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1 Introduction

This report focuses on the implications of the changed inflation environment for the ECB's monetary policy strategy, including the lessons learned from both the low inflation and high inflation periods, and the transition from one to the other. The starting point of the report is the outcome of the Monetary Policy Strategy Review 2020-21. While the previous review was conducted in an economic environment of low inflation, with interest rates in proximity to the effective lower bound (ELB), the inflation surge that followed the COVID-19 pandemic underscores the importance of a monetary policy strategy that enables the Governing Council to effectively respond to major changes in the inflation environment.

The report contains five chapters. **Chapter 2** assesses the ECB's experience with its evolving monetary policy toolkit. The chapter starts with an overview of the policy decisions taken since the last strategy review and assesses the monetary policy stance during that period, together with its impact on inflation. In a second part, the chapter evaluates the effectiveness, transmission and side effects of stance-oriented and transmission-geared monetary policy tools. It discusses the effectiveness of tools at the ELB and during the inflation surge, highlighting trade-offs between flexibility and commitment, and between the intensity of use of a single tool versus a mix of tools. It analyses side effects, including those on central bank profitability and on banks and non-bank financial institutions, and discusses proportionality considerations and the secondary objective. A third part assesses the role of interest rates as the primary tool during the inflation surge.

Chapter 3 investigates issues regarding the ECB's reaction function. The first part analyses the operationalisation of the medium-term orientation of the strategy. It reassesses the case for looking through supply shocks and identifies factors supporting or weakening the case for looking through such shocks. The second part analyses the role of asymmetries in the reaction function. It also analyses under which conditions policy needs to be forceful or persistent. The analysis reassesses the case for especially forceful or persistent policy action when the economy is close to the ELB, as was the case at the time of the monetary policy strategy review 2020-21. The chapter then discusses the case for similarly forceful or persistent action also in response to large, sustained upside deviations of inflation from target, such as those experienced during the recent inflation surge.

Chapter 4 examines how to better deal with risk and uncertainty in policy-setting. It considers different sources of uncertainty and how policy should react to them. Furthermore, it discusses how to operationalise the integration of uncertainty considerations in monetary policy preparation, e.g. through the use of alternative scenarios in addition to the projection baseline, as well as the evaluation of alternative monetary policy paths under such alternative scenarios.

Chapter 5 focuses on monetary policy communication. It discusses the benefits of simple strategies in communicating to the public and the communication challenges related to the complexity of the monetary policy toolkit. It also analyses the specific

communication during the inflation surge and, more specifically, the “three-element” reaction function stressed in communication after March 2023. The chapter closes with an evaluation of outreach initiatives undertaken by the Eurosystem since the last strategy review.

2 Experience with the monetary policy toolkit during the pandemic easing cycle and post-pandemic inflation surge

2.1 Monetary policy during the pandemic easing cycle and the post-pandemic inflation surge

2.1.1 Track evolution of monetary policy over the full cycle

This section summarises the monetary policy decisions taken since the conclusion of the ECB's Monetary Policy Strategy Review 2020-21 (see Table 1 for an overview).[1,2] At the time of the 2020-21 review, monetary policy was highly accommodative and the instruments in use included, among other measures, asset purchases (through the asset purchase programme – APP – and the pandemic emergency purchase programme – PEPP), targeted longer-term refinancing operations (TLTROs), negative rates (negative interest rate policy – NIRP) and forward guidance.[3]

In autumn 2021 the ECB initiated the process of monetary policy normalisation. In September 2021, based on an assessment of still favourable financing conditions, a slight upward revision to the inflation outlook and concerns that price pressures could become more persistent should supply bottlenecks be prolonged, the Governing Council decided to moderate the pace of net purchases under the PEPP. In December 2021 the Governing Council announced that net asset purchases under the PEPP would be discontinued at the end of March 2022, while net purchases under the APP would be temporarily stepped up in the second and third quarters of 2022 to ensure that the monetary policy stance remained consistent with inflation stabilising at its target over the medium term. At the same time, it extended the PEPP reinvestment horizon until at least the end of 2024. The Governing Council also highlighted its commitment to flexibility in the implementation

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1 An earlier version of **Table 1**, with information up to December 2023, was featured in Lane (2024a).

2 During this period there were also several supervisory and macroprudential actions. For example, in June 2021 the ECB extended the leverage ratio relief for banks until the end of March 2022 (see the 18 June 2021 press release). In February 2022 the ECB decided not to extend capital relief beyond December 2022 (see the 10 February 2022 press release). From late 2021-2022 onwards, several authorities started gradually tightening capital and/or borrower-based macroprudential measures to bolster bank resilience, address relevant vulnerabilities and ensure sound lending standards in mortgage markets (see the 2 November 2022 and 28 June 2024 Governing Council Statements on macroprudential policies).

3 In July 2021 the Governing Council revised its forward guidance on interest rates to say: "In support of its symmetric two per cent inflation target and in line with its monetary policy strategy, the Governing Council expects the key ECB interest rates to remain at their present or lower levels until it sees inflation reaching two per cent well ahead of the end of its projection horizon and durably for the rest of the projection horizon, and it judges that realised progress in underlying inflation is sufficiently advanced to be consistent with inflation stabilising at two per cent over the medium term. This may also imply a transitory period in which inflation is moderately above target" (see the 22 July 2021 Monetary Policy Decisions).

of monetary policy whenever threats to monetary policy transmission might jeopardise the attainment of price stability. This included the flexible adjustment of PEPP reinvestments over time and across asset classes and jurisdictions in the event of renewed market fragmentation related to the pandemic. Finally, the Governing Council confirmed that it expected the special conditions applicable under the third series of targeted longer-term refinancing operations (TLTRO III) to end in June 2022.

