic, our analysis suggests that both supply and weak demand were responsible for persistently low inflation. These findings hold up in a number of robustness checks and are also robust in a pseudo real-time analysis estimating the factors recursively.

As an additional exercise, we use the estimated factors to assess the demand and supply effects of monetary policy shocks and of financial shocks (specifically shocks to the excess bond premium of Gilchrist and Zakrajšek (2012), thus exploring the relevance and strength of demand and supply channels in the monetary and financial transmission process. Most empirical papers analyse the effects of monetary policy and financial shocks on output and inflation which only provides information on whether supply or demand effects dominate. We assess whether and, if yes, how the shocks affect both supply and demand. This analysis relates to the literature on the supply effects of monetary policy and financial shocks through a cost channel (Barth and Ramey 2001, Christiano et al. 2005, Gilchrist et al. 2017) or through capital re-allocation across firms (Baqaee et al. 2021).

Finally, while the main part of the analysis is focused on the United States, we also assess the evolution over time of supply and demand conditions in the euro area. This part of the analysis is based on quarterly data for the four major euro-area economies (France, Germany, Italy, Spain) going back to 1999. The results suggest that, in the overlapping period of analysis, the dynamics of demand and supply in the euro area have been similar to those in the United States. Specifically, in the post-pandemic inflation surge, also both strong demand and weak supply factors appear to have been at work. However, tight supply conditions have been relatively more important compared to the United States, in particular in the first two quarters of 2022. This finding is consistent with the notion that supply factors play a relatively more important role in the euro-area inflation surge due to greater constraints in energy supply related to the Russia-Ukraine war.

The remainder of the paper is structured as follows. In section 2 we present the data. In section 3 we lay out the methodology to identify and estimate the structural demand and supply factors. Section 4 reports the main results of the analysis together with robustness checks and a real-time analysis. In section 5 we examine the dynamic effects of monetary policy and financial shocks on demand and supply. The analysis and the results for the euro area are reported in section 6. Section 7 concludes.

2 Data

The data used in the analysis comprise measures of inflation and of real economic activity in the United States over the period 1970Q1 until 2022Q2. The individual data series included in the database are listed in the appendix in Table A.1. There, we also provide information about the sources of the data, how they are transformed prior to the analysis and on the sign restrictions applied to the factor loading in the analysis.

In the group of inflation measures, the data set includes measures of aggregate and sectoral inflation, changes in labor costs, as well as indicators of inflation expectations. In the group of measures of real economic activity, the dataset covers measures of real output growth, in particular real GDP and its components, as well as industrial production growth at the aggregate and sectoral level, measures of aggregate and sectoral employment growth, unemployment rates and capacity utilisation rates. Overall, the dataset comprises a roughly equal number of inflation and economic activity data series. It is unbalanced as some series are not available over the entire sample period. In order to obtain a balanced dataset, we use the expectation maximisation (EM) algorithm to interpolate those data series where observations were missing (see Stock and Watson 2002*a* for details).

Since the factor model requires stationary data, the variables are transformed accordingly. Inflation rates are quarter-on-quarter log changes of price indices. Real GDP, industrial production and employment etc. also enter as quarter-on-quarter log changes of the underlying level series, while unemployment rates and capacity utilisation rates enter in levels. We remove outliers following the procedure proposed by Stock and Watson (2005).[2] Finally, we normalise each series to have a zero mean and a unit variance. We collect the data for the analyses below in the N-dimensional vector of variables $X_t = (x_{1,t}, \dots, x_{N,t})'$ for $t = 1, \dots, T$.

3 Methodology

The estimation of the demand and supply factors proceeds in several steps as summarised in Table 1. The first step is the estimation the factor model. The subsequent steps identify the structural factors through sign restrictions.

3.1 Factor model

We apply a factor model to X_t based on Stock and Watson (2002*b*) and Bai and Ng (2002). Each element of X_t is assumed to be the sum of a linear combination of r common factors $F_t = (f_{1,t}, \dots, f_{r,t})'$ and an idiosyncratic or variable-specific

[2]Outliers are here defined as observations of the stationary data with absolute median deviations larger than 6 times the interquartile range. They are replaced by the median value of the preceding five observations.

Table 1: **Summary of the estimation approach**

Step 1: Estimation of the factors F_t as the first r principal components of X_t, the vector of macroeconomic variables (which have zero mean and unit variance). This yields the $r \times 1$-dimensional vector $\widehat{F}_t$. Those factors are only identified up to a rotation: For any orthonormal $r \times r$-dimensional matrix Q ($Q'Q = I_r$) we can write $\lambda_i' F_t = \lambda_i' Q\prime Q F_t = \underline{\widetilde{\lambda}}_i' \underline{F}_t$ with $\underline{\widetilde{\lambda}}_i' = \lambda_i' Q'$ and $\underline{F}_t = QF_t$. While this means that the raw principal component factors are not interpretable, it also means that factors can be identified by finding matrices Q that yield economically meaningful factor loadings.

Step 2: $\widehat{F}_t$ are rotated along the lines of Rubio-Ramírez et al. (2010). I.e. Q is obtained from a QR decomposition of a $r \times r$ random matrix, where each element has an independent standard normal distribution. This yields $\underline{\widehat{F}}_t = Q\widehat{F}_t$. See Rubio-Ramírez et al. (2010) for details.

Step 3: Regression of each variable on the rotated factor estimates, i.e. OLS estimation of $x_{it} = \overline{\lambda}_i \underline{\widehat{F}}_t + v_{it}$ for $i = 1, ..., N$. This yields, among others, estimates of $\overline{\lambda}_i$, $\widehat{\overline{\lambda}}_i$.

Step 4: Verify if the sign restrictions listed in Table 3 are satisfied for $\widehat{\overline{\lambda}}_i$ on average over all countries and the corresponding variables. If yes, keep $\underline{\widehat{F}}_t$ (and Q), otherwise reject the draw.

Step 5: Repeat steps 2-4 until 200 valid draws (i.e. 200 vectors of $\underline{\widehat{F}}_t$ for which the sign restrictions are satisfied) are obtained.

Step 6: While the 200 $\underline{\widehat{F}}_t$s are shown as black lines in Figure 1, the red line refers to the "Median Target" factors. Following Fry and Pagan (2007), we pick the one rotation matrix which yields demand and supply factors that are most closely related to the median factors. For details, see Fry and Pagan (2007).

component e_{it}:

$$x_{i,t} = \lambda_i' F_t + e_{i,t}, \quad i = 1, \dots N \tag{3.1}$$

where λ_i is the $r \times 1$ vector of common factors loadings, and $\lambda_i' F_t$ is the common component of variable i. The factors are mutually orthogonal and uncorrelated with the idiosyncratic errors. The latter can be weakly mutually and serially correlated in the sense of Chamberlain and Rothschild (1983).

The commonality (i.e. the variance shares explained by the common factors) of a given set of variables is given by $var(\lambda_i' F_t)/var(x_{i,t})$. The common factors are estimated as the first r principal components of $X = (X_1, \dots, X_T)'$, $\widehat{F} = (\widehat{F}_1, \dots, \widehat{F}_T)' = \sqrt{T}v$, where v is the matrix of eigenvectors corresponding to the first r eigenvalues of XX', and the loadings are estimated as $\widehat{\Lambda} = (\widehat{\lambda}_1, \dots, \widehat{\lambda}_N)' = X'\widehat{F}/T$.

Table 2 provides the variance shares and the cumulative variance shares explained by the first 10 principal components. The results suggest that three factors explain more than 50% of the variance of the dataset on average over all variables, which is a reasonable share for a heterogeneous macroeconomic dataset. Based on this informal criterion, we proceed in the subsequent analysis with three factors, identifying two as demand and supply respectively. The third factor is restricted not to satisfy the restrictions imposed on the other two factors. It is meant to capture everything else that is systematically driving the data besides the structural factors.

Table 2: **Cumulative variance shares**

Number of factors	Cumulative variance share
1	25
2	43
3	52
4	58
5	62
6	65
7	67
8	69
9	71
10	73

Notes: Cumulative variance shares explained by the first 10 principal components (in %).

As is well known, the common factors and factor loadings are not identified separately (see, e.g., Bai and Ng 2006) because

$$X_t = \Gamma F_t + v_t = \Gamma Q' Q F_t + v_t \tag{3.2}$$

where Γ is the matrix of factor loadings and Q denotes an orthonormal rotation matrix such that $Q'Q = I_r$. Conceptually motivated restrictions are needed to identify structurally interpretable factors.

3.2 Identification approach

The factors are identified by picking linear combinations of the elements of $\widehat{F}_t$ which yield signs on the factor loadings that are consistent with prior theoretical considerations (steps 4 to 8 in Table 1). Specifically, equation (3.2) can be written as follows:

$$X_t^L = \widetilde{\Gamma} Q F_t + v_t \tag{3.3}$$

where $\widetilde{\Gamma} = \Gamma Q'$. The sign restrictions are applied to the elements of the matrix $\widetilde{\Gamma}$. The corresponding identified factor is obtained as $\widetilde{F}_t = QF_t$.

To identify supply and demand, we propose a set of theoretically motivated sign restrictions on the factor loadings of inflation and economic activity indicators. The sign restrictions are based on a standard supply and demand framework, where changes in supply move inflation and output in opposite directions, while changes in demand move both variables in the same direction. Supply expansions would boost output and dampen inflation, while demand expansions would boost both inflation and output.

This translates – broadly – into the following sign restrictions on the factor loadings: inflation measures load negatively while real economic activity measures load positively on the supply factor; both inflation and real economic activity measures load positively on the demand factor. Table 3 summarises our broad identifying restrictions employed to disentangle demand and supply factors. Appendix Table A.1 provides more detailed information on which restrictions we impose on individual variables.

Specifically, we require the restrictions to hold for the arithmetic means of the loadings, for key variables which we define *ex ante* and for a large share of variables.[3] We leave some variables (unit labor cost variables, government consumption

[3] 92.5% is the largest share possible. When we try to restrict loadings of more variables, no

and investment and government consumption and investment deflators, variables capturing labor force participation) unrestricted. And we only restrict the loadings of the demand, not of the supply factor on capacity utilization and employment measures (including unemployment and hours worked) as the development of those variables to a change in aggregate supply is ambiguous *a priori*.

Table 3: **Identifying sign restrictions on factor loadings**

	Demand factor	Supply factor
Measures of price inflation	+	−
Measures of real economic activity	+	+

Notes: The table summarises the identifying restrictions in a broad sense. Appendix Table A.1 provides more detailed information on which restrictions we impose on individual variables.

