Analysis

The monetary policy response to high inflation

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1 Introduction and summary

After a long period of below-target inflation, euro area inflation surged in the course of 2021 and 2022, causing the ECB to sharply raise its policy rate in response. Inflation increased above the 2% target following the reopening of the economy after the COVID-19 crisis, which was accompanied by a sharp increase in demand, helped by generous government support for businesses and households. At the same time, supply chains were still under pressure from the pandemic and past and then still prevailing lockdowns, leading to shortages in many sectors of the economy. In addition, the increase in energy prices due to Russia's unjustified invasion of Ukraine added fuel to the inflation fire. Inflation in the euro area ultimately reached a peak of 10.6% in October 2022. In response to rising inflationary pressures the ECB sharply raised its policy rate from July 2022 onward. This, together with an end to and then a reversal of the ECB's asset purchases, was aimed at bringing back inflation towards the 2% target in the medium term.

In this analysis we assess the drivers of recent inflation developments in more detail, focusing on the contribution of monetary policy. Using a Bayesian Vector Autoregressive (BVAR) model, we find that the surge in inflation in 2021-2022 was the result of a mix of demand and supply shocks. During this initial inflation phase, the still-accommodative monetary policy, while not a main driver, also contributed to inflation. However, once the ECB started its series of fast-paced rate hikes in mid-2022, monetary policy quickly reached the level of restriction justified by economic conditions and ended up being even slightly more restrictive, compared to its historical behaviour. This contributed to a faster than expected decline in inflation. Looking at the full episode, at its peak in 2022 the "gap" between the actual policy response and the model-predicted response explains 1 percentage point of the 8 percentage point rise in inflation above target. This gap disappeared after the ECB started its aggressive hiking cycle. These model-based findings support the notion that the ECB was initially too late in hiking rates, but then made up for this through a very forceful reaction. Of course, these findings are based on ex-post data and reflect the benefit of hindsight, as elevated uncertainty driven by the waning pandemic and a war in Europe made real-time policymaking challenging.

Secondly, we describe the transmission process of the monetary policy tightening. Already in early 2022, before the first rate hike took place in July, longer-term risk-free rates started increasing due to the winding down of net asset purchases and the anticipation by market participants of the ECB tightening its policy. The speed of interest rate hikes (450 basis points in 14 months) was quick compared to past hiking cycles. The higher policy rates were also swiftly transmitted to lending rates for households and firms, while the increase in deposit rates was more sluggish. As borrowing became more expensive, credit growth came to a virtual standstill. In turn, economic activity stagnated, in particular in the (more capital-intensive) manufacturing sector. Quarterly GDP growth in the euro area was close to zero from the end of 2022 throughout 2023, and only picked up again at the start of 2024. A recession was however avoided. Inflation started to fall rapidly in the course of 2023, starting with falling energy prices, and followed by falling inflation for goods and food. Services inflation, which is closely related to wage growth, proved stickier. Importantly, longer-term inflation expectations, which are crucial for maintaining price stability, remained broadly anchored. Based on the latest (June 2024) projections, inflation is expected to return to its 2% target by the end of 2025.

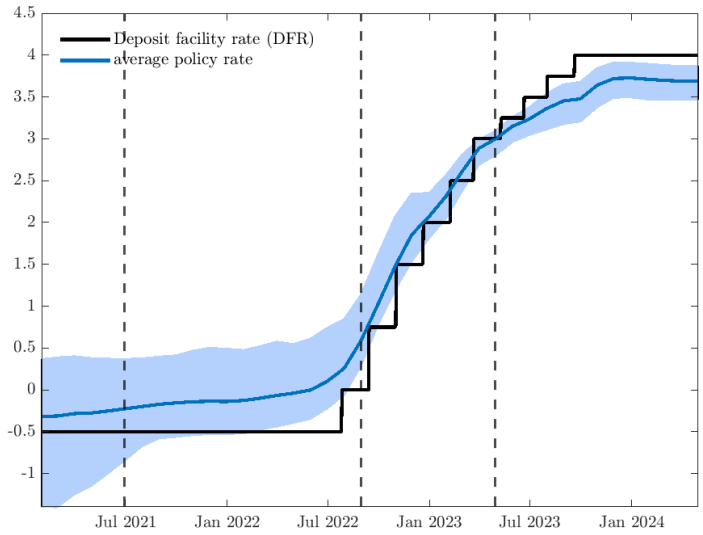
2 The causes of the inflation surge and the role of monetary policy

2.1 Introduction and overview of different phases

In this section, we study the contribution of economic drivers to the recent inflation episode, with a particular focus on the role of monetary policy. Following an extended period where inflation was below the 2% target and even negative during the first part of the pandemic, inflation started to rise from the end of 2020 (Galati and Hoeberichts, 2021)**.** This post-pandemic inflation surge was the result of a combination of demand and supply factors. The relative importance of these economic drivers is subject of an ongoing debate, with some analyses pointing to demand as more important than or at least as relevant as supply (Ascari et al., 2023, Bergholt et al., 2024 and Giannone and Primiceri, 2024) and other studies arguing that supply had a more prominent role (Bańbura et al., 2024 and Ascari et al., 2024, among others, who specifically include factors such as supply bottlenecks). Our analysis in section 2.2 relies on the leaner model from Ascari et al. (2023).

We distinguish three different phases over the post-pandemic period based on the response of monetary policy to the state of the economy. Our definition of different phases relies on a comparison between the Deposit Facility Rate (DFR) – the (de facto key) policy rate set by the ECB - and the policy rate path implied by a simple – so-called thick – modelling approach with a large set of Taylor rules (see figure 1). The latter corresponds to the policy rate that would have been justified by the state of the economy, under the assumption that the central bank would have conducted monetary policy according to its past behavior.[1]

1. Policy rate path implied by thick Taylor rule modeling



Source: DNB calculations. Note: The solid blue line and shaded area reflect, respectively, the average rate and min-max range of over 1,500 fitted contemporaneous and forward-looking Taylor rule specifications. Estimation period from January 2001 until December 2009. Last observation: April 2024. The dashed vertical bars separate the different phases.

[1] The reference to past behavior means that the Taylor rule coefficients are estimated on the pre-Great recession sample, a sample during which the policy rate was also the primary monetary instrument.

The first phase (the initial response), from July 2021 to August 2022, is characterized by a sharp increase in inflation. This increase followed the end of the COVID-19 pandemic and was intensified after Russia's unjustified invasion of Ukraine. According to its historical behavior, the ECB should have implemented a slightly more restrictive monetary policy from the end of 2021 (black line below blue shaded area). At this point in time, the ECB did shift its forward guidance and announced a tapering of asset purchases, but interest rates were kept unchanged until the first hike in July 2022.[2] According to the simple comparison in figure 1, the state of the economy (in particular the high inflation rate) would have suggested an earlier increase in rates from -0.5% towards positive territory. At the same time, the ECB's decisions at that time should be seen against the background of large uncertainty about both the persistence of inflation and the economic and financial stability effects of the waning pandemic and the Russian invasion of Ukraine. Note also that our analysis is based on the latest available data, while real-time data during the pandemic generally suggested a larger economic fallout.