Following the Russian invasion of Ukraine, the resulting surge in energy prices and the increasing persistence of inflationary pressures, the ECB continued to normalise its balance sheet over the course of 2022. In March 2022 the Governing Council announced a reduction in the pace of APP purchases and its expectation to conclude them in the third quarter. This was confirmed at the Governing Council's June 2022 monetary policy meeting and net purchases under the APP ended on 1 July 2022. In response to elevated market volatility and evidence for an uneven transmission of the normalisation of monetary policy across jurisdictions, the Governing Council decided on 15 June 2022 to accelerate the completion of the design of a new anti-fragmentation tool and to apply flexibility in reinvesting redemptions coming due in the PEPP portfolio to preserve the functioning of the monetary policy transmission mechanism. In July 2022 the Governing Council approved the transmission protection instrument (TPI) as a backstop to support the effective transmission of monetary policy in case of unwarranted, disorderly market dynamics.[4] In December 2022, the Governing Council decided that the Eurosystem would only reinvest part of the redemptions under the APP from March 2023 onwards, as a gradual and predictable step towards balance sheet normalisation, while the policy rates were intended to be the active marginal instrument determining the monetary policy stance (Lane, 2024a).

During the second half of 2022 the Governing Council raised the key ECB interest rates in large steps, in light of elevated inflationary pressures. In June 2022, the Governing Council assessed that the rate "lift-off" criteria under its forward guidance had been met and signalled its intention to start raising the key ECB interest rates in July and its expectation to raise them again in September. At the same time, it highlighted "data dependence" to inform its assessment.[5] Owing to further inflation surprises, the interest rate path previously outlined was revised in July 2022, with a first rate hike of 50 basis points and the decision to switch to a "meeting-by-meeting approach to interest rate decisions".[6] Following continuous upward revisions to the inflation outlook throughout the autumn, the Governing Council raised the key ECB interest rates by a cumulative 200 basis points over the last three meetings of 2022. In March 2022, the Governing Council also announced that, from July 2022, it would begin phasing out the collateral easing measures

4 See the 15 June 2022 and 21 July 2022 press releases.

5 See the 9 June 2022 Monetary Policy Decisions.

6 See the 21 July 2022 Monetary Policy Decisions.

established at the onset of the pandemic.[7] In October 2022, the ECB recalibrated the terms and conditions of TLTRO III to reinforce the transmission of policy rates to bank lending conditions.

In 2023 the Governing Council raised interest rates into restrictive territory and pledged to keeping them at sufficiently restrictive levels for as long as necessary to ensure a timely return of inflation to its 2% medium-term target. In February and March 2023, the Governing Council decided to raise the key policy rates by 50 basis points. In addition, in March 2023 it clarified that, as part of the data-dependent approach, its decisions would be determined by its assessment of three key elements: the inflation outlook in light of the incoming economic and financial data, the dynamics of underlying inflation and the strength of monetary policy transmission. The Governing Council subsequently hiked interest rates by 25 basis points at the next four meetings, initially maintaining the pledge that interest rates would be "brought to levels sufficiently restrictive to achieve a timely return of inflation to the 2% medium-term target and will be kept at those levels for as long as necessary".[8] It also announced in May 2023 its expectation to discontinue reinvestments under the APP, starting in July 2023.[9] In September 2023 the Governing Council delivered its last rate hike in the tightening cycle and assessed that "the key ECB interest rates have reached levels that, maintained for a sufficiently long duration, will make a substantial contribution to the timely return of inflation to the target".[10] In December 2023 it announced its intention to fully reinvest repayments from maturing securities under the PEPP in the first half of 2024 and subsequently reduce the PEPP portfolio by €7.5 billion on average over the second half of the year, with net reinvestments to cease at the end of 2024.[11]

After maintaining policy rates constant for nine months, and given the progress made since September 2023 in bringing down inflation, the Governing Council decided to start reducing the degree of policy restriction in June 2024.[12] The updated assessment of the inflation outlook, the dynamics of underlying inflation and the strength of monetary policy transmission supported the decision to reduce the degree of restriction. Interest rates were lowered again by 25 basis points in September, October and December 2024.[13] In light of the significant progress made in the disinflation process, communication was adapted at the

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7 The package of temporary easing measures included a temporary increase in the Eurosystem's risk tolerance, an easing of the conditions for the use of credit claims as collateral, a general reduction of collateral valuation haircuts, a waiver to accept Greek sovereign debt instruments as collateral in Eurosystem credit operations and steps to mitigate the impact of possible rating downgrades on collateral availability. For details, see the 7 April 2020 and 22 April 2020 press releases. For the timeline of the phasing out of these measures, see the 24 March 2022 press release.