We implement this identification scheme as explained in steps 2-4 in Table 1. The procedure yields 200 structural demand and supply factor estimates for which the sign restrictions are satisfied. We report in the following the full range of these 200 factors as well as the "Median Target" factors along the lines of Fry and Pagan (2007) (step 6 in Table 1).

The factors are orthogonal by construction. Orthogonality of the factors is an identifying assumption as it is for structural shocks. This assumption is, however, not exceedingly restrictive since nothing prevents the factors to affect each other with a lag. In order to facilitate the quantitative interpretation of the factors, we normalise them on real GDP growth, by multiplying the factors with the respective standard deviation and the factor loading. The units of the factors are in percentage points as the reflect the deviation of variables measured in percent from their normal level defined by the sample mean.

The structural factors thus identified are broadly defined. They incorporate any possible shifter of demand and supply, such as changes in preferences, monetary policy, fiscal policy, energy price changes, labour supply changes etc. However, this broad-based nature of the identified factors is exactly what we are aiming at, since the goal of our analysis is to identify factors that represent the structural drivers of demand and supply conditions in the broadest sense rather than the effects of some narrowly defined specific structural drivers, such as e.g. a mark-up shock.

The factors can be interpreted as measures of aggregate demand and supply

valid model (i.e. model where sign restrictions are satisfied) is found.

conditions. A level of the demand factor above zero would indicate expansionary demand conditions, with a large number of inflation and real activity measures above their normal levels defined by their sample averages. A level of the supply factor above zero would indicate expansionary supply conditions, reflecting a large number of inflation measures below their normal level and a large number of real activity measures above normal levels. When both inflation and real activity rise, this would be reflected in the an increase in the level of the demand factor. If inflation falls and output rises, the supply factor would move up.

4 Empirical results

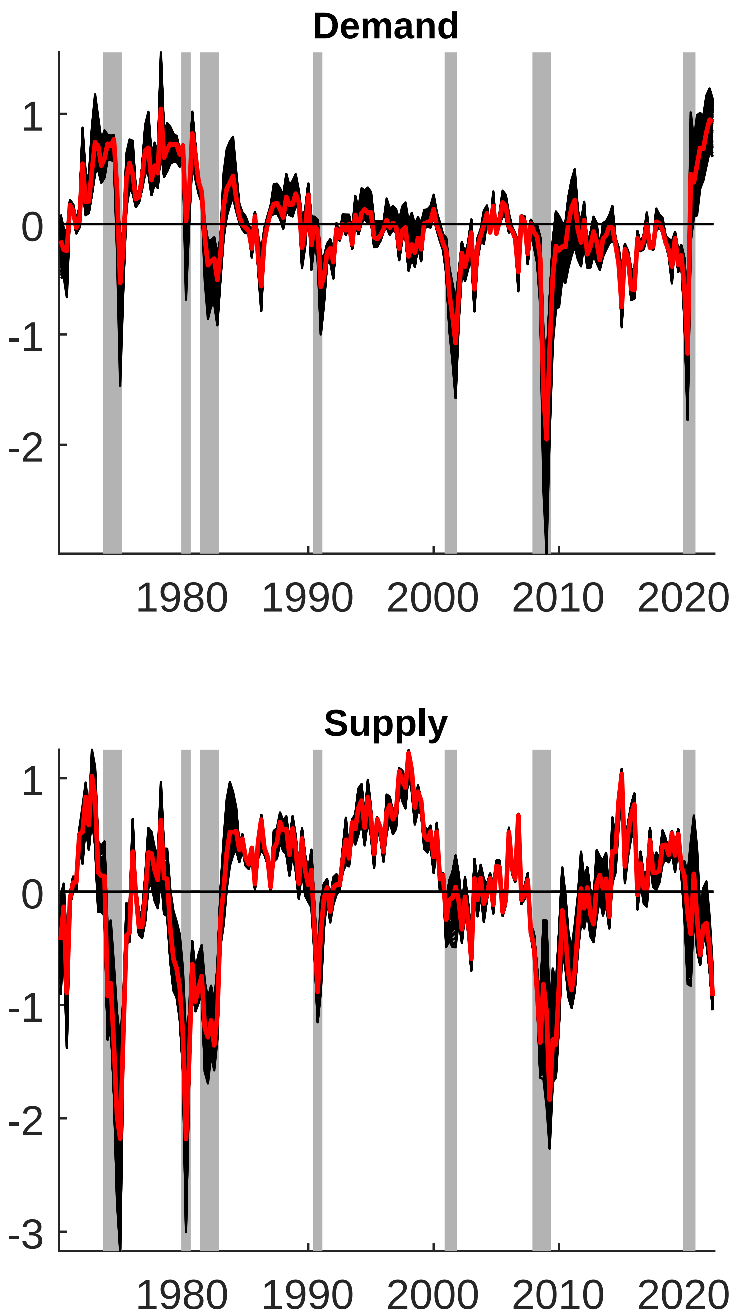
4.1 Aggregate demand and supply factors

Figure 2 shows the evolution of the estimated structural demand and supply factors over the sample period 1970Q1 – 2022Q2. We show the factors associated with all models satisfying the sign restrictions in black and the "Median Target" factors in red. As discussed before, a higher level of the factors reflect more expansionary demand and supply conditions, respectively. The shaded areas indicate recession dates as identified by the National Bureau of Economic Research (NBER).

Given the large cross section we do not need to account for estimation uncertainty (see also Bernanke et al. 2005). The range of factor estimates therefore only reflects the amount of identification (or model) uncertainty. The factor range is for most periods fairly tight. Hence, identification uncertainty does, in general, not seem to be a major issue.

The estimated factors offer a narrative of the evolution of demand and supply conditions over the past five decades. The results suggest that the Great Inflation of the 1970s was characterised by persistently strong demand and episodically tight supply conditions related to the oil price shocks. The charts also show how excess demand was eliminated in the wake of the Volcker disinflation in the early 1980s. Supply conditions eased only later, after the 1981–82 recession when oil prices receded sharply.

Figure 2: **Demand and supply conditions in the United States**



Notes: In percentage points. Normalised to have the same standard deviation as GDP growth and multiplied with its loadings. Red: Median Target estimates, black: estimates from all models. Grey bars: NBER recessions.

The period from the mid-1980s until the turn of the millennium was then characterised by a combination of mostly neutral demand conditions and generally strong supply. This was interrupted by the early 1990s recession, when demand contracted and at the same time supply tightened in the wake of the oil price shock triggered by the Iraq war. Subsequently, supply conditions loosened significantly, reflecting the so-called New Economy boom. Supply conditions strengthened considerably throughout the 1990s, peaking in 1998 and then receding sharply just before the bursting of the dot-com bubble in early 2000. The subsequent recession was associated with a marked tightening of demand conditions.

The first decade of the 2000s was characterised again by strengthening supply and on average balanced demand. The Great Recession in the wake of the GFC of 2007 – 2009 was associated with a strong contraction in both demand and supply. The post-crisis years were then characterised by subdued demand and supply conditions, with demand initially rebounding faster than supply. This would explain why the recession was not followed by a stronger and more persistent decline in inflation, i.e. the missing disinflation. From 2013 up to the outbreak of the Covid pandemic in 2020, supply conditions strengthened, while demand conditions were mostly subdued. This suggests that a combination of strong supply and weak demand seems to have been driving persistent low inflation over these years.

The Covid-19 recession in 2020 was associated with a steep fall in demand but also with tighter supply conditions. In 2021, demand conditions started to rebound sharply in the wake of catch-up demand effects as well as extraordinary monetary and fiscal policy easing. Supply conditions instead further tightened as supply bottleneck persisted and energy prices surged in the wake of the Russia-Ukraine war. In 2022Q2, the last observation of our sample period, estimated demand conditions reached the highest level on record, even higher than the levels seen in the 1970s, while supply conditions stayed restrictive.

In order to assess the role of demand and supply conditions in observable dynamics of inflation, we perform a historical decomposition based on the estimated factor models. We use the estimated factors and the respective estimated factor loadings to back out the contribution of the factors to the dynamics of individual inflation measures. Figure 3 shows the results for two key inflation gauges, quarter-on-quarter (not annualised) CPI inflation and core CPI inflation. Figure A.1 in the Appendix provides further historical decompositions for Personal Consumption Expenditure (PCE) deflator inflation, Gross Domestic Product (GDP) deflator inflation, Produce Price Index (PPI) inflation and unit labour cost inflation (based on unit labour costs in the non-farm business sector).

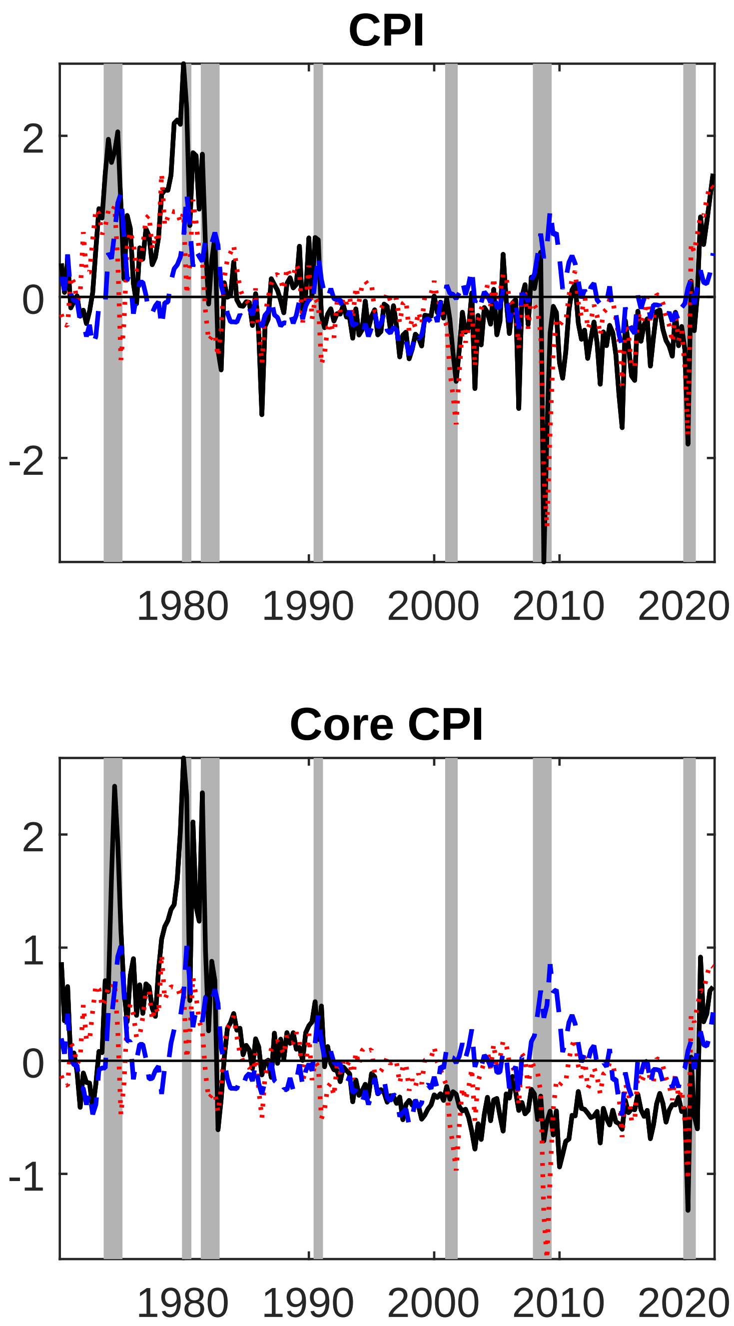
The charts reveal the varying relative importance of demand conditions (red dotted lines) and supply conditions (dashed blue lines) in inflation dynamics over the past 50 years, further substantiating the narrative provided above. While the contributions of demand and supply vary somewhat for different gauges of inflation, the overall picture is very similar. For instance, in the 1970s, high levels of inflation primarily reflected strong demand conditions. Supply conditions also played an important role, but more episodically at times of the oil price shocks. The disinflation of the early-1980s was initially driven by weaker demand and later also by stronger supply conditions.