The second phase, from September 2022 to April 2023, is characterized by a historically fast pace of interest rate hikes from 0% to 3%. This moved monetary policy from its previous accommodating stance into restrictive territory. According to figure 1, already the (historically large) 75bps hike decided in September 2022 put the policy rate in line with the level consistent with a Taylor rule and the subsequent sizeable increases kept that path. During this phase, the speed and size in the increase in the policy rate was justified by the historically high level of inflation.

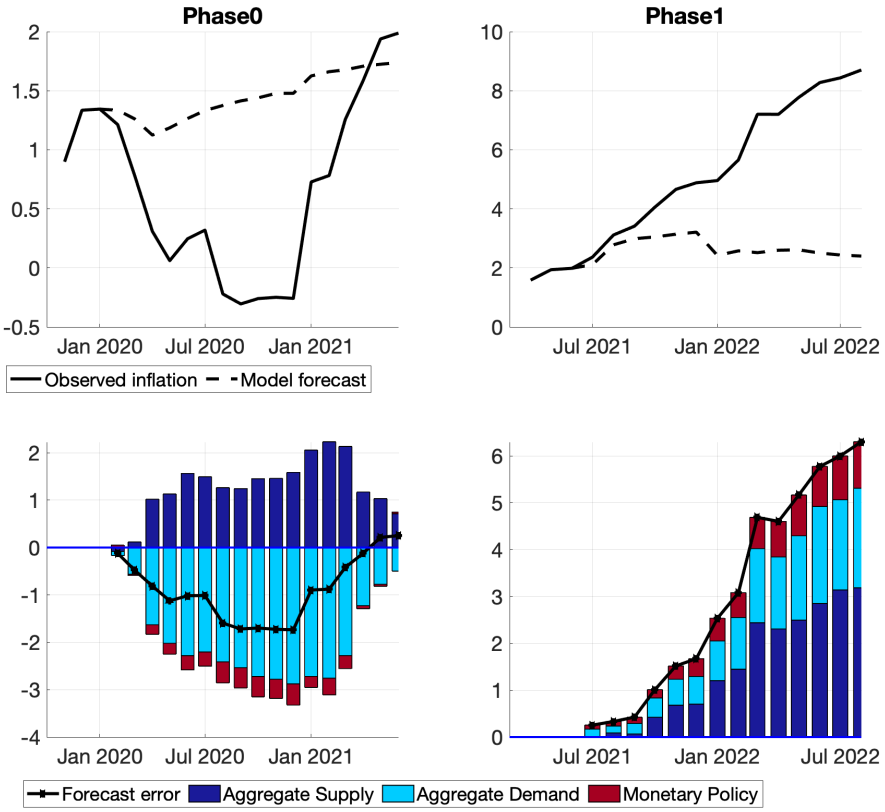
The third phase, from May 2023 to April 2024, can be considered the 'last hiking mile'. From May 2023 the ECB started slowing down the pace of interest rate increases, gradually further tightening the policy stance. While the policy interest rates increased at a slower pace than during the second phase, in this phase it even surpassed the Taylor rule prescribed rate conditional on the state of the economy. Until spring 2024, the policy rate remained around 25bps above the prescribed level of interest rates, a stance motivated by the ECB's desire to return inflation to its 2% medium target in a timely manner.

2.2 The role of monetary policy through the lens of a model

As a next step, we quantify the effect of monetary policy on inflation using a simple Bayesian Vector Autoregressive (BVAR) model. In particular, we use the model introduced by Ascari et al. (2023) to identify shocks associated with three distinct economic drivers: aggregate demand (AD), aggregate supply (AS) and monetary policy (MP). As measure of the monetary policy stance we use the 2-year interest rate which also partly captures the effect of nonstandard policy measures aimed at compressing longer term rates. The identification is obtained by imposing sign restrictions that are consistent with economic theory (see Appendix for details). The model allows us to quantify the contribution of the identified economic drivers in each of the different phases described. We also add a phase 0 to highlight from which economic environment the euro area was coming from.

[2] Together with the anticipation by markets of rate hikes, the shift in unconventional policies has led to an increase in longer-term interest rates before the first policy rate hike actually took place (see section 3.1).

2. Decomposition of inflation forecast errors (phase 0 and 1)



Source: DNB calculations.

Phase 0 (before July 2021): the early pandemic and low inflation episode

Comparing the model forecast with ex-post observed inflation highlights the role of large and unexpected shocks during the first two phases. The top left panel of figure 2 illustrates that inflation was below target in early 2020 – following already a decade of low inflation - and then even dropped into negative territory during the first year of the pandemic (solid line). Conditional on the information in January 2020, the BVAR model predicted a gradual increase in inflation towards levels slightly below 2% (dashed line). The forecast produced by the model assumes that no shocks hit the economy during the forecasting period. Of course, in reality shocks are never equal to zero, and in particular this phase is characterized by the economy being unexpectedly hit by the Covid-19 pandemic; a very large shock in retrospective.

Despite a very expansionary monetary policy stance, monetary policy was still too tight in this early pandemic period. The difference between the observed outcome (solid line) and the forecast (dashed line) is the forecast error. Since the latter is due to unexpected shocks, we can decompose it into the contribution of the aforementioned economic drivers (see also Ascari et al., 2023). This is done in the bottom left panel of figure 2, in which the forecast error (solid-dotted line) is divided into the contributions of demand (dark blue), supply (light

blue) and monetary policy (red). The inflation drop is primarily determined by a combination of negative supply and demand factors that move in opposite directions with demand factors more than offsetting the upward pressure from supply. The ECB introduced various expansionary measures, including a very substantial pandemic emergency purchase program (PEPP). Despite all this, with the interest rate constrained by the effective lower bound (meaning that lowering rates further would not stimulate the economy), monetary policy was still not expansionary enough and could not prevent inflation from falling (the negative red bars in figure 2).