8 See the 4 May 2023 Monetary Policy Decisions and the 15 June 2023 Monetary Policy Decisions.

9 This was confirmed at the June 2023 meeting.

10 See the 14 September 2023 Monetary Policy Decisions.

11 These decisions were reconfirmed at the June 2024 and December 2024 meetings respectively.

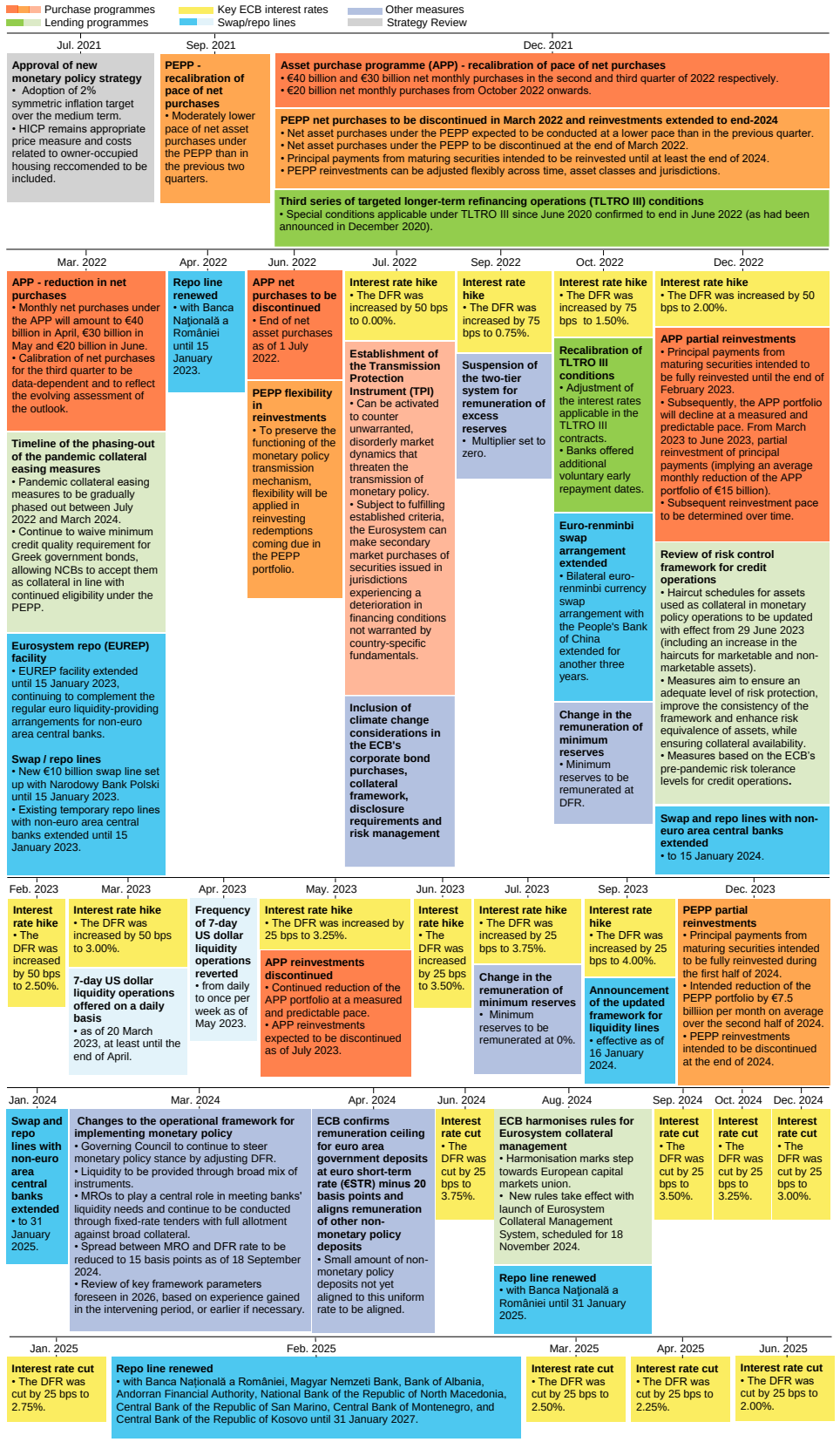
12 In April 2024 the Governing Council announced that the key ECB interest rates had reached levels that were making a substantial contribution to the ongoing disinflation process and signalled the possibility of a less restrictive stance if warranted by the assessment of the three key elements of its reaction function.

13 At the September meeting, the spread between the DFR and the rate on the main refinancing operation (MRO) was also set to 15 basis points, as pre-announced in March 2024 as part of changes to the operational framework for implementing monetary policy. It was also clarified that the DFR is the rate through which the Governing Council steers the monetary policy stance.

December meeting, replacing the pledge to keep a sufficiently restrictive stance to ensure a timely return of inflation to target with a pledge to set an appropriate stance to ensure that inflation stabilised sustainably at target. Interest rates were further lowered by 25 basis points in January, March, April, and June 2025, respectively.