The decompositions suggest that around the GFC the disinflationary effects of weak demand conditions were counterbalanced by the inflationary effects of tighter supply. This supports the notion that the missing disinflation was due to tighter supply conditions neutralising the disinflationary effects of weak demand. For the period of persistently low inflation between 2012 and 2020, our analysis suggests that this was driven by weak demand and strong supply to roughly equal extents.

For the recent period, the results suggest that the drop in inflation in 2020 reflected primarily the collapse in demand in the wake of the Covid-19 pandemic. The subsequent inflation surge since 2021 has then been driven both by demand and supply, reflecting the strong upsurge in demand and the tightening of supply conditions. Quantitatively, demand seems to be playing a somewhat larger role than supply. These findings are broadly consistent with those of Shapiro (2022*b*) who also finds that both demand and supply have driven the recent inflation surge, but that supply played a somewhat greater role than demand quantitatively.[4]

[4]Shapiro (2022*b*) splits the PCE basket into demand- and supply-driven groups, identifying the former as those where unexpected changes in prices and quantities move in the same direction and the latter where they move in opposite direction. The approach is developed in more detail in Shapiro (2022*a*).

Figure 3: **Historical decompositions**



Notes: Quarter-on-quarter, in %. Black: demeaned time series estimates. Red: contributions of the Median Target demand factor. Blue: contributions of the Median Target supply factor. Grey bars: NBER recessions.

4.2 Robustness analysis

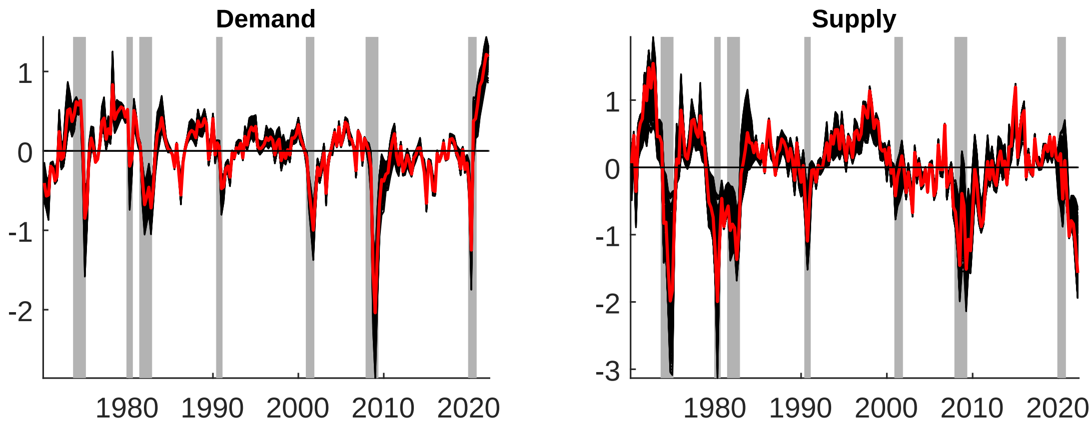
An important concern for our our analysis is structural change over time which could give rise to model instability. The analysis cuts across the volatile high inflation regime of the 1970s and the subsequent low-inflation Great Moderation regime. In order to assess whether structural breaks affect our analysis, we re-estimate the model accounting for possible structural breaks in two different ways. First, we re-estimate the model adjusting the time series included in the factor model for breaks in the mean. To that effect, we apply the Bai and Perron (1998) test for multiple breaks in the mean to each series in the dataset, determine the number of breaks based on the 5% significance level, adjust the series for the identified breaks in the mean and then re-estimate the model with the adjusted time series. Second, we re-estimate the model using only data from 1988. This takes into account not only different means of the variables over this sample period compared to the preceding one, but more generally also allows for changing dynamics in the factor model due to changes in the macroeconomic and monetary policy regime.

The results of these two robustness checks are in line with those of the baseline estimation. The evolution of the demand and supply factors over time is visually very similar to the baseline ones (Figure 4, panels (a) and (b)). This visual impression is confirmed by high correlations of the demand and supply factors estimated in the two robustness checks with the baseline factors (Table 4).

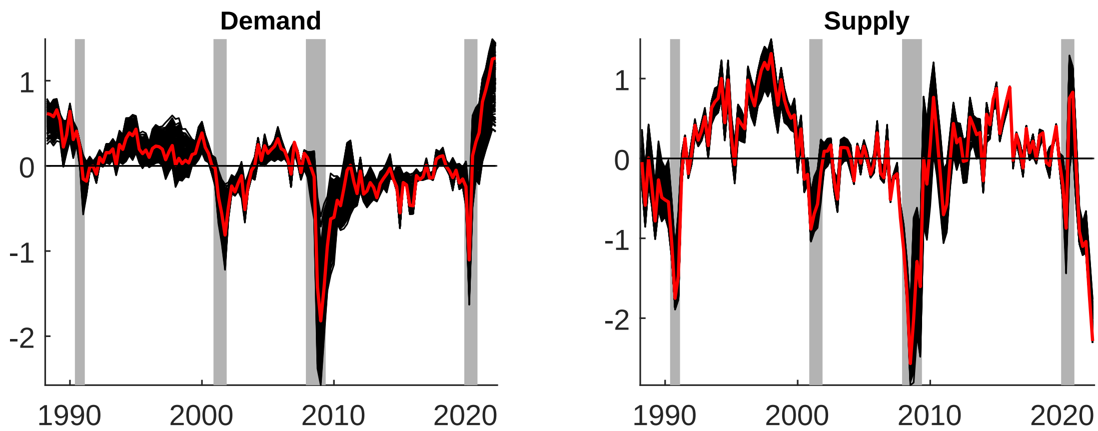
The narrative of demand and supply conditions over time therefore remains unaffected qualitatively, and also quantitatively the assessment of supply and demand conditions in specific points in time turns out to be very similar. In particular, the assessment that the recent surge in inflation has been driven by a combination of strong demand and restrained supply is confirmed. In fact, with respect to the role of demand conditions, the message comes out even more strongly. In both robustness checks, demand conditions register record highs at the end of the sample period in 2022Q2.

Figure 4: **Robustness checks**

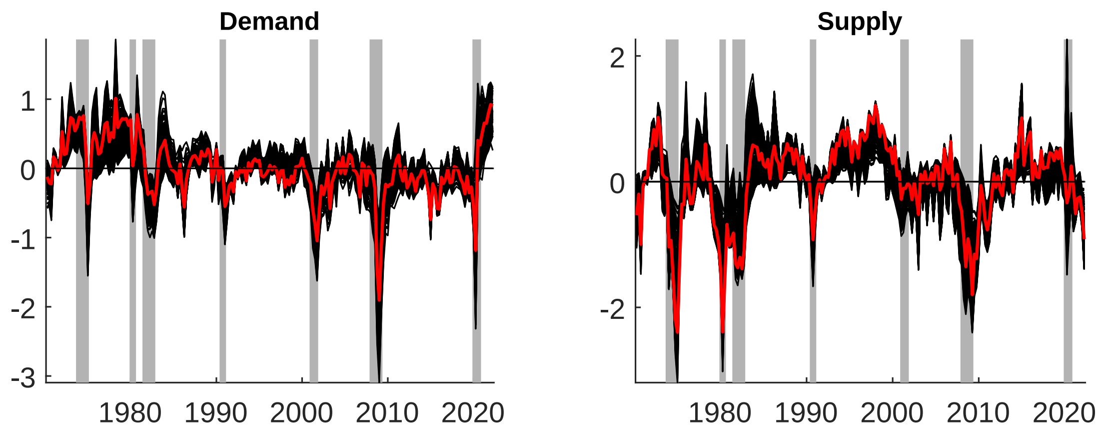
(a) Data adjusted for breaks in mean



(b) Post-1987 estimation



(c) Four factors



Notes: In percentage points. Normalised to have the same standard deviation as GDP growth and multiplied with its loadings. Red: Median Target estimates, black: estimates from all models. Grey bars: NBER recessions.

Another concern is robustness with respect to the number of factors included in the model. The fourth factor still explains a significant share (6%) of the variation in the data (see Table 2), so including or excluding it might affect the structural factor analysis. Hence, we re-estimate the factor model with four factors (and require now not only the third, but also the fourth factor not to satisfy the sign restrictions we impose to identify the supply and demand factors). The results barely differ from the baseline results except that model uncertainty is somewhat higher when the fourth factor is included (Figure 4, panel (c)). This is also reflect in an essentially perfect correlation of the factors with those from the baseline estimation (Table 4).

Table 4: **Correlations with baseline factors for different robustness checks**

Robustness checks	Demand factor	Supply factor
Breaks in mean adjusted data	0.91	0.92
Post-1987 estimation	0.90	0.76
Four factors	1.00	1.00

Notes: The table displays the correlation of the Median Target structural demand and supply factors obtained under the different robustness checks with those obtained in the baseline case.

4.3 Real-time analysis

Reliability in real time is a key criterion of indicators. In order to assess the reliability of the demand and supply indicators in real time, we vary the end of the sample period, estimating the model recursively for sample end points in 1998Q1, 2003Q1, 2008Q1, 2013Q1, 2018Q1. If the model produces reliable indicators in real time, we would see little revision in the estimated factors as we recursively estimate the model.