Phase 1 (July 2021 – August 2022): the initial response

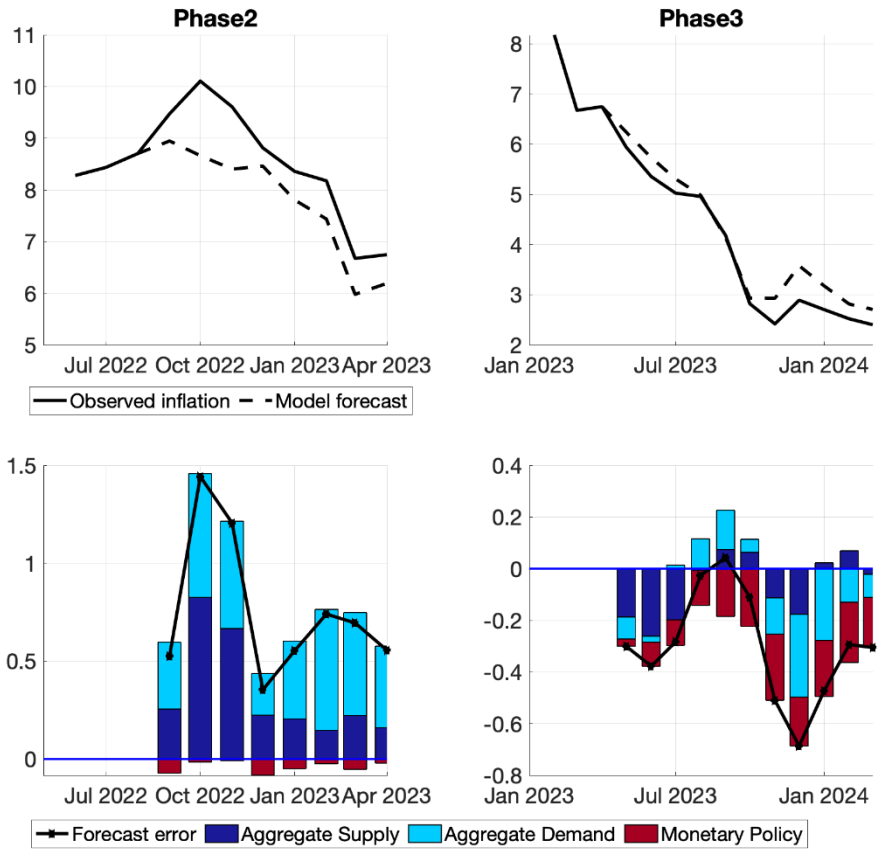
Following the early pandemic period inflation started to rise quicker than expected. The top right panel of figure 2 shows that the level of HICP inflation in June 2021 was exactly at the central bank inflation target of 2%. Conditional on this information, the BVAR model would have forecasted an increasing inflation path up to roughly 3% in the fourth quarter 2021, followed by a gradual decrease to the inflation target. Instead, inflation increased faster than expected to almost 9% at the end of the period. Why was the model (and were most of the economic experts) so wrong? First, the economic recovery from the pandemic has been stronger than expected. The fact that the model is wrong reflects the exceptional nature of the Covid shock and that it is difficult to predict its consequences (including the response of fiscal policy) for the economy. Second, this phase has also been characterized by another big shock: Russia's unjustified attack against Ukraine, and the corresponding rise in gas prices.

A decomposition of the forecast error indicates that during this phase monetary policy had a positive contribution to inflation. The inflation surge shown in the bottom right panel of figure 2 reflects a combination of both supply and demand factors. Given the rapid increase inflation, the model would have expected a strong reaction from monetary policy. Instead, in a period of economic uncertainty and financial stability concerns caused by both Covid and the outbreak of a war, the ECB tightened more cautiously[3]. It first wound down its asset purchases and retracted its forward guidance, before a first rate hike in July. Due to this discrepancy between the model-projected rate path and the one implemented by the ECB, the contribution of monetary policy to inflation is positive during this first phase. It reaches a peak of around 1 percentage point by summer 2022. At the same time, inflation has risen from 2% to around 9% during this phase. Qualitatively, this picture is in line with the widening gap between the actual policy rate and the one prescribed by the set of Taylor rules shown in figure 1.[4]

[3] The challenge in assessing the inflation outlook amid the outbreak of a potentially recessionary war is also reflected in the ECB macroeconomic projections of March 2022, which contain different scenarios. While the baseline scenario back then suggested a return of inflation to target by 2024, the adverse scenario suggested higher inflation in the short-term but then below-target inflation by 2024, due to lower economic growth.

[4] Quantitatively, the BVAR estimate of the monetary policy contribution can be considered as an upper bound: it only focuses on headline inflation and doesn't discriminate between persistent and more temporary (food, energy prices) drivers. Figure 1, on the other hand, contains a range of specifications, some of which focus on core inflation, that does exclude these more volatile prices and started rising only later.

3. Decomposition of inflation forecast errors (phase 2 and 3)



Source: DNB calculations.

Phase 2 (September 2022 – April 2023): the fast hiking

During the second phase, monetary policy was in line with economic conditions; at least according to the BVAR-model. During this phase prices again grew faster than is forecasted by the BVAR-model, with inflation reaching its peak of more than 10% in October 2022 (left panels of figure 3). These positive forecast errors can be attributed to a combination of supply and demand factors, with the contribution of the latter increasing in the last part of the period. The contribution of monetary policy, on the other hand, has disappeared. This does not mean that the strong increase in interest rates had no downward effect on inflation: it means that the fast increase in interest rates is exactly what the model expected given the high inflation rate. In other words, the model suggests the very aggressive monetary policy reaction implemented by the ECB implemented to be justified by economic conditions.

Phase 3 (May 2023 – March 2024): the last hiking mile

In the third phase, monetary policy acted more forcefully than the model predicted. During this phase, interest rate hikes became more gradual and then paused in September 2023. Still, monetary policy was tighter than expected by the model (in line with the Taylor rule

estimates in figure 1). At the same time inflation decreased, consistently and slightly faster than the model expectations (top right panel of figure 3). The persistent and forceful response of monetary policy to inflation contributed to a faster return of inflation towards target (red bars in bottom right panel of figure 3).

In summary, while monetary policy initially contributed positively to the inflation surge, it subsequently offset this with a strong tightening response as justified by the economic conditions or even stronger. The comparison of the actual policy rate with a set of Taylor rules in section 2.1 suggests that the former was initially lagging the latter, but then caught up with a fast pace of rate hikes and paused at a slightly tighter stance than prescribed by the Taylor rules in the later phase of the inflation cycle. This qualitative comparison is in line with the decomposition from the BVAR model introduced in section 2.2, showing that monetary policy initially had a positive contribution to inflation, was broadly appropriate in the second phase, and contributed negatively in the third phase. Overall, the peak contribution of monetary policy has been 1 percentage point – out of the 8 percentage point rise in inflation above target – and the forceful catching up has caused the positive contribution of monetary policy to be fully offset by the end of 2023 (see Appendix figure A.1).

3 The monetary policy response and transmission process

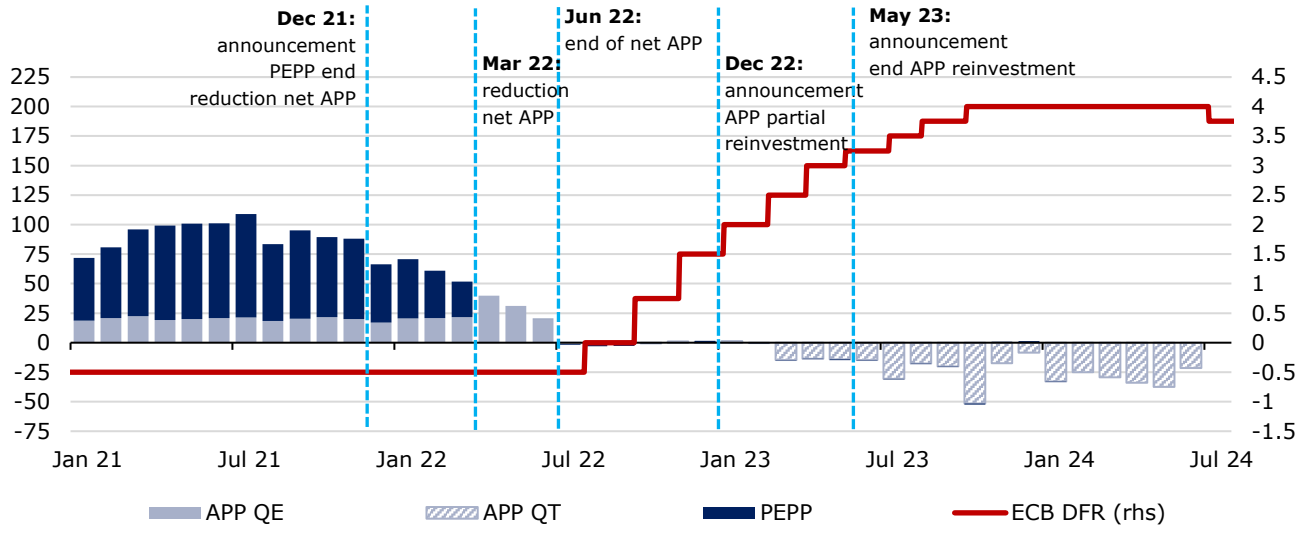
The previous chapter explained the role of monetary policy in the inflation surge through a macro-lens. But how does monetary tightening contribute to lower inflation? In this chapter, we retrace the transmission of the ECB's tightening moves over the recent cycle, through financial conditions to the real economy.