Table 1

ECB monetary policy and other measures since July 2021



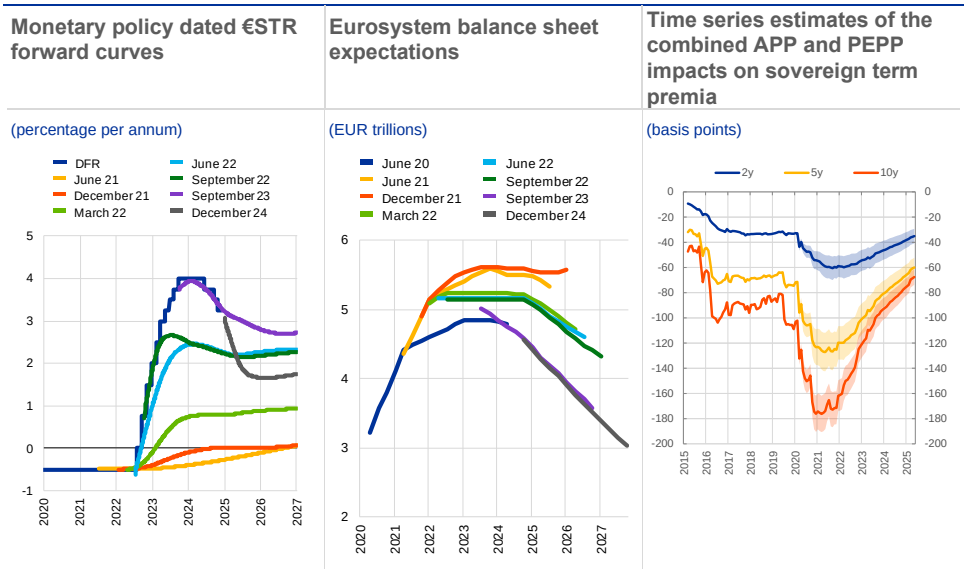
Source: ECB.

2.1.2 Assessment of the stance over the full cycle

Following a long period of rates at the ELB and large-scale asset purchases (LSAPs), the ECB started normalising its balance sheet policies in December 2021. In December 2021 market expectations were for rate lift-off – measured as a 10 basis point increase in the deposit facility rate (DFR) – to occur in late 2022, with rates expected to exceed zero only in late 2024 (**Chart 1**, left panel). At the time, the median respondent in the Survey of Monetary Analysts (SMA) expected rate lift-off to occur in December 2023 and net purchases under the APP to continue until mid-2023 (**Chart 1**, middle panel).[14] As inflation surged, expectations for policy rate tightening shifted rapidly, with a major upward shift in the forward curve already occurring before the first rate hike in July 2022. Similarly, balance sheet expectations over the longer term adjusted rapidly downwards, with about half the adjustment taking place by the first rate hike despite the commitment to continue reinvestments for an extended period. While still substantial, a quarter of the sovereign term premium compression was unwound during 2022, in particular because of the lower duration extraction expected over the longer term (**Chart 1**, right panel).

Chart 1

Evolution of market and survey-based policy expectations, and estimated APP/PEPP impact on sovereign term premia



Sources: Bloomberg, Survey of Monetary Analysts (SMA), Eser et al. (2023).
Notes: Left panel: the dark blue line represents realised values for the DFR. The cut-off dates for the data used for the €STR forward curves are based on the following dates: 10 June 2021 (June 21), 23 November 2021 (December 21), 28 February 2022 (March 22), 17 May 2022 (June 22), 22 August 2022 (September 22), 5 September 2023 (September 23) and 3 December 2024 (December 24) with data being adjusted for the DFR space by applying a spread of 8 basis points. Middle panel: median SMA expectations for APP and PEPP holdings in the survey vintages. Right panel: impact is derived on the basis of an arbitrage-free affine model of the term structure with a quantity factor (see Eser et al. 2023) – upper range of areas/smaller impact estimates – and an alternative version of the model recalibrated so that the model-implied yield reactions to the March PEPP announcement match the two-day yield changes observed after 18 March – lower range of areas/greater impact estimates. The model results are derived using GDP-weighted averages of the zero-coupon yields of the "big four" sovereign issuers (Germany, France, Italy and Spain). The latest observation is for May 2025.

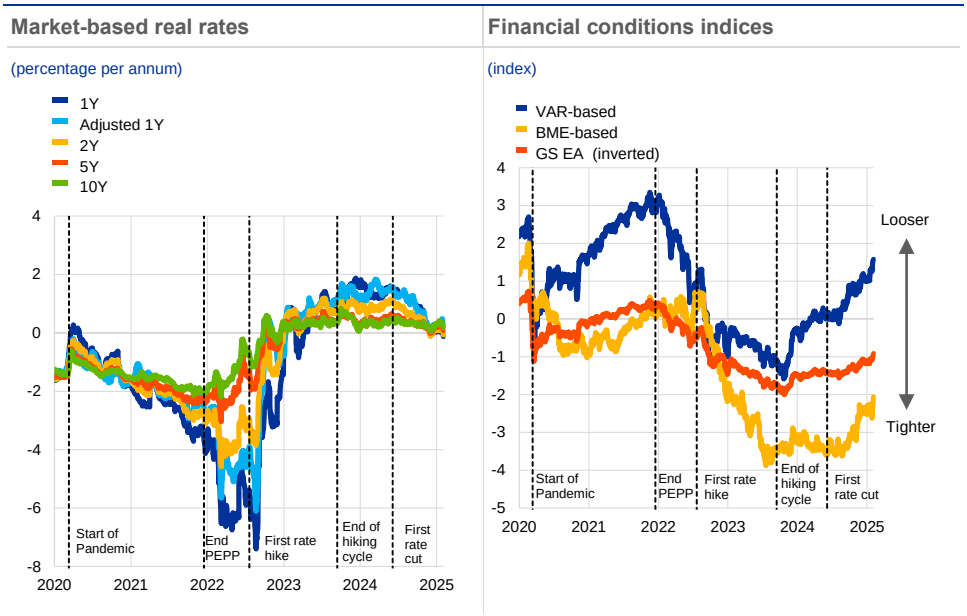
Short-term real rates shifted up after rate lift-off in summer 2022. Real interest rates across short, medium, and long maturities were negative before the inflation