This is, of course, a pseudo real-time analysis as we do not consider revisions in the data, i.e. we do not recursively estimate the model using real-time data. This should not be a major caveat as factor model outcomes are less prone to data revisions. As long as revisions are not systematic they would be captured by the idiosyncratic components. More generally, the existing evidence suggests that end-of-sample reliability of the estimated model is of greater importance for real-time reliability of indicators than data revisions. For instance, for the output gap, the most prominent single business cycle indicator, Orphanides and van Norden (2002) show that it suffers in particular from "pervasive unreliability of the end-of-sample estimate of the trend in output" while ex-post revision of published data plays only a secondary role.

Figure 5 shows the recursive factor estimates, together with the baseline factor estimates. The figures suggest that the demand and supply factors barely change as more data are added to the model, which is also confirmed by high correlations of the recursively estimated factors with the baseline factors (Table 5). Overall, this suggests that our factors are good indicators in real time, as no large revisions are necessary with incoming information. Together with the fact that our factor estimates match well with common narratives, are easy to construct and to update, this suggests that they can be used as indicators in regular policy analysis. One possibility is to include them in standard macro (or macro-finance) models and to assess the effects of structural shocks on them, something we will illustrate in the next section.

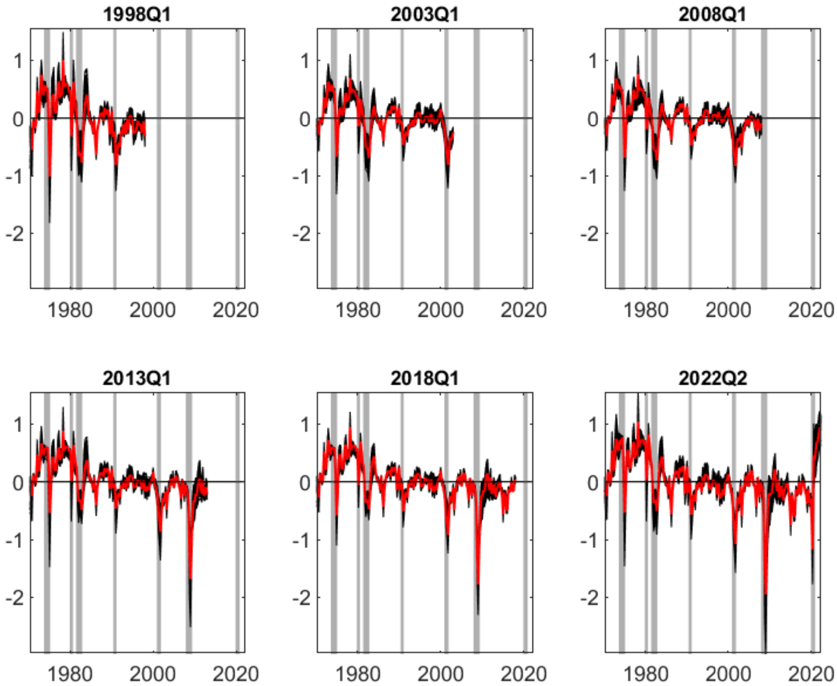
Table 5: **Correlations with baseline factors for recursive estimations**

Sample end points	Demand factor	Supply factor
1998Q1	0.97	0.94
2003Q1	0.94	0.83
2008Q1	0.92	0.75
2013Q1	0.99	0.97
2018Q1	0.99	0.98

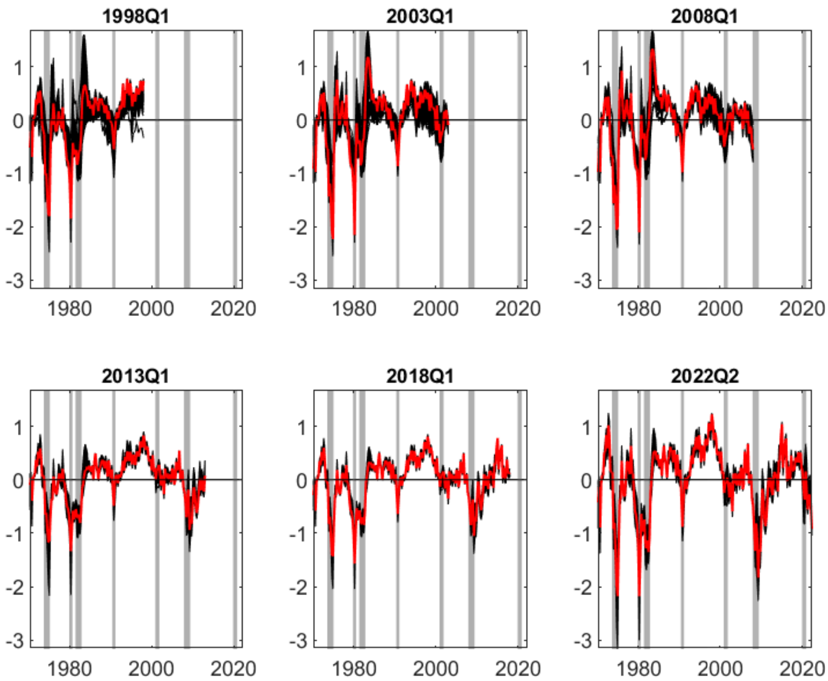
Notes: The table displays the correlation of the Median Target structural demand and supply factors obtained for different sample end points of the recursive estimations with those obtained in the baseline case.

Figure 5: **Real-time factors**

(a) Real-time demand factors



(b) Real-time supply factors



Notes: In percentage points. Normalised to have the same standard deviation as GDP growth and multiplied with its loadings. Red: Median Target estimates, black: estimates from all models. Grey bars: NBER recessions.

5 Impact of monetary policy and financial shocks on demand and supply

We next assess the impact of monetary and financial shocks on demand and supply conditions. This question is of particular relevance against the background of tightening monetary policy and tighter financial conditions in the wake of surging economic and geopolitical uncertainty. We address it by estimating the impact of monetary policy shocks and of shocks to the excess bond premium (EBP) of Gilchrist and Zakrajšek (2012) on the demand and supply factors.[5]

From a conceptual point of view, monetary policy and financial shocks can affect both demand and supply. In the standard New Keynesian model, monetary policy affects consumption demand through an intertemporal substitution effect (Clarida et al. 1999) while investment demand depends negatively on the real value of the capital stock, which is in turn negatively related to the real interest rated and risk premia (Smets and Wouters 2003). Through these channels, a tightening in monetary policy and in financial conditions through risk premia would dampen aggregate demand.

Supply-side effects of monetary policy and financial shocks may arise through several channels. If firms have to borrow working capital to finance their wage bill (Christiano et al. 2005), higher interest rates raise the cost of working capital and exert a negative effect on supply, mitigating the inflation response to an interest rate shock and amplifying the output response. Barth and Ramey (2001), Chowdhury et al. 2006 and Gilchrist et al. 2017 provide evidence of this "cost channel" of monetary policy and financial shocks. An alternative supply-side effect of changes in monetary and financial conditions highlighted by Baqaee et al. (2021) runs through the reallocation of resources to high-markup firms, alleviating misallocation. Through this channel, a loosening of monetary and financial conditions would boost supply, generate positive productivity effects and favourable cost effects, mitigating the impact on inflation. At the same time, there could be supply-side effects that reinforce the transmission of monetary policy through a cleansing channel similar to the recession cleansing effect suggested by Caballero and Hammour (1994). Tighter monetary policy could lead to a cleansing of unproductive firms and an increase in aggregate productivity. Such effects are implied by the analysis in

[5] The excess bond premium is a component of corporate bond credit spreads that is unrelated to expected default risk, providing a measure of investor risk appetite and hence of financial conditions more generally.

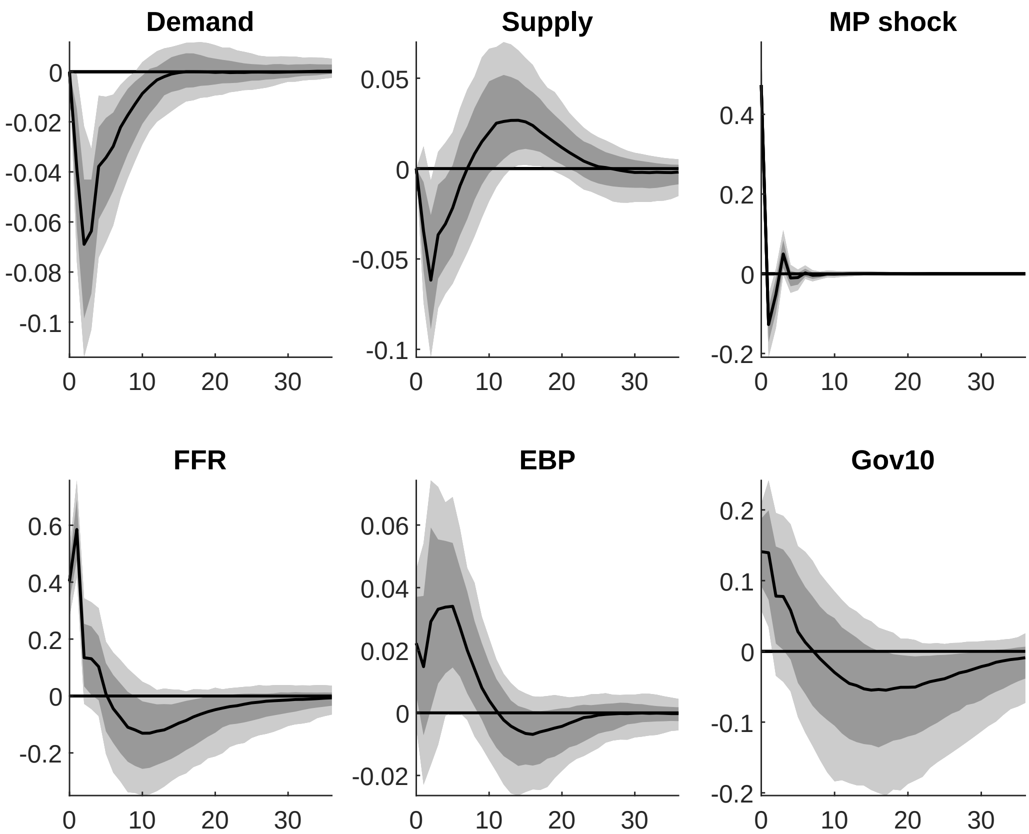
Banerjee and Hofmann (2022) who find that that low interest rates have fostered the rise in so called zombie firms which are a drag on economies' supply side.