3.1 Start of the hiking cycle

Following the announcement of a gradual wind-down of asset purchases in December 2021, markets started to anticipate further tightening. The first significant step in the tightening process was the conclusion of net purchases under the PEPP in March 2022 (figure 4). After the end of the PEPP, the ECB continued to taper its purchases under its 'regular' asset purchase programme (APP), culminating in the end of net purchases in June 2022 and clearing the way for the first rate hike in July. The market had already started to anticipate this shift in policy as early as December 2021, as reflected in the upward movement of the €STR forward curve – the benchmark for key overnight lending in the euro area. As market participants priced in the expected start of policy normalization, they effectively induced a tightening impulse even before the actual rate hikes were implemented. This pre-emptive market adjustment helped to smoothen the transition to a higher interest rate environment.

4. Purchase programmes and policy rate

Monthly net purchases, billion euros; percentages



Source: DNB calculations.

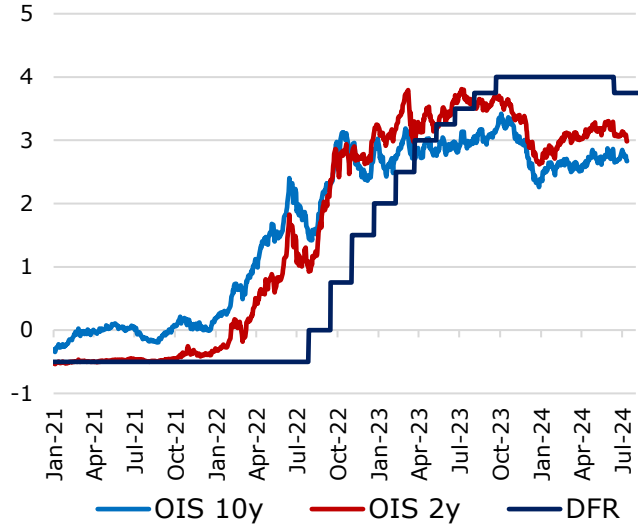
The anticipation and subsequent implementation of the ECB's policy normalization had a pronounced impact on both short-term and long-term risk-free interest rates. The expected increases in short-term rates were largely driven by nearby rate decisions and market expectations thereof. However, the policy normalization also exerted upward pressure on longer-term interest rates, influenced by the reduction of asset purchase (Lane, 2019) (figure 5). This

shift was evident in the steadily increasing borrowing costs for governments within the euro area, as reflected in higher yields on government bonds. The rise in these borrowing costs signaled a broader tightening of financial conditions, affecting various sectors of the economy (see below). This tightening of financial conditions was further amplified by spillovers from tightening monetary policy abroad, most notably from the US.

The rate adjustments initiated by the ECB in July 2022 are notable for their speed and scale, distinguishing the current cycle from past tightening cycles (figure 6). The ECB raised its policy rate in substantial, back-to-back increments from -0.5% to 4% in a relatively short period. This rapid increase was unprecedented in the history of the euro area and was driven by two main factors: the exceptionally low level of interest rates from which the ECB was departing, against, more recently, the background of the Covid-19 shock, and the significant inflationary pressures facing the economy.

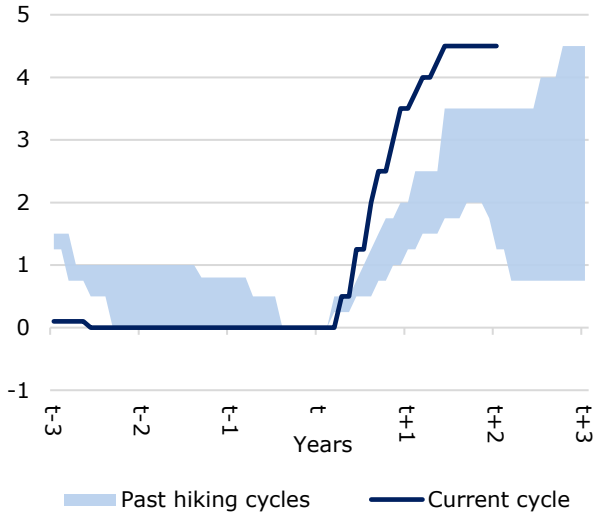
5. Risk-free rates

Percentages



6. Policy rate cycle comparison

Cumulative changes in percentage points



Source: LSEG, ECB

3.2 Transmission to broader financial conditions

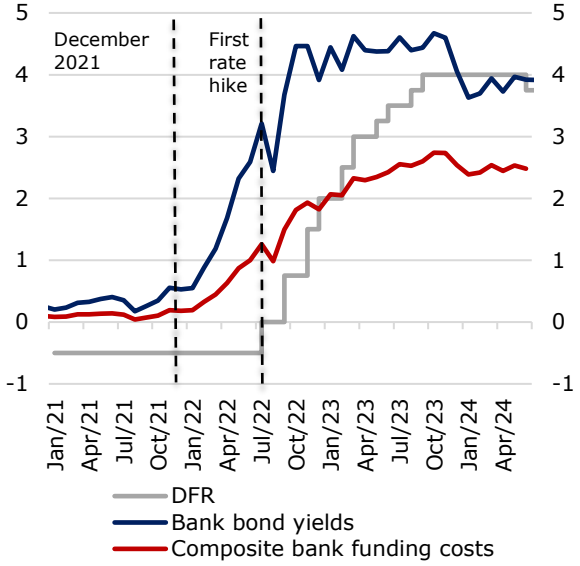
The rise in risk-free rates first led to an increase in bank funding costs and longer-term loan rates in the beginning of 2022. The increase in longer-term risk free rates (figure 5) raised bank bond yields, pushing up composite bank funding costs making it more expensive for banks to fund their portfolio (figure 7). This, in turn, also raised longer-term loan rates for households and NFCs, such as fixed rate mortgages, even before the ECB implemented its first policy rate hike (figure 8).

Shorter-term loan rates started to rise subsequently. Short-term loan rates are largely determined by money market developments and therefore closely linked to the ECB's policy rate

(Lane, 2022). Whereas interest rates on loans with a longer maturity started to rise from the beginning of 2022, rates on shorter-term loans only followed a few months later, and only really picked up pace when the ECB raised the policy rate for the first time in July 2022 (figure 8). The total pass through from the DFR to short-term rates is currently almost 90%, while it is roughly 60% for longer-term rates, similar to previous hiking cycles.