[14] In December 2021 the median SMA respondent anticipated that inflation would return to 2.4% in the third quarter of 2022 and then fall below the target to 1.4% in the following quarter.

surge (**Chart 2**, left panel). Long-term real rates rose swiftly as the market priced in expectations for a change in policy stance in response to inflation, while short-term real rates declined until the rate lift-off. From late 2022 onwards, real rates turned positive. This timing aligns with the Governing Council's statement in October 2022, noting that it had made substantial progress in withdrawing monetary policy accommodation and later stating that policy had moved to a restrictive stance by the end of the year. As policy normalisation progressed, financial conditions, which had eased on account of the policy response to the pandemic, tightened considerably, primarily reflecting movements in short-term rates (**Chart 2**, right panel).

Chart 2

Evolution of real rates and financial condition indices



Sources: Bloomberg, Refinitiv, Bernardini et al. (2024) and ECB calculations
Notes: Left panel: The blue, yellow, red, and green lines represent real interest rate calculated by subtracting the inflation-linked swap rates from the nominal overnight interest swap (OIS) rates for 1-year, 2-year, 5-year, and 10-year maturities, respectively. The cyan line represents the 1-year real interest rate, calculated using Inflation Fixing Swaps, as described by Bernardini et al. (2024), accounting for the strong bias introduced by the lagged indexation of ILS during the post-pandemic period. The latest observation is for 3 February 2025. Right panel: The VAR- and BME-based FCIs are constructed as weighted averages of the OIS 1Y, OIS 10Y, euro NEER-38 and EuroStoxx Index. The VAR-based weights are derived from the impulse response of HICP inflation to a shock in each of the four variables gleaned from individual VAR models. The weights for the BME-based FCI are derived from the Basic Model Elasticities (BMEs). GS stands for Goldman Sachs. The event lines correspond to the following: the start of the COVID-19 pandemic as declared by the WHO; the December 2021 monetary policy statement announcing the end of net asset purchases under the PEPP in March 2022; the announcement of the first rate hike in July 2022; the announcement of the final rate hike in September 2023; and the announcement of the first rate cut in June 2024. The latest observation is for 3 February 2025.

2.1.3 The empirical assessment of monetary policy contributions to inflation over the full cycle

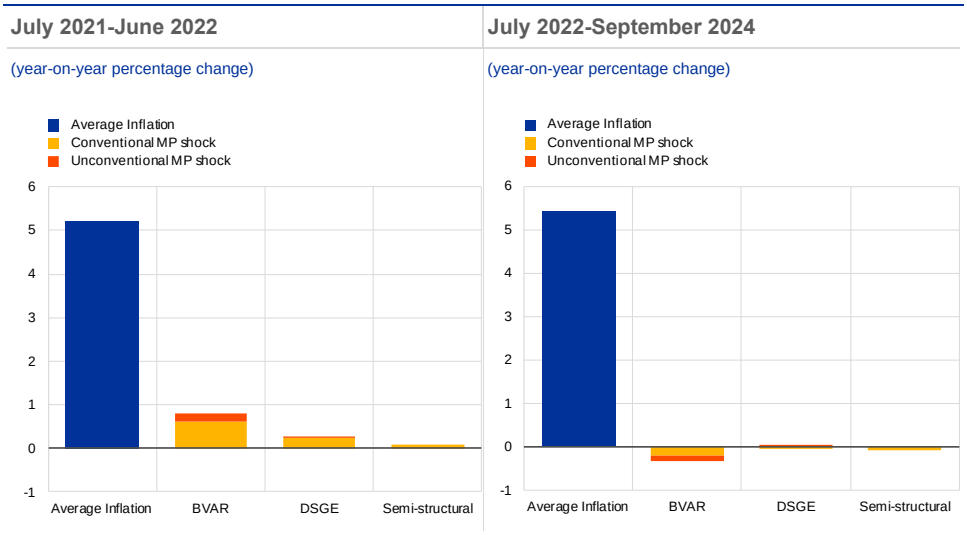
The ECB's monetary policy has broadly followed historical regularities in the period since the conclusion of the 2020-21 monetary policy strategy review.

The overall impact of monetary policy on inflation and the real economy is a sum of two parts: (i) monetary policy shocks and (ii) the systematic component of monetary policy. Monetary policy shocks in isolation cannot be used to infer the impact of policy on inflation, but they can be used to assess whether policy has followed

historical regularities.[15] The contribution of monetary policy shocks to inflation is positive when monetary policy is more accommodative than based on historical regularities and negative when policy is more restrictive**.** According to a set of ECB and national central bank (NCB) models, the contribution of monetary policy shocks to inflation at the end of the ELB period was positive on average, suggesting that policy was somewhat more accomodative than if it had followed historical regularities. However, the contribution of monetary policy shocks to the inflation surge is small in comparison with the contribution of other shocks analysed in Section 2.2 of the Workstream 1 report (European Central Bank (2025b)) and in relation to average inflation developments (**Chart 3**, left panel). The contribution of monetary policy shocks to inflation between July 2021 and June 2022 ranges between 0.1 and 0.8 percentage points across models, averaging around 0.3 percentage points. Following the start of the rate hiking cycle, the contribution from monetary policy shocks to inflation, turned mildly negative, implying that policy was tightened somewhat more than historical regularities would have suggested (**Chart 3**, right panel). All in all, this evidence suggests that the shock component of monetary policy did not play a major role and policy broadly followed historical regularities over the cycle.