We assess the dynamic impact of monetary policy and EBP shocks on the demand and supply factors based on two vector autoregressive models (VARs) estimated with two lags each. The first VAR includes the demand and supply factors from the baseline model (extracted from all models, i.e. taking into account model uncertainty), the Romer and Romer (2004) monetary policy shock series extended to 2007Q4 by Wieland and Yang (2020)[6], the Federal Funds rate, the EBP and the 10-year Treasury yield. The sample period is 1970Q1-2007Q4. We identify the monetary policy shock based on a recursive identification scheme, with the variables ordered as they were listed above. This ordering implies that the monetary policy shocks can affect financial variables and the policy rate immediately and the macroeconomic factors with a lag. This is in line with standard recursive identification schemes applied in the literature. The second VAR is identical to the first, but we omit the Romer-Romer shock measure. The financial shock is the residual associated to the EBP equation. We use a bootstrap based on 300 draws. We show median estimates as well as 68% and 90% confidence bands which account for both model and VAR parameter uncertainty.

Figure 6 shows the dynamic effects of a one standard deviation monetary policy shock. The results suggest that a monetary policy tightening (which leads to an instantaneous increase in the Federal Funds rate by 0.4 percentage points) is followed by a contraction of both demand and supply. Specifically, demand falls by up to 0.07 percentage points after the shock and the response is statistically highly significant. The negative impact on supply is somewhat smaller, with a peak decline of about -0.05 percentage points, but it is more short lived and it is generally not statistically significant. Overall, these results suggest that for monetary policy shocks the traditional demand effects dominate while there is uncertainty about the relevance of supply effects that might weaken the ultimate impact on inflation.

[6] The Romer and Romer shocks are derived by regressing the change in the intended Federal Funds rate around FOMC meeting days on internal Fed forecast of inflation and the real economy.

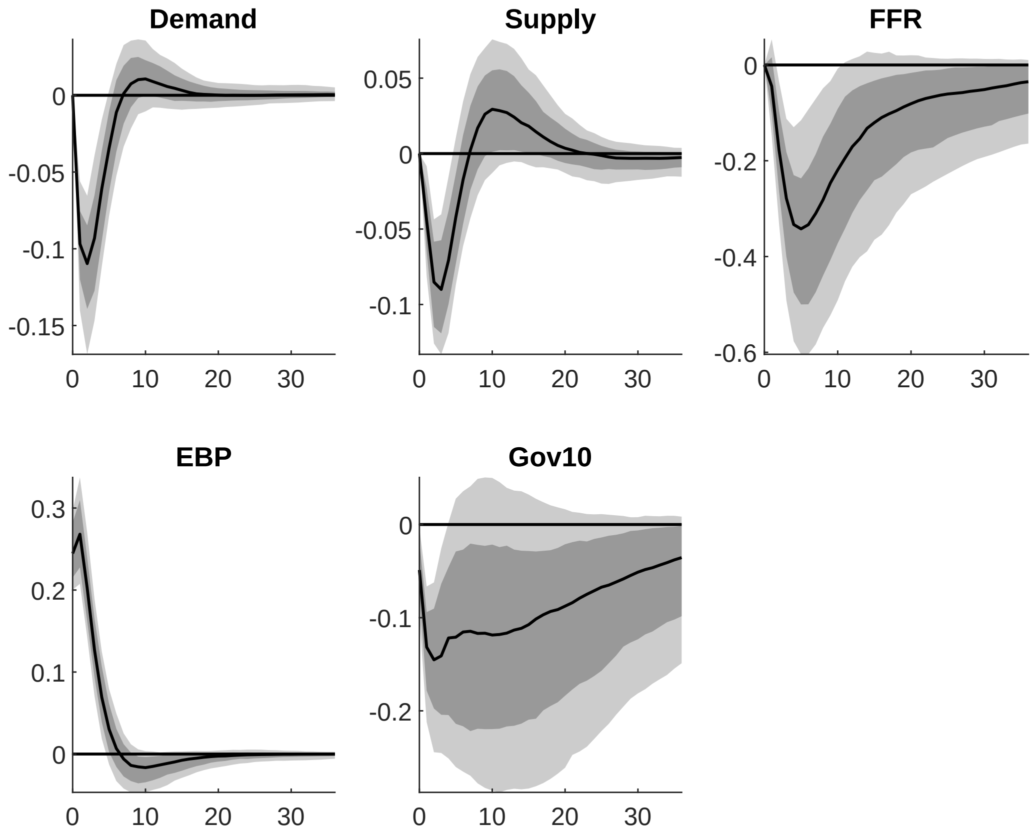
Figure 6: **Dynamic effects of a contractionary monetary policy shock**



Notes: Impulse responses to a one standard deviation monetary policy shock of demand and supply factors, the Romer-Romer shock measures, the FFR, the EBP and the government bond yield in percentage points. Black: median estimate, areas: 68% and 90% confidence bands.

What do these estimates imply for the current monetary policy tightening? Given the high uncertainty around the impulse response functions and the fact that the estimates of demand and supply conditions themselves are surrounded by model uncertainty, we obviously need to be very cautious in deriving policy implications. Yet, back-of-the-envelope calculations suggest that, given our estimates, a 6 percentage points increase in the Federal Funds rate would be needed to bring current demand conditions back to normal levels, i.e. from 1 percentage points to 0. In order to further compensate for inflationary pressure coming from tight supply conditions a further depression of demand by 1 percentage point would be needed, which would imply a further 6 percentage points rate rise. While these numbers seem excessive and unrealistic, the observation that the Federal Funds rate increased by 14 percentage points between 1977 and 1981 (from 5% in 1977 to 19% in 1981) puts it somewhat into perspective.

Figure 7: **Dynamic effects of a contractionary financial shock**



Notes: Impulse responses to a one standard deviation EBP shock of demand and supply factors, the EBP, the FFR and the government bond yield in percentage points. Black: median estimate, areas: 68% and 90% confidence bands.

Figure 7 shows impulse responses for the second VAR model for a one standard deviation EBP shock. The charts suggest that a shock that raises the EBP by 0.25 percentage points lowers both supply and demand by about the same amount (about 0.1 percentage points). Both the demand and supply effects of the shock are statistically highly significant. This result suggests that adverse supply side effects may mitigate the disinflationary impact of a tightening of financial conditions consistent with the cost and re-allocation channels described above. The more significant supply-side effects of the EBP shock compared to the monetary policy shock may reflect the fact that the EBP captures financial conditions for firms and that these supply-side channels primarily operate through the corporate sector.

Our finding of significant adverse supply effects of financial shocks is in line with previous literature which finds no large role of financial shocks for inflation dynamics in terms of variance decomposition (Abbate et al. 2022, Furlanetto et al. 2022). The finding also at least in part explains the "missing disinflation" during and after the GFC: the large negative financial shock associated with the crisis not only had strong negative demand effects, but also led to tighter supply with the effects on inflation via those channels broadly cancelling each other out. For the current juncture, it implies that adverse financial shocks on top of monetary tightening, e.g. through rising risk aversion, may dampen economic activity but provide little help in curbing inflationary pressures.

6 Demand and supply in the euro area

We estimate euro-area demand and supply factors using a quarterly database over the period 1999Q1 – 2022Q2. The euro-area database comprises data on various measures of inflation and economic activity for the four major euro-area countries (France, Germany, Italy, Spain) as well as euro-area aggregates. Table A.2 in the Appendix provides details on the data series, their sources, variable transformations and on the sign restrictions imposed on each individual series.

The data are transformed in the same way as the U.S. data before, i.e. they are standardised and outlier-adjusted and data gaps are closed through the EM algorithm. We then estimate the factor model and apply the same procedure described before to identify demand and supply factors. Also for the euro area, we estimate the model with three factors, which again explain more the 50% of the variance of the data (Table 4).[7]

Figure 8 reports the estimated demand and supply factors for the euro area. The results suggest a similar picture of the evolution of demand and supply conditions as in the United States in the overlapping period. In particular, we see a combination of strong demand and supply in the pre-GFC period. The GFC was associated with a strong tightening of both demand and supply. After a short recovery in particular in demand, both demand and supply tightened again markedly in the recession associated with the euro-area sovereign debt crisis in 2012. In the subsequent period until the outbreak of the Covid-19 pandemic in 2020, which was also in the euro area characterised by persistently low inflation, our factors indicate a combination of overall weak demand and strong supply.

[7]The share of loadings for which the sign restrictions need to hold is lower (85%) than for the United States. This is because no valid rotation is found for a higher share, and the reason may be larger heterogeneity in the euro area.

Table 6: **Cumulative variance shares for the euro area**

Number of Factors	Cumulative variance share
1	27
2	43
3	53
4	60
5	65
6	68
7	71
8	73
9	75
10	77

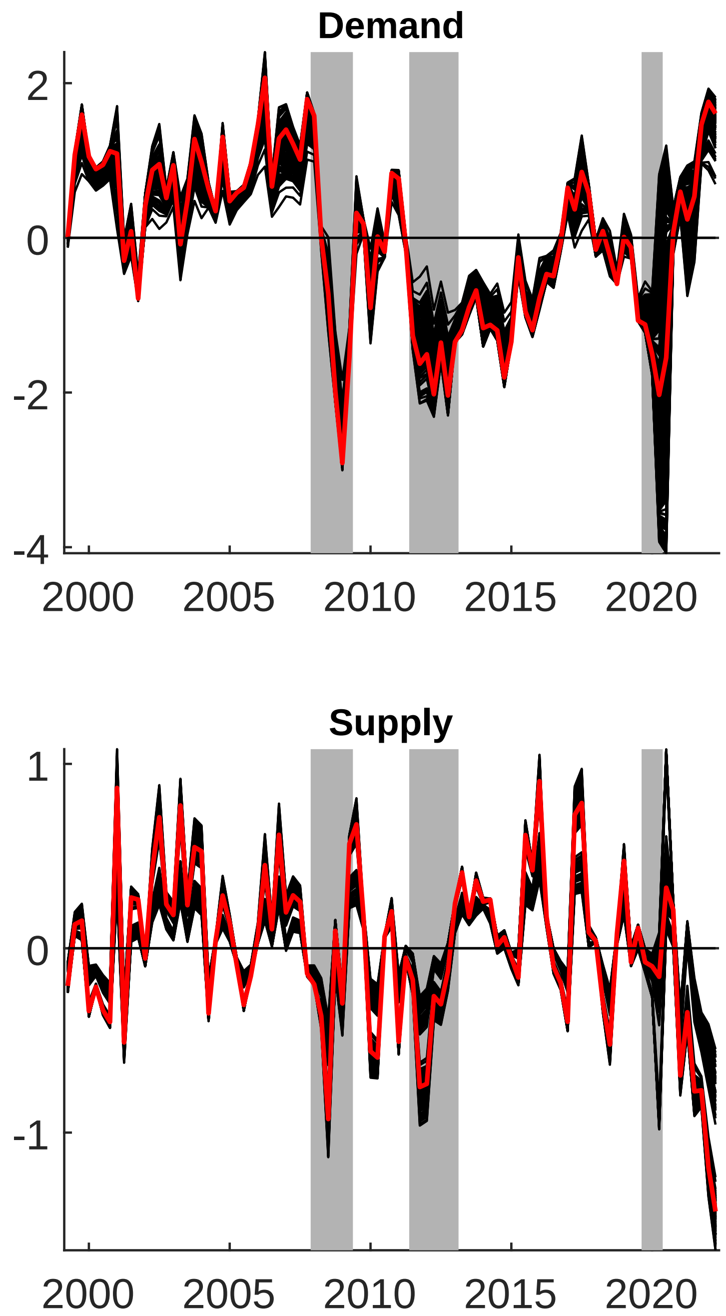
Notes: Cumulative variance shares explained by the first 10 principal components (in %) for the euro area dataset.