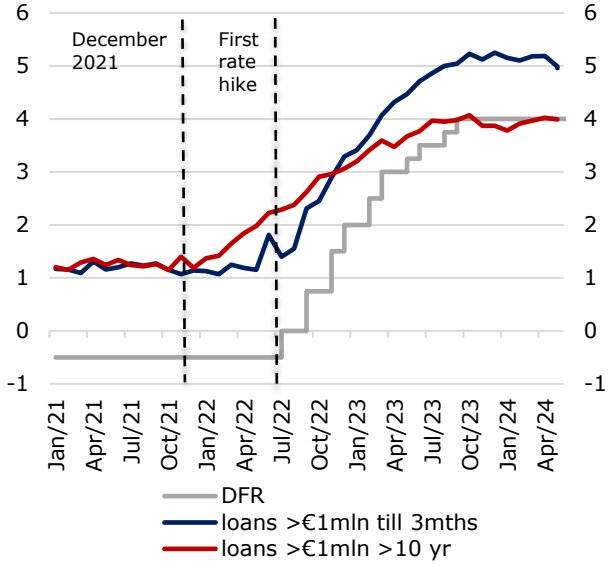
7. Bank funding costs

Percentages, monthly



8. Average cost of borrowing NFCs

Percentages, monthly



Source: MFI-mir data, new business

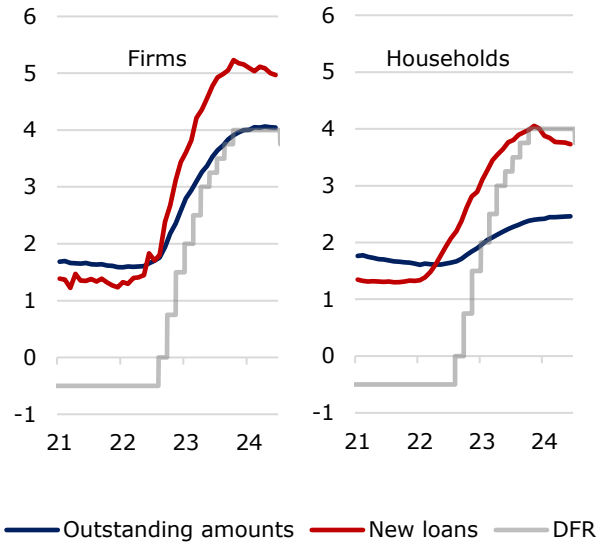
Not everyone felt the impact of tighter financial conditions at the same time. Most household and business loans have rates that are fixed for a certain period. This means that the average interest rate on all existing loans is rising relatively slowly, because only new loans carry higher rates (figure 9). Interest rates on loans that have longer fixed-term periods will not go up until their reset date. The share of households and NFC loans that have fixed interest rates differs across euro area countries. For example, mortgages in the Netherlands largely have a fixed interest rate for 5 to 10 years or even longer, while these are mostly variable in Finland (EMF, 2024). Because of this, the speed of transmission of monetary policy to the real economy can differ across countries (Gilbert et al., 2023).

The tightening of monetary policy did not lead to fragmentation across countries. After the ECB announced at its June 2022 meeting that it would start hiking in July, interest rates for both firms and sovereigns rose more sharply in high-debt countries than in low-debt ones (DNB, 2022). When this happens orderly and reflects fundamentals, it does not hinder monetary policy transmission. Disorderly overshooting of market rates would however limit the ECB's control over financing conditions. To avoid differences in financing conditions not driven by fundamentals, and to ensure that the tightened monetary policy stance would be transmitted smoothly across all euro area countries, the ECB therefore introduced the Transmission

Protection Instrument (TPI) in July 2022. The TPI allows the ECB to purchase sovereign bonds issued by countries which face sharp interest rate movements that are not justified given their economic fundamentals and that jeopardise monetary transmission (ECB, 2022). Interest rate differentials have not been problematic for the monetary transmission during the remainder of the hiking cycle, and the TPI has thus far not been used.

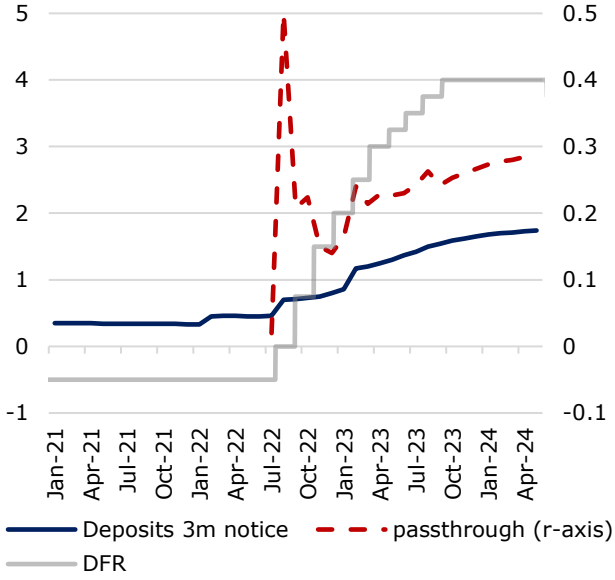
9. Interest rate on bank loans to NFCs and households

Percentage



10. Transmission to savings rates

Percentage



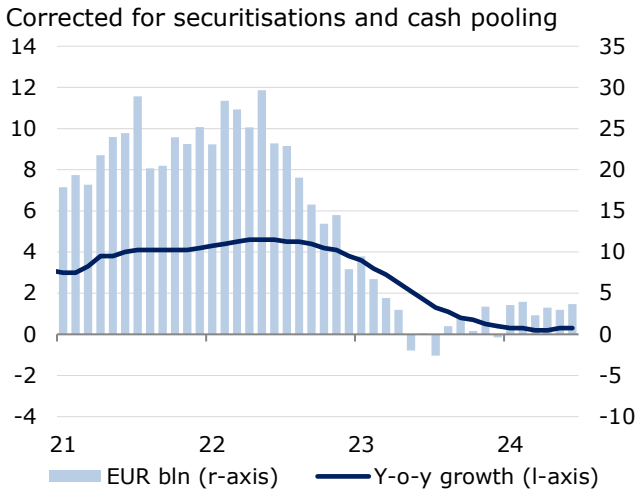
Source: MIR data

Interest rates on deposits rise slower than lending rates. Banks can only charge higher interest rates on new loans or variable rate loans, while existing fixed-rate loans remain unchanged. A rise in interest rates therefore only partially affects banks' loan portfolios and thus their interest income. In contrast, deposits tend to have variable interest rates. A higher interest rate on deposits therefore directly affects (nearly) all deposits and thus banks' funding costs. Banks are faced with a trade-off between raising rates on savings immediately when the policy rate rises, which erodes interest margins, or deferring rate hikes, which may cause customers to shop around and potentially withdraw their deposits (Drechsler et al, 2017). Many banks tend to raise their deposit rates later than their lending rates. However, the first interest rate hike was an exception as this hike meant an end to the negative policy rate, and many banks quickly passed this rate increases on to customers previously holding saving accounts with negative interest rates (figure 10). Afterwards the saving rate rose steadily and the pass through from the DFR to saving rates stood at 28% in May 2024, comparable with previous cycles (Van der Heijden et al., 2023).