Chart 3

Contribution of monetary policy shocks to inflation before and after the first rate increase



Sources: Calculations based on BVAR models: Bonomolo et al. (2024), Kataryniuk et al. (forthcoming), Barauskaite Griskeviciene et al. (forthcoming); DSGE models: MMR model (Mazelis et al., 2023), NAWM II model (Coenen et al., 2018); Semi-structural model: the ECB-BASE model (Angelini et al., 2019).
Notes: The charts show the mean of estimates from a range of studies mentioned above. Average inflation is the mean of inflation over the specified periods. The contributions of monetary policy shocks are derived from the historical decompositions of HICP inflation and reflect the average impact over the specified periods.

Overall, monetary policy tightening exerted significant downward pressure on inflation during the inflation surge period. The total impact of monetary policy tightening, which includes both the impact of monetary policy shocks and the systematic response, is assessed using a range of ECB and NCB macroeconomic

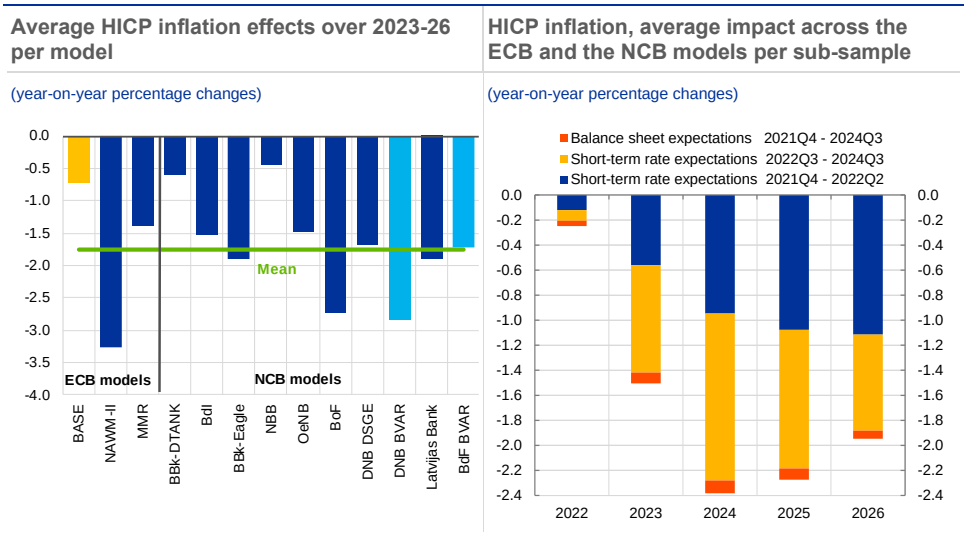
[15] Historical regularities refer to the established empirical relationships – often captured by estimated policy rules or reaction functions – that describe how monetary policy has systematically responded to economic developments over time, as identified through historical data and econometric models.

models. Utilising a set of models provides robustness given uncertainties surrounding transmission channels and lags. The analysis shows that the total impact of policy tightening since December 2021, accounting for both interest rate and balance sheet policies, has been both large and negative on inflation. Compared with a no-policy tightening counterfactual, the tightening lowered inflation by around 1.7 percentage points per year, on average, across models over the period 2023-26 (**Chart 4**, left panel). The NCB models fall broadly within the range spanned by the ECB models (ECB BASE, NAWM II and MMR), suggesting that the range of ECB models regularly used in policy preparation adequately captures model uncertainty. Importantly, around half of the impact of monetary policy tightening on inflation was due to the expected shift in stance before the lift-off occurred (**Chart 4**, right panel, blue portion of bars). This is because monetary policy works through the whole forward curve, and the substantial shift in market expectations before the first rate hike (**Chart 1**, left panel) helped subsequently to bring inflation down. By contrast, meeting-to-meeting changes in the policy rate are less consequential when they are well-anticipated and do not send signals that lead to significant changes in the forward curve. Balance sheet policies made some, but quantitatively less important, contributions to the disinflation process, in line with the primacy of the policy rates as a major adjustment lever away from the ELB (**Chart 4**, right panel, red portion of bars) and the relatively limited decline in the volume of securities held for monetary policy purposes between the end of 2021 and the third quarter of 2024.[16]

[16] The impact of policy tightening also depends on the way expectations are modelled. The assumed expectation formation mechanism in different models influences the effects of monetary policy on inflation and output. Semi-structural models, like the ECB-BASE, have backward-looking expectations, which means that households and firms do not adjust their expectations of future policy and do not take it into account in their decision-making ex ante. This implies slower transmission and smaller effects on inflation and the real economy. In contrast, agents in DSGE models, like the MMR and NAWM models, adjust their pricing, consumption and production decisions based on how they expect policy to evolve in the future. As a result, the impact of policies – actual and expected – on inflation and the real economy occurs earlier than in backward-looking models. The VAR models in the sample, the DNB and BdF BVARs, have a fairly large impact on inflation, in line with the DSGE models. Also, DSGE models tend to have stronger transmission mechanisms, resulting in larger effects on inflation. BBk-DTANK (Gerke et al., 2022), NBB (Rannenberg, 2024) and MMR models all have mechanisms to mitigate the forward guidance puzzle, and the effects in all models are computed using unexpected shocks only.