The Covid-19 recession in 2020 was associated with a sharp tightening in demand, while supply conditions remained broadly unaffected. For the subsequent inflation surge since 2021, our estimates suggest also for the euro-area countries strong demand in combination with tight supply. However, in comparison to the estimates for the United States, the relative strength of the two factors is somewhat different. In the euro area, the latest estimate of demand conditions for 2022Q2 is at similar levels as in the mid 2000s. Supply conditions in 2022, by contrast, have been at the their tightest level over the sample period.

Historical decompositions of HICP inflation rates in the euro area countries shown in Figure 9 further substantiate the narrative of the demand (dotted red lines) and supply (dashed blue lines) drivers of inflation in the euro-area countries. The charts show in particular the combined role of weak demand and tight supply in holding down euro area inflation in the years 2012 – 2017. In 2021/2022, the supply factor overall mostly contributed to the inflation surge in all four countries, albeit the contribution of demand is significant and in some countries almost matches that of supply. This differs from the United States where the demand factor has been the dominant driver of inflation over this period. These findings support the notion that supply factors play a relatively more important role in the euro-area inflation surge due to greater constraints in energy supply related to the Russia-Ukraine war. They are also consistent with Gonçalves and Koester (2022) who apply the methodology of Shapiro (2022*a*) to decompose the demand and supply drivers of euro area core

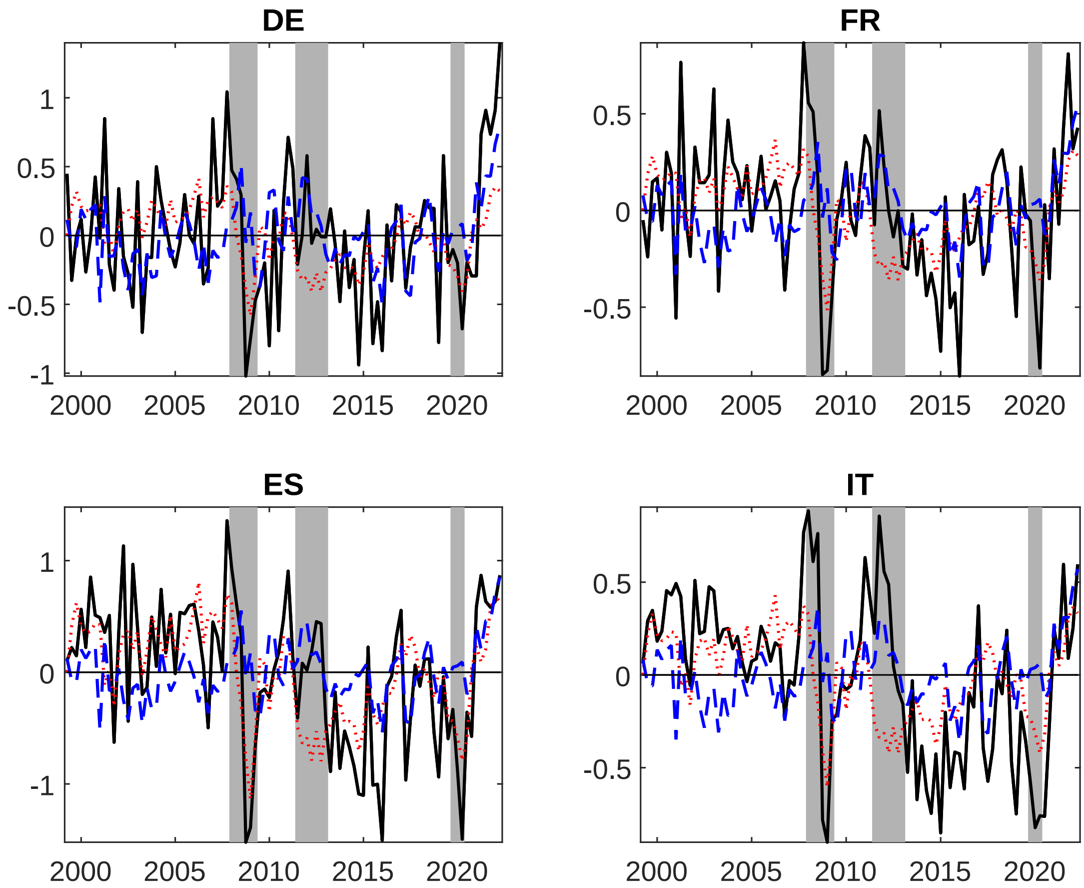
HICP inflation.

Figure 8: **Demand and supply conditions in the euro area**



Notes: In percentage points. Normalized to have the same standard deviation as GDP growth and multiplied with its loadings. Red: Median Target estimates, black: estimates from all models. Grey bars: CEPR recessions.

Figure 9: **Historical decompositions of euro-area CPI inflation**



Notes: Quarter-on-quarter, in %. Black: de-meaned time series estimates. Red: contribution of the median target demand factor. Blue: contribution of the median target supply factor. Grey bars: CEPR recessions.

7 Conclusions

Our analysis provides indicators of aggregate demand and supply conditions in the United States over the past 50 years, including the inflation surge since 2021. For key historical episodes, the indicators offer a narrative of the respective role of demand and supply factors. Specifically, the results suggest that a combination of persistently strong demand and episodically tight supply were at work during the Great Inflation of the 1970s and that the Volcker disinflation of the early-1980s was driven by the elimination of strong demand. The GFC was characterised by a collapse of demand as well as a marked tightening in supply, which explains the missing disinflation during the crisis. The period of persistently low inflation that followed reflected a combination of weak demand and strong supply.

The most recent observations indicate that the inflation surge since mid-2021 has been driven by a combination of extraordinarily expansionary demand conditions and tight supply. Similar indications obtain for the euro area. An important difference is the relatively greater role of tight supply conditions in the recent inflation surge, reflecting the adverse energy supply developments in the euro area in the wake of the Russia-Ukraine war. That said, also in the euro area demand conditions have been highly expansionary over this period and made a significant contribution to rising inflation.

Finally, our analysis further suggests that tighter monetary policy primarily dampens demand. By contrast, financial shocks, e.g. through higher risk aversion reflected in higher bond spreads, adversely impact demand and supply in a similar fashion, reflecting financial supply-side channels highlighted by the previous literature. This implies that central banks would be able to bring inflation back down through an appropriate tightening of the monetary policy stance. Adverse financial shocks that come on top of monetary tightening may dampen economic activity but provide little help in curbing inflationary pressures.

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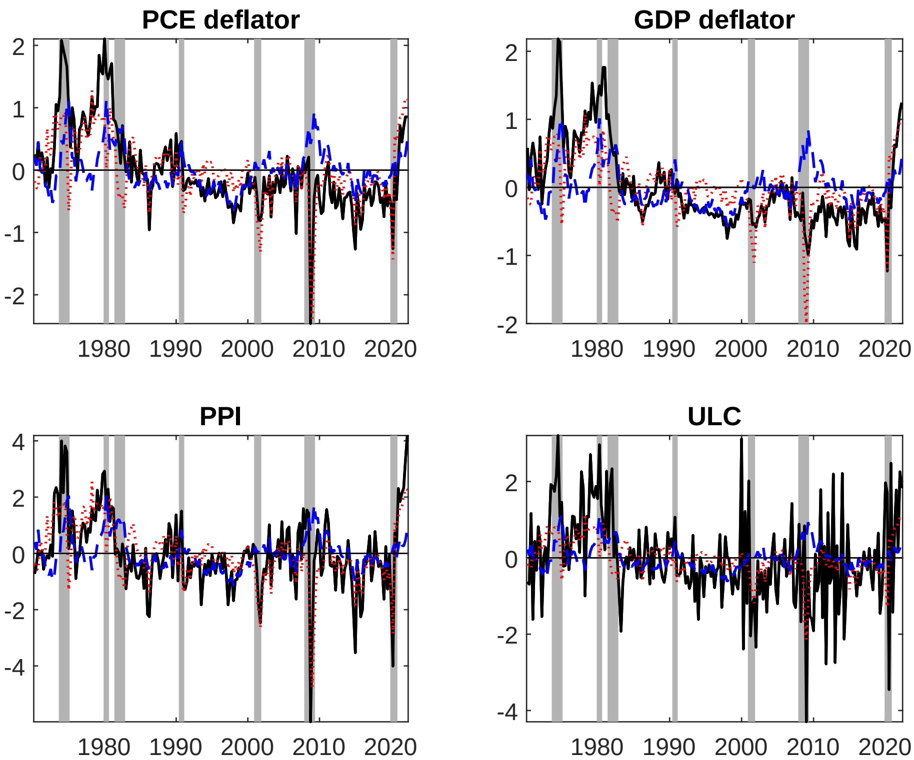
Appendix

A Appendix figures and tables

Figure A.1: Historical decompositions, more variables



Notes: Quarter-on-quarter, in %. Black: demeaned time series estimates. Red: contributions of the Median Target demand factor. Blue: contributions of the Median Target supply factor. Grey bars: NBER recessions.