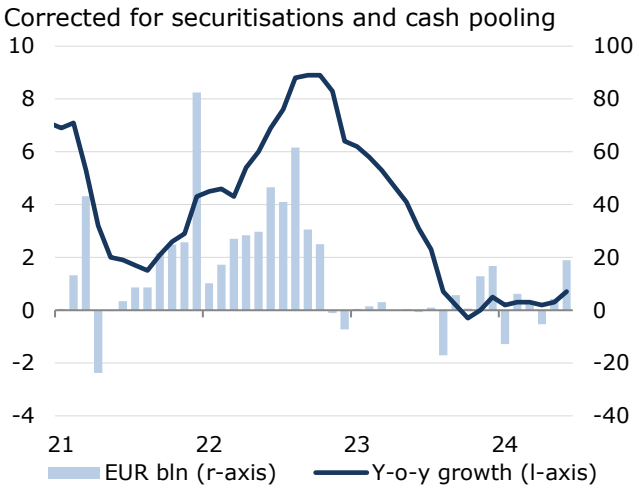
3.3 Transmission to the real economy

As financial conditions tightened, bank credit growth to households and firms started to decline in the course of 2022. Until mid-2022, household credit volumes grew at an annual rate of around 4%. However, after the first rate hike the growth rate gradually declined and stabilized just above 0% in early 2024 (figure 11). As household credit mainly consists of mortgage loans, this also had a large impact on housing markets. House prices in the euro area started to decline (year-on-year) in 2023 for the first time since 2013. For firms, the fall in credit growth was even more pronounced, from a peak of over 8% year-on-year in mid-2022 to around 0% one and half years later (figure 12). Unlike the US where capital markets are more developed, firms in the euro area are highly dependent on bank financing (Altavilla et al., 2019) which makes bank credit an important channel of monetary transmission.

11. Credit to households



12. Credit to firms

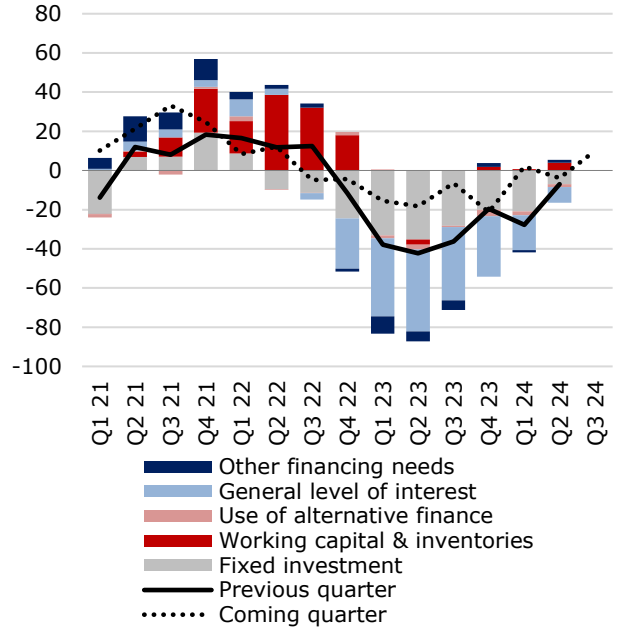


Source: ECB

The slowdown in credit growth to households and firms can be attributed to both supply and demand factors. The quarterly Bank Lending Survey (BLS) provides information on credit standards and demand based on questionnaires to banks (see Köhler-Ulbrich et al., 2016 for an extensive description of the BLS). BLS results indicate that perceived credit demand by firms fell significantly starting in the course of 2022, with the general level of interest and lower investment needs reported as main factors (figure 13). For households (not shown in the figure) a similar decline in credit demand occurred, with the interest rate level, consumer confidence and housing market prospects reported as main drivers. A decrease in credit demand following higher interest rates is a direct result of tighter monetary policy. However, the effects of tighter monetary policy can also be amplified through the banking sector, on top of the direct effect of higher interest rates (Lane, 2023). For example, following monetary tightening banks might face higher funding costs or be less willing to lend in the face of a weaker economic environment and higher credit risk. This is consistent with the BLS pointing to a tightening of credit standards once monetary policy started to tighten. Increased risk perceptions and decreased risk tolerance were reported as main drivers (figure 14).

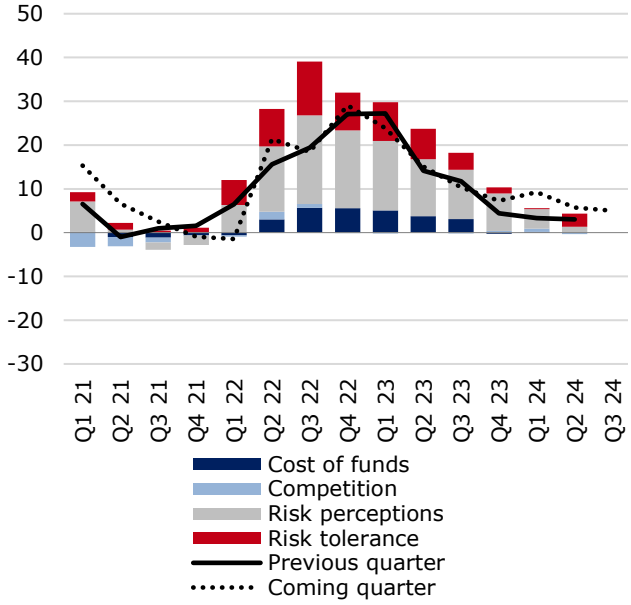
13. Credit demand (firms)

Net percentage of banks reporting an increase in demand



14. Credit standards (loans to firms)

Net percentage of banks reporting a tightening of standards

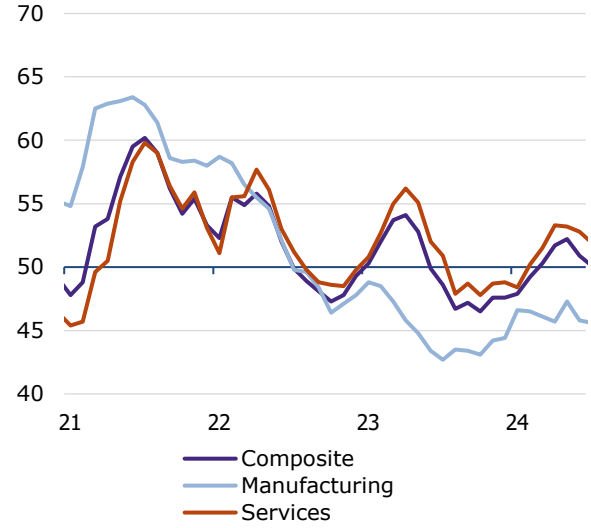


Source: ECB, Bank Lending Survey

Soft and hard indicators recorded a decline in economic activity as the tightening cycle proceeded. Following a strong economic recovery after the COVID-pandemic economic sentiment worsened (figure 15). This was particularly the case in the manufacturing sector, which is more sensitive to interest rate changes (see for example Hauptmeier and Holm-Hadulla, 2023), among other things likely due to higher capital needs. GDP growth fell back to below potential and hovered around 0% for around a year (2022Q4-2024Q4; figure 16). As a result, the output gap turned negative in the euro area, meaning that economic activity had fallen below its "potential" or equilibrium level. Ultimately, weak demand should result in producers lowering their prices, which is the last step in the transmission process from tighter monetary policy to lower inflation.