Chart 4

Impact of monetary policy tightening on inflation according to a suite of models



Sources: Calculations based on the NAWM II model (Coenen et al., 2018), the MMR model (Mazelis et al., 2023) with the exercises documented in the Handbook on Inflation (Coenen et al., 2025), the ECB-BASE model (Angelini, et al., 2019), for Bundesbank, Gerke et al. (2022) and an extension of Gomes et al. (2012); for Banca d'Italia, Burlon, et al. (2015); for National Bank of Belgium, Rannenberg (2024); for Bank of Finland, Kortelainen (2024); for De Nederlandsche Bank DSGE, Ascari et al. (forthcoming), while for BVAR an extension of Bonomolo et al. (2024); for Latvijas Banka, Bušs and Grüning (2023), for Banque de France, Lhuissier (2025).
Notes: The left panel reports the results of a counterfactual simulation involving changes to short-term rate expectations between December 2021 and September 2024 and changes to expectations regarding the ECB's balance sheet between October 2021 (to account for anticipation) and September 2024. The yellow bar refers to a semi-structural model, the blue bars to DSGE models, and light blue bar to VAR models. For technical details of the analysis, see Darracq Paries et al. (2023). The right panel shows the same exercise but conducted in two phases, i.e. it assesses the impact of change in policy rate expectations before the rate lift-off (blue), and after the rate lift-off (yellow). The average impact across the three ECB and nine NCB models for each year plotted with the blue area reflecting the impact on inflation from changes in rate expectations between December 2021 and June 2022, and the yellow area reflecting the impact from changes in rate expectations between June 2022 and September 2024. The underlying interest rate expectations are computed from MP-dated €STR forward rates on the final cut-off dates of the relevant projections. The models that account for the impact of balance sheet policies are ECB-BASE, NAWM-II, MMR, BBk-DTANK, and BdI.

2.2 Evaluation of balance sheet policies, negative interest rate policy and forward guidance

2.2.1 Evaluation of stance-oriented tools (NIRP, forward guidance, QE/QT and TLTROs)[17]

Several instruments have been designed and deployed to ease the monetary policy stance when policy rates reach the zero level. Each tool (NIRP, forward guidance, asset purchases and TLTROs) has its unique transmission channels and their effects complement one another (Altavilla et al., 2021a). This section updates the assessment of the Monetary Policy Strategy Review 2020-21 in relation to the instruments' transmission mechanisms and their effectiveness on the basis of more recent experience and new evidence; their side effects are discussed in **Section 2.2.3**.

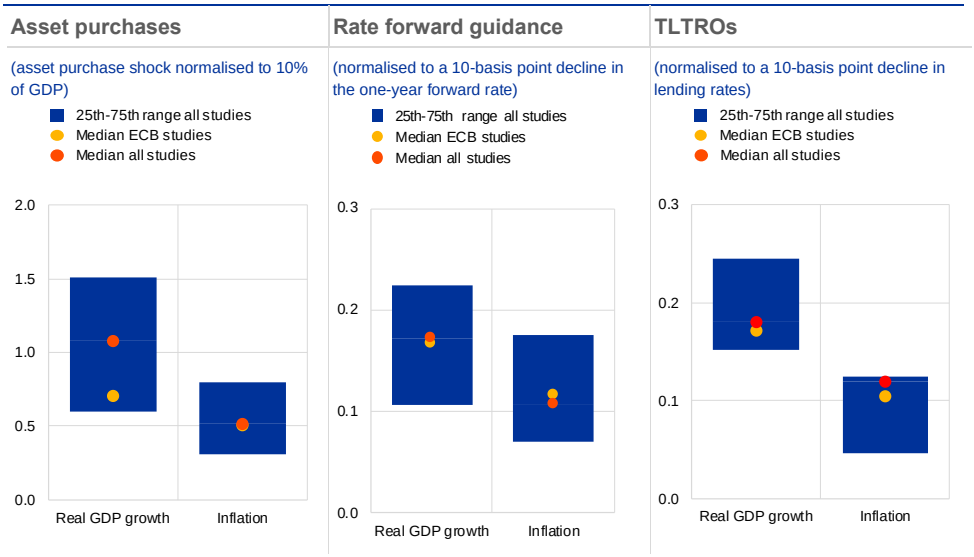
Overall, the judgement that instruments are powerful in easing financial conditions and boosting growth and inflation when interest rates reach the

[17] This section abstracts from both structural portfolios and lending operations linked to the Operational Framework Review conclusions announced in March 2024.

zero level has not changed. An updated meta study confirms the effectiveness of asset purchases, rate forward guidance and TLTROs in boosting inflation and GDP growth (**Chart 5**). Studies accounting for more recent evidence do not point to either a stronger or weaker effect of the various instruments on the macroeconomy. In particular, the instruments appear to have also remained effective during the pandemic-related easing phase, as confirmed by newer evidence about additional state-dependent effects of certain tools.

Chart 5

Estimated impact of the ECB's monetary policy measures on euro area inflation and growth – a meta-analysis among ECB and NCB researchers



Sources : Andrade et al. (2016), Burlon et al. (2015), Cova et al. (2019), Gambetti and Musso (2017), Gerke et al. (2018), Haldane et al. (2016), Hohberger et al. (2019), Kühl (2018), Mouabbi and Sahuc (2019), Nelimarkka and Kortela (2020), Pascual and Wieladek (2016), Sahuc (2016), Rostagno et al (2021b), Mandler and Scharnagl (2020, 2022), Goodhead (2024), Bartocci et al. (2024), Laine and Nelimarkka (2021, 2023), ECB and ECB calculations.
Notes: Horizons of cumulated macroeconomic effects differ across studies, ranging from 1 to several years.
Panel a) The chart shows the median and 25th-75th interquartile range of estimates from a range of studies mentioned above, as well as the range of ECB and NCB estimates comprising the Eurosystem staff assessment based on a suite of structural and time series models, the extended New Area-Wide Model (NAWM-II), the ECB-BASE model and the assessment documented in Rostagno et al. (2021b). The estimate refers to the cumulative impact on euro area inflation and real GDP growth of an increase in the stock of asset purchases normalised to 10% of euro area GDP.
Panel b) The chart shows the median and 25th-75th interquartile range of estimates from a range of studies mentioned above and a range of models developed by the Eurosystem FORE Taskforce (ECB Occasional Paper Series, 2021), comprising time series models and structural models, as well as the range of ECB staff estimates. The estimate refers to the cumulated impact on euro area inflation and real GDP growth of a forward guidance shock normalised to a 10-basis point decline in the one-year forward rate.
Panel c) The chart shows the median and 25th-75th interquartile range of estimates from a range of studies mentioned above and a range of ECB models, including the following six models: (1) Christiano, Motto and Rostagno (2010, 2014); (2) Altavilla at al. (2020); (3) Darracq-Pariès and De Santis (2015); (4) a medium-scale Bayesian vector autoregression (BVAR) model for the euro area; (5) the NAWM-II; and (6) the ECB-BASE. The impact on inflation and real GDP growth refers to the cumulative impact over the simulation horizon from a 10 basis point decline in bank lending rates.

Negative interest rate policy (NIRP)

The NIRP conducted by the Governing Council continued to be effective, including through synergies with other instruments in the toolkit. Signalling was a key transmission channel of negative interest rates: beyond merely shifting down the forward curve of overnight rates, negative rates also introduced downside risk around the central rate path (Rostagno et al., 2025b), thereby (increasingly) pushing out the maturities beyond which positive rates prevailed (Czudaj, 2020; and Carboni et al., 2020). This, together with the easing bias in the rate forward guidance

("rates to remain at their present or lower levels"), facilitated a temporary inversion of the term structure in negative territory, e.g. in the course of 2019 and 2020. The risk-taking and portfolio rebalancing channels also remained prominent. NIRP encouraged banks and the non-bank financial intermediation (NBFI) sector to shift towards riskier assets or expand credit supply to preserve profitability (Bottero et al., 2022; and Bubeck et al., 2020), thereby reducing risk premia in a range of financial asset prices (Carboni et al., 2020).[18] In addition, Altavilla et al. (2022) show that non-financial corporations with significant bank deposits tend to invest more to reduce the costs of negative deposit rates, further stimulating economic activity. Finally, balance sheet policies complement NIRP by generating large amounts of excess liquidity. Banks more exposed to negative rates (by holding more excess liquidity "remunerated" at a negative DFR) are found to expand credit more, ceteris paribus (Demiralp et al., 2021), before the introduction of the two-tier system for remunerating excess reserve holdings. Tiering, together with the reduction in funding costs provided by TLTRO III (see also **Section 2.2.3**), partly countered banks' profitability challenges arising from negative rates.

The de facto floor for retail deposit rates might hamper the effect of NIRP relative to positive rate policies. The de facto zero floor of retail deposits raises the average funding rate of banks with high reliance on retail deposit funding to commensurately higher rates than for banks with predominantly wholesale funding (Demiralp et al., 2021). As a result, banks that relied heavily on household deposits partly extended negative rates to larger retail deposits (Michaelis, 2023; and Ulbing, 2024). However, such practices were outlawed in some jurisdictions following customer protection initiatives. Money market fund shares, as well as stablecoins, provide at least partial protection against negative deposit rates, which explains why the correlation between policy rates and money market fund inflows turned negative during NIRP times (Cipriani et al., 2024), possibly hampering the stance impact of NIRP at the margin. Finally, tiering can, in principle, mute the stance effects of NIRP by lessening pass-through to retail deposit rates and reducing the pressure on banks to search for yield. There is some evidence of these effects in other jurisdictions, such as Switzerland (Basten and Mariathasan, 2023; and Fuster et al., 2024), but such effects did not seem to be evident in the euro area, where the two-tier system successfully supported the bank-based transmission of monetary policy during the NIRP period (Boucinha et al., 2022).

Evidence suggests that the euro area did not reach the "reversal rate" during the ELB period. The reversal rate is the theoretical rate at which further rate cuts would become contractionary for lending because of their impact on banks' profit margins (Brunnermeier and Koby, 2018; Abadi et al., 2023; and Repullo, 2020). Various studies provide empirical evidence for the existence of a reversal rate and/or imperfect pass-through of rate cuts to lending rates at the micro-level, and across different regions and types of lending. In particular, banks with a combination of thin capital, high reliance on deposit funding and high pricing power did not fully pass on rate cuts to depositors or cut lending at the onset of NIRP (Fungáčová et al., 2