Table A.1: Supplementary information on the U.S. data

# Variable	Group	Transf	Sign	Source
Gross Domestic Product: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Personal Consumption Expenditures: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Personal Consumption Expenditures: Goods: Price Index (SA, 2012=100)	1	2	1	BEA
PCE: Durable Goods: Chain Price Index (SA, 2012=100)	1	2	1	BEA
PCE: Nondurable Goods: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Personal Consumption Expenditures: Services: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Gross Private Domestic Investment: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Private Fixed Investment: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Private Nonresidential Fixed Investment: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Pvt Nonresidential Fixed Investment: Structures: Chain Price Index(SA, 2012=100)	1	2	1	BEA
Pvt Nonresidential Fixed Investment: Equipment: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Private Residential Fixed Investment: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Exports of Goods & Services: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Imports of Goods & Services: Chain Price Index (SA, 2012=100)	1	2	1	BEA
Govt Consumption Expenditures & Gross Investment: Chain Price Index(SA,2012=100)	1	2	0	BEA
Federal Consumption Expenditures & Gross Invest: Chain Price Index(SA, 2012=100)	1	2	0	BEA
State & Loc Consumption Expenditures & Gross Invest: Price Index (SA, 2012=100)	1	2	0	BEA
Real Gross Domestic Product (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Personal Consumption Expenditures (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Personal Consumption Expenditures: Goods (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Personal Consumption Expenditures: Durable Goods (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Personal Consumption Expenditures: Nondurable Goods (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Personal Consumption Expenditures: Services (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Gross Private Domestic Investment (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Private Fixed Investment (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Private Nonresidential Fixed Investment (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Private Nonresidential Fixed Investment: Structures (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Private Nonresidential Fixed Investment: Equipment (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Private Residential Fixed Investment (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Exports of Goods & Services (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Imports of Goods & Services (SAAR, Bil.Chn.2012$)	2	2	1	BEA
Real Government Consumption Expenditures & Gross Investment(SAAR, Bil.Chn.2012$)	2	2	0	BEA
Real Federal Consumption Expenditures & Gross Investment (SAAR, Bil.Chn.2012$)	2	2	0	BEA
Real State & Local Consumption Expenditures & Gross Invest (SAAR, Bil.Chn.2012$)	2	2	0	BEA
Industrial Production Index (SA, 2017=100)	2	2	1	FRB
Industrial Production: Manufacturing [SIC] (SA, 2017=100)	2	2	1	FRB
Industrial Production: Manufacturing [NAICS] (SA, 2017=100)	2	2	1	FRB
Industrial Production: Durable Goods [NAICS] (SA, 2017=100)	2	2	1	FRB
Industrial Production: Wood Products (SA, 2017=100)	2	2	1	FRB
Industrial Production: Nonmetallic Mineral Products (SA, 2017=100)	2	2	1	FRB
Industrial Production: Primary Metals (SA, 2017=100)	2	2	1	FRB
Industrial Production: Fabricated Metal Products (SA, 2017=100)	2	2	1	FRB

Industrial Production: Machinery (SA, 2017=100)	2	2	1	FRB
Industrial Production: Computer and Electronic Components (SA, 2017=100)	2	2	1	FRB
Industrial Production: Electrical Eqpt, Appliances & Components (SA, 2017=100)	2	2	1	FRB
Industrial Production: Motor Vehicles and Parts (SA, 2017=100)	2	2	1	FRB
Industrial Production: Aerospace & Miscellaneous Transport Equip (SA, 2017=100)	2	2	1	FRB
Industrial Production: Furniture and Related Products (SA, 2017=100)	2	2	1	FRB
Industrial Production: Miscellaneous Durable Goods (SA, 2017=100)	2	2	1	FRB
Industrial Production: Nondurable Manufacturing (SA, 2017=100)	2	2	1	FRB
Industrial Production: Food, Beverages, and Tobacco (SA, 2017=100)	2	2	1	FRB
Industrial Production: Textile and Product Mills (SA, 2017=100)	2	2	1	FRB
Industrial Production: Apparel and Leather Goods (SA, 2017=100)	2	2	1	FRB
Industrial Production: Paper (SA, 2017=100)	2	2	1	FRB
Industrial Production: Printing and Related Support Activities (SA, 2017=100)	2	2	1	FRB
Industrial Production: Petroleum and Coal Products (SA, 2017=100)	2	2	1	FRB
Industrial Production: Chemicals (SA, 2017=100)	2	2	1	FRB
Industrial Production: Plastics and Rubber Products (SA, 2017=100)	2	2	1	FRB
Industrial Production: Other Manufacturing [Non-NAICS] (SA, 2017=100)	2	2	1	FRB
Industrial Production: Mining (SA, 2017=100)	2	2	1	FRB
Industrial Production: Electric and Gas Utilities (SA, 2017=100)	2	2	1	FRB
Capacity Utilization: Industry (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Manufacturing [SIC] (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Manufacturing [NAICS] (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Durable Goods Mfg [NAICS] (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Wood Products (SA, % of Capacity)	2	1	2	FRB
Capacity Utilization: Nonmetallic Mineral Products (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Primary Metal (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Fabricated Metal Product (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Machinery (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Computer and Electronic Products (SA, % of Capacity)	2	1	2	FRB
Capacity Utilization: Elec Eqpt, Appliances & Components (SA, % of Capacity)	2	1	2	FRB
Capacity Utilization: Motor Vehicles and Parts (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Aerospace & Misc Transportation (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Furniture and Related Products (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Miscellaneous Durable Goods (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Nondurable Goods Manufacturing (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Food, Beverage, & Tobacco Products (SA, % of Capacity)	2	1	2	FRB
Capacity Utilization: Textile and Product Mills (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Apparel and Leather (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Paper (SA, Percent of Capacity)	2	1	2	FRB
Capacity Util: Printing & Related Support Activities (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Petroleum and Coal Products (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Chemicals (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Plastics and Rubber Products (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Other Manufacturing [Non-NAICS] (SA, Percent of Capacity)	2	1	2	FRB
Capacity Utilization: Mining (SA, Percent of Capacity)	2	1	2	FRB

Capacity Utilization: Electric and Gas Utilities (SA, Percent of Capacity)	2	1	2	FRB
Civilian Unemployment Rate: 16 yr + (SA, %)	2	0	2	BLS
Civilian Unemployment Rate: Men, 16 Years and Over (SA, %)	2	0	2	BLS
Civilian Unemployment Rate: Women, 16 Years and Over (SA, %)	2	0	2	BLS
Civilian Unemployment Rate: 16-19 Years (SA, %)	2	0	2	BLS
Civilians Unemployed: Job Losers (SA, Thous.)	2	2	2	BLS
Civilians Unemployed: Job Leavers (SA, Thous.)	2	2	2	BLS
Civilians Unemployed: Reentrants (SA, Thous.)	2	2	2	BLS
Civilians Unemployed: New Entrants (SA, Thous.)	2	2	2	BLS
Civilians Unemployed for Less Than 5 Weeks (SA, Thous.)	2	2	2	BLS
Civilians Unemployed for 5-14 Weeks (SA, Thous.)	2	2	2	BLS
Civilians Unemployed for 15 Weeks and Over (SA, Thous.)	2	2	2	BLS
Civilians Unemployed for 15-26 Weeks (SA, Thous.)	2	2	2	BLS
Civilians Unemployed for 27 Weeks and Over (SA, Thous.)	2	2	2	BLS
Unemployed for Less Than 5 Weeks: % of Civilians Unemployed (SA, %)	2	1	2	BLS
Unemployed for 5-14 Weeks: % of Civilians Unemployed (SA, %)	2	1	2	BLS
Unemployed for 15 Weeks and Over: % of Civilians Unemployed (SA, %)	2	1	2	BLS
Unemployed for 15-26 Weeks: % of Civilians Unemployed (SA, %)	2	1	2	BLS
Unemployed for 27 Weeks and Over: % of Civilians Unemployed (SA, %)	2	1	2	BLS
All Employees: Total Nonfarm (SA, Thous)	2	2	1	BLS
All Employees: Total Private Industries (SA, Thous)	2	2	1	BLS
All Employees: Goods-producing Industries (SA, Thous)	2	2	1	BLS
All Employees: Mining and Logging (SA, Thous)	2	2	1	BLS
All Employees: Construction (SA, Thous)	2	2	1	BLS
All Employees: Manufacturing (SA, Thous)	2	2	1	BLS
All Employees: Durable Goods Manufacturing (SA, Thous)	2	2	1	BLS
All Employees: Nondurable Goods Manufacturing (SA, Thous)	2	2	1	BLS
All Employees: Private Service-providing Industries (SA, Thous)	2	2	1	BLS
All Employees: Wholesale Trade (SA, Thous)	2	2	1	BLS
All Employees: Retail Trade (SA, Thous)	2	2	1	BLS
All Employees: Transportation & Warehousing (SA, Thous)	2	2	1	BLS
All Employees: Utilities (SA, Thous)	2	2	1	BLS
All Employees: Information Services (SA, Thous)	2	2	1	BLS
All Employees: Financial Activities (SA, Thous)	2	2	1	BLS
All Employees: Professional & Business Services (SA, Thous)	2	2	1	BLS
All Employees: Education & Health Services (SA, Thous)	2	2	1	BLS
All Employees: Leisure & Hospitality (SA, Thous)	2	2	1	BLS
All Employees: Other Services (SA, Thous)	2	2	1	BLS
All Employees: Government (SA, Thous)	2	2	1	BLS
PPI: Finished Goods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Goods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Foods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Crude Foods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Processed Foods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Goods ex Foods (SA, 1982=100)	1	2	1	BLS

PPI: Finished Consumer Nondurable Goods less Foods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Consumer Durable Goods (SA, 1982=100)	1	2	1	BLS
PPI: Finished Goods: Capital Equipment (SA, 1982=100)	1	2	1	BLS
PPI: Capital Equipment: Manufacturing Industries (SA, 1982=100)	1	2	1	BLS
PPI: Capital Equipment: Nonmanufacturing Industries (SA, 1982=100)	1	2	1	BLS
PPI: Intermediate Materials, Supplies and Components (SA, 1982=100)	1	2	1	BLS
PPI: Intermediate Materials for Manufacturing (SA, 1982=100)	1	2	1	BLS
PPI: Intermediate Materials/Components for Construction (SA, 1982=100)	1	2	1	BLS
PPI: Intermediate Materials: Processed Fuels & Lubricants (SA,1982=100)	1	2	1	BLS
PPI:Intermediate Materials: Containers (SA, 1982=100)	1	2	1	BLS
PPI: Intermediate Supplies (SA, 1982=100)	1	2	1	BLS
PPI: Crude Materials for Further Processing (SA, 1982=100)	1	2	1	BLS
PPI: Crude Foodstuffs and Feedstuffs (SA, 1982=100)	1	2	1	BLS
PPI: Crude Nonfood Materials for Further Processing (SA, 1982=100)	1	2	1	BLS
CPI-U: All Items (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Food (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Food at Home (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Cereals and Bakery Products (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Meats, Poultry, Fish and Eggs (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Dairy and Related Products (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Fruits and Vegetables (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Nonalcoholic Beverages (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Other Foods at Home [ex Beverages] (NSA, 1982-84=100)	1	2	1	BLS
CPI-U: Energy (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Energy Commodities (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Fuel Oil (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Motor Fuel (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Gasoline (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Energy Services (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Household Electricity (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Utility [Piped] Gas Service (SA, 1982-84=100)	1	2	1	BLS
CPI-U: All Items Less Food and Energy (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Commodities Less Food & Energy Commodities (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Apparel (SA, 1982-84=100)	1	2	1	BLS
CPI-U: New Vehicles (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Used Cars and Trucks (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Medical Care Commodities (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Alcoholic Beverages (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Tobacco & Smoking Products (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Services Less Energy Services (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Shelter (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Rent of Primary Residence (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Owners' Equivalent Rent of Residences (SA, Dec-82=100)	1	2	1	BLS
CPI-U: Medical Care Services (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Physicians' Services (SA, 1982-84=100)	1	2	1	BLS