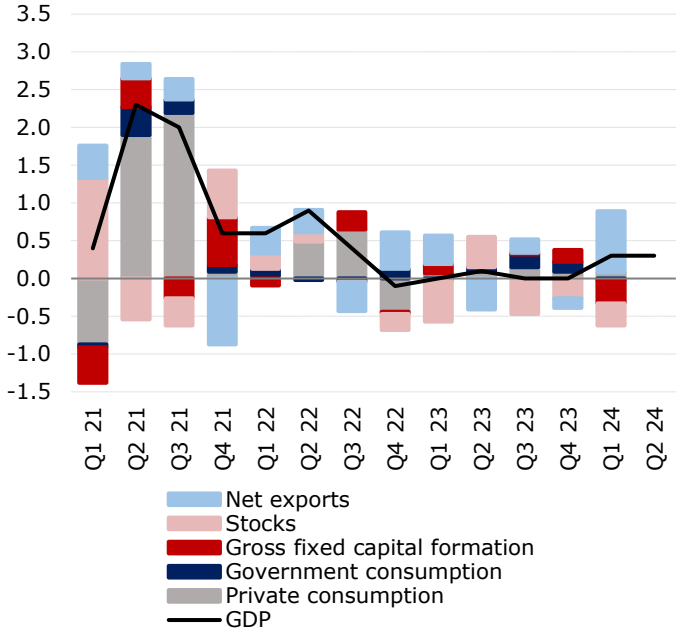
15. Purchasing managers index

Euro area, monthly, balance = 50 points



16. Decline in GDP growth

Percent q-o-q and contributions



Source: S&P Global (PMI), Eurostat (GDP growth

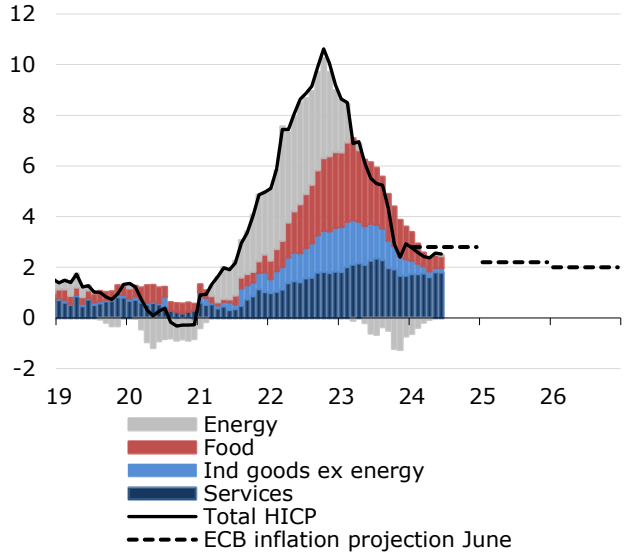
4 The slowdown in inflation

The euro area HICP inflation peak was reached in October 2022 at 10.6%. Extremely high energy prices, in Europe especially for natural gas, were an important force behind this high inflation (figure 17). But also inflation for services, industrial goods and food was high due to supply chain problems, high prices for inputs such as energy and strong demand. Late 2022, inflation in the euro area started to come down.

A key contribution of monetary policy was to keep longer-term inflation expectations for the euro area broadly anchored during the inflation surge. While actual HICP-inflation in the euro area increased from around 2% mid-2021 to above 10% in the second half of 2022, inflation expectations for longer horizons remained close to 2% (figure 18). Inflation expectations shape the behaviour of households and businesses (Visco, 2023) and ensuring that expectations are well-anchored is crucial for central banks to maintain price stability. The fact that long-term inflation expectations stayed firmly anchored, indicates that participants in financial markets and professional forecasters remained confident that inflation would return to around 2% in the medium term. By contrast, there is some evidence that households' inflation expectations have become less firmly anchored during the high-inflation episode (Galati et al, 2022), though also household expectations have started to decline again.

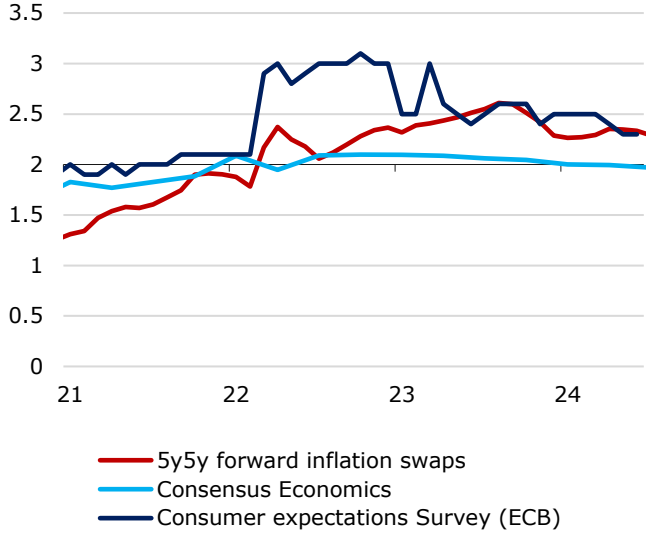
17. Composition of HICP-inflation

Percent and contributions



18. Long-term inflation expectations

Percent



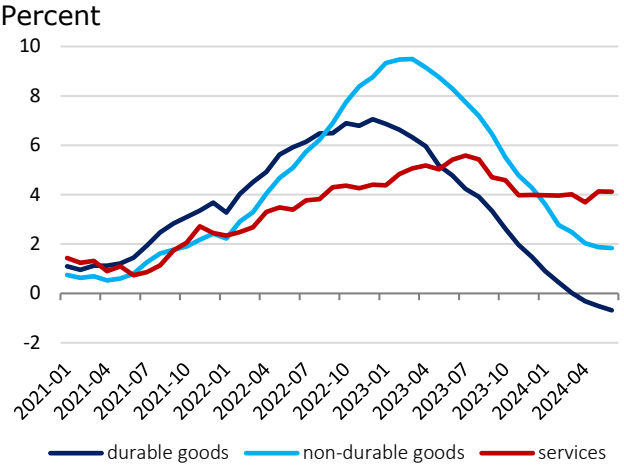
Source: Eurostat; ECB, Consensus Economics, Reuters.

In the course of 2023 inflation fell rapidly due to falling energy prices and the impact of tightened monetary policy. From 2023Q2 onwards, inflation for industrial goods and food fell as supply chains normalized, lower energy prices were passed through and aggregate demand cooled, helped by higher interest rates. The decline in inflation for durable goods like furniture, electronics and cars started relatively early in January 2023 and was relatively steep (figure 19). Durable consumption goods, and especially cars, are regularly financed through

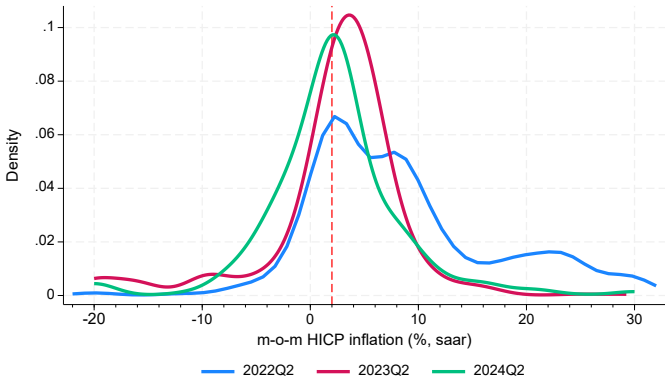
consumer credit and therefore particularly sensitive to financial conditions (see Casalis and Krustev, 2022). Services inflation proved to be stickier and only fell below 5% after the summer of 2023. Since September 2023, services inflation has hovered around 4%. Persistence in services inflation is partly the result of slower adjustment of services prices but is also supported by increasing nominal wages that are catching up with past inflation.

The distribution of month-on-month price changes of all 283 items in the HICP consumption basket illustrates the process of inflation normalization (figure 20). In 2022Q2, 26% of the consumption basket had an inflation rate above 10%. These were mainly food and energy items. As figure 20 shows, inflation was very dispersed with, besides the high-inflation items, many items in services still with an inflation rate of around 3%. This is an indication of strong relative price changes with food and energy becoming more expensive relative to services. By 2023Q2 the distribution had become far more symmetric, with only around 5% of items experiencing price increases above 10%. Falling energy prices are responsible for the fat tail at the left-hand side of the 23Q2 distribution, while high services inflation (median 4.4%) keeps total HICP-inflation on the high side. In 2024Q2, the whole distribution of annualized monthly price changes has shifted to the left, quite symmetrically around the 2% target and with median inflation at 2.4%.

19. Sectoral inflation dynamics



20. Distribution of price changes



Source: Eurostat, DNB calculations.

Wages only reacted sluggishly to increased inflation and are expected to catch up with past inflation in the next quarters. By the end of 2022 negotiated wages in the euro area were around 3% higher compared to one year earlier, while consumer prices had increased by around 10%. As a result, real wages fell significantly in 2022 and a large part of 2023. In 2023Q4, real wages started recovering when inflation fell below 3% while wages increased by more than 4%. This catching up of wages with past inflation is likely to continue over the next few quarters while higher wages will be partly absorbed by lower profit margins. Once real

wages have recovered and profit margins have normalised, nominal wage growth is expected to fall again to a level that is consistent with the ECB's 2% inflation target.

After three years of above-target inflation, restored price stability is now in sight. The latest projections for the euro area, published in June 2024, show inflation returning to target by the end of 2025. As revisions to earlier projections have been quite small recently, confidence has increased that by the end of 2025 inflation will be around 2%. Over the past two and a half years, monetary policy has contributed to lower inflation by tightening financial conditions to cool aggregate demand and keep inflation expectations anchored, while a severe recession has been avoided. Of the main inflation components, services inflation is the one that remains stubbornly high, partly due to solid wage growth supported by a strong labour market. Forward-looking wage indicators show some moderation in wage growth in the course of 2024. Moreover, lower profit margins for firms and higher productivity absorb some of the wage growth and thereby contribute to price stability. The ECB will carefully monitor the evolution of wages, profits and productivity going forward.

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Appendix - The monthly Bayesian VAR

5.1 The model

We specify a VAR at monthly frequency for 4 variables: HICP inflation, output, the 2 year overnight index swap, and HICP energy inflation. The VAR is essentially the same as in Ascari et al. (2023), with a difference: we use an interpolated monthly measure of GDP, instead of the industrial production index, as the output variable. Inspired by Villani (2009), the VAR is expressed in deviations from a long-run equilibrium. We assume that the equilibrium values are constant steady states for the inflation and the interest rate series, and a linear trend for GDP.

5.2 Estimation

The sample goes from January 2001 until March 2024. As in Ascari et al. (2023), we estimate the model using Bayesian methods, specifying a Minnesota type prior for the coefficients of the lags with hyperparameters equal to 0.2 for the overall tightness, 1 for the cross-variable tightness and lag length decay. The prior for the variance covariance matrix is uninformative, and the shocks are set-identified imposing zero and sign restrictions using the method by Arias et. al (2018). "The prior distributions for the constant steady states are centered around the respective sample mean, with the exception of the inflation rate for which we use a tight prior around the 2% target. Finaly, the parameters of the linear trend have a prior distribution centered around the OLS estimate of a linear trend in a simple univariate model."

5.3 Identification

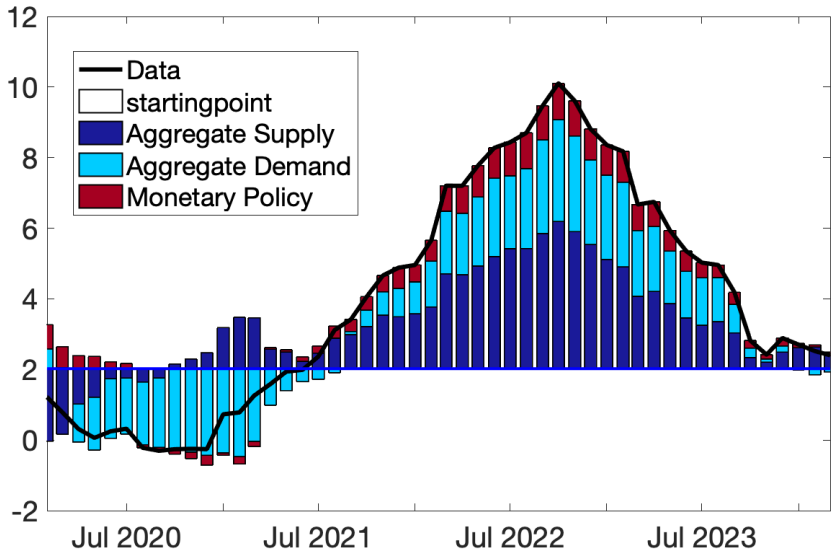
The combination of zero and sign restrictions reported in Table A1 allows to identify 4 shocks. All restrictions are imposed on impact.

Table A1: Identification restrictions

	AD	MP	AS	
	Shock 1	**Shock 2**	**Shock 3**	**Shock 4**
HICP	+	+	+	+
GDP	+	+	-	-
Interest rate	+	-		
HICP energy		0	0	+

Shock 1 moves output, inflation and the interest rate in the same direction, so it can be interpreted as a demand factor. Shock 2 moves inflation and output in the same direction, but the interest rate in the opposite one, so it is interpreted as a monetary policy shock. Shock 3 and Shock 4 move output and inflation in opposite directions, so they represent supply disturbances. The zero restriction on the impact of Shock 3 to HICP energy is originally imposed by Ascari et al (2023) to isolate an energy cost push shock. In the current analysis we are not directly interested in this distinction, so we group together the two shocks under the common label: "Aggregate Supply".

Figure A.1: Historical decomposition of headline annual inflation



Source: DNB calculations.