CPI-U: Hospital Services (SA, Dec-96=100)	1	2	1	BLS
CPI-U: Transportation Services (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Motor Vehicle Insurance (SA, 1982-84=100)	1	2	1	BLS
CPI-U: Airline Fare (SA, 1982-84=100)	1	2	1	BLS
Business Sector: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Nonfarm Business Sector: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Manufacturing Sector: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Durable Manufacturing: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Nondurable Manufacturing: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Nonfinancial Corporations: Unit Labor Cost (SA, 2012=100)	1	2	0	BLS
Business Sector: Real Compensation Per Hour (SA, 2012=100)	1	2	0	BLS
Manufacturing Sector: Real Compensation Per Hour (SA, 2012=100)	1	2	0	BLS
Durable Manufacturing: Real Compensation Per Hour (SA, 2012=100)	1	2	0	BLS
Nondurable Manufacturing: Real Compensation Per Hour (SA, 2012=100)	1	2	0	BLS
Nonfinancial Corporations: Real Hourly Compensation (SA, 2012=100)	1	2	0	BLS
Business Sector: Hours of All Persons (SA, 2012=100)	2	2	0	BLS
Nonfarm Business Sector: Hours of All Persons (SA, 2012=100)	2	2	2	BLS
Manufacturing Sector: Hours of All Persons (SA, 2012=100)	2	2	2	BLS
Durable Manufacturing: Hours of All Persons (SA, 2012=100)	2	2	2	BLS
Nondurable Manufacturing: Hours of All Persons (SA, 2012=100)	2	2	2	BLS
Nonfinancial Corporations: Employee Hours (SA, 2012=100)	2	2	2	BLS
Median Usual Wkly Earnings: Full Time Wage & Salary Wkrs(SA, 1982-84 CPI-U Adj$)	1	2	1	BLS
Median Usual Wkly Earn: Full Time Wage & Salary Wkrs: Men(SA, 82-84 CPI-U Adj$)	1	2	1	BLS
Median Usual Wkly Earn: Full Time Wage & Salary Wkr: Women(SA, 82-84 CPI-U Adj$)	1	2	1	BLS
Nonfarm Business Sector: Compensation Per Hour, Index 2012=100, Seasonally Adjusted	1	2	1	BLS
Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma, Dollars per Barrel, Not Seasonally Adjusted	1	0	0	BBG

Notes: Column Transf reports transformation types: 0=level, 1=log level, 2=log diff, 3: diff; Column Sign reports Sign restrictions: 0=no restriction, 1=supply and demand factor loading restrictions, 2=demand factor loading restriction.

Table A.2: Supplementary information on the euro area data

	Country	Group	Transf	Sign
Consumer Price Index (SA, 2015=100)	DE	1	2	1
Total Industry excluding Construction (SA, 2015=100)	DE	1	2	1
GDP Deflator (2010=100)	DE	1	2	1
Gross Domestic Product (SWDA, Mil.Chn.2015.Euros)	DE	2	2	1
Unemployment Rate (%, NSA) - Seasonal Adjustment, All	DE	2	0	2
Federal Government Expenditures (SA, Mil.Euros)	DE	2	2	0
Gross Fixed Capital Formation (SWDA, Mil.Chained.2015.Euros)	DE	2	2	1
Private Consumption Expenditure (SWDA, Mil.Chn.2015.Euros)	DE	2	2	1
Export Price Index (NSA, 2015=100)	DE	1	2	1
Import Price Index (NSA, 2015=100)	DE	1	2	1
Germany: GDP: Exports of Goods & Services (SWDA, Mil.Chn.2015.US$)	DE	2	2	1
Imports of Goods & Services (SWDA, Mil.Chn.2015.US$)	DE	2	2	1
Employed Population Aged 15 and Over (NSA, Mil.Persons)	DE	2	2	1
Total Wages and Salaries (NSA, Mil.EUR) - Seasonal Adjustment, All	DE	1	2	1
Early Estimates of Unit Labor Cost: Total Economy (SA, 2015=100)	DE	1	2	0
Industrial Production: Total Industry ex Construction(SWDA, 2015=100)	DE	2	2	1
Capacity Utilization: Manufacturing (SA, %)	DE	2	1	2
Consumer Prices (2010=100, NSA)	FR	1	2	1
Producer Prices [All Industries] (2010=100)	FR	1	2	1
GDP Deflator (2010=100)	FR	1	2	1
Gross Domestic Product (SWDA, Mil.Chn.2014.Euros)	FR	2	2	1
Unemployment Rate (SA, %)	FR	2	0	2
General Budget Expenditures (SA, Mil.Euros)	FR	2	2	0
Gross Fixed Capital Formation (SWDA, Mil.Chn.2014.Euros)	FR	2	2	1
Household Consumption (SWDA, Mil.Chn.2014.Euros)	FR	2	2	1
Exports [Unit Value]: Total (NSA, 2005=100)	FR	1	2	1
Imports [Unit Value]: Total (NSA, 2005=100)	FR	1	2	1
Exports of Goods & Services (SWDA, Mil.Chn.2014.US$)	FR	2	2	1
Imports of Goods & Services (SWDA, Mil.Chn.2014.US$)	FR	2	2	1
Employed Population Aged 15 and Over (NSA, Mil.Persons)	FR	2	2	1
Labor Force: Over 15 Years (NSA, Mil)	FR	2	2	0
Total Wages and Salaries (NSA, Mil.EUR) - Seasonal Adjustment, All	FR	1	2	1
Early Estimates of Unit Labor Cost: Total Economy (SA, 2015=100)	FR	1	2	0
Industrial Production excluding Construction (SWDA, 2015=100)	FR	2	2	1
Capacity Utilization: Total Industry (SA, %)	FR	2	1	2
Consumer Prices (2010=100, NSA)	IT	1	2	1
Producer Prices (2010=100, NSA)	IT	1	2	1
GDP Deflator (2010=100)	IT	1	2	1
Gross Domestic Product (SWDA, Mil.Chn.2015.EUR)	IT	2	2	1
Unemployment Rate (%, NSA) - Seasonal Adjustment, All	IT	2	0	2

Central Government Expenditures (SA, Mil.Euros)	IT	2	2	0
Gross Fixed Investment (SWDA, Mil.Chn.2015.EUR)	IT	2	2	1
Private Consumption Expenditure (SWDA, Mil.Chn.2015.EUR)	IT	2	2	1
Exports [Unit Value Index] (NSA, 2015=100)	IT	1	2	1
Imports [Unit Value Index] (NSA, 2015=100	IT	1	2	1
Exports of Goods and Services(SWDA, Mil.Chn.2015.US$)	IT	2	2	1
Imports of Goods and Services(SWDA, Mil.Chn.2015.US$)	IT	2	2	1
Employed Population Aged 15 and Over (NSA, Mil.Persons)	IT	2	2	1
Labor Force SUSPENDED (NSA, Mil)	IT	2	2	0
Total Wages and Salaries (NSA, Mil.EUR) - Seasonal Adjustment, All	IT	1	2	1
Early Estimates of Unit Labor Cost: Total Economy (SA, 2015=100)	IT	1	2	0
Total Industry excl Construction (SWDA, 2015=100)	IT	2	2	1
Consumer Prices (2010=100, NSA)	ES	1	2	1
Industrial Prices (2010=100, NSA)	ES	1	2	1
GDP Deflator (2010=100)	ES	1	2	1
Gross Domestic Product (NSA, Mil.Ch.15.EUR) - Seasonal Adjustment, All	ES	2	2	1
Unemployment Rate (%, NSA) - Seasonal Adjustment, All	ES	2	0	2
Central Government Expenditures (SA, Mil.Euros)	ES	2	2	0
Gross Fixed Capital Formation (SWDA, Mil.Chn.2015.Euros)	ES	2	2	1
Private Consumption Expenditure (SWDA, Mil.Chn.2015.Euros)	ES	2	2	1
Export Price Index (NSA, 2005=100)	ES	1	2	1
Import Price Index (NSA, 2005=100)	ES	1	2	1
Exports of Goods & Services (SWDA, Mil.Chn.2015.US$)	ES	2	2	1
Imports of Goods & Services (SWDA, Mil.Chn.2015.US$)	ES	2	2	1
Employed Population Aged 15 and Over (NSA, Mil.Persons)	ES	2	2	1
Total Labor Force (NSA, Mil)	ES	2	2	0
Total Wages and Salaries (NSA, Mil.EUR) - Seasonal Adjustment, All	ES	1	2	1
Early Estimates of Unit Labor Cost: Total Economy (SA, 2015=100)	ES	1	2	0
Industrial Production excluding Construction (SWDA, 2015=100)	ES	2	2	1
Consumer Prices Index (2010=100)	XM	1	2	1
Domestic PPI: Industry excluding Construction (SA, 2015=100)	XM	1	2	1
GDP Deflator (2010=100)	XM	1	2	1
Gross Domestic Product (SWDA, Mil.Chn.2015.EUR)	XM	2	2	1
Unemployment Rate (%) - Seasonal Adjustment, All	XM	2	0	2
Gross Fixed Capital Formation (SWDA, Mil.Ch.2015.Euros)	XM	2	2	1
Priv Consumption Expenditure(SWDA,Mil.Chn.2015.EUR)	XM	2	2	1
Export Prices: Total (NSA, 2015=100)	XM	1	2	1
Import Prices: Total (NSA, 2015=100)	XM	1	2	1
Exports of Goods and Services(SWDA, Mil.Chn.2015.US$)	XM	2	2	1
Imports of Goods and Services(SWDA, Mil.Chn.2015.US$)	XM	2	2	1
Employed Population Aged 15 and Over (NSA, Mil.Persons)	XM	2	2	1
Labor Force: 15 Years and Over (NSA, Mil)	XM	2	2	0
Total Wages and Salaries (NSA, Mil.EUR) - Seasonal Adjustment, All	XM	1	2	1

Early Estimates of Unit Labor Cost: Total Economy (SA, 2015=100)	XM	1	2	0
Industry excluding Construction (SWDA, 2015=100)	XM	2	2	1

Notes: Column Transf reports transformation types: 0=level, 1=log level, 2=log diff, 3: diff; Column Sign reports Sign restrictions: 0=no restriction, 1=supply and demand factor loading restrictions, 2=demand factor loading restriction.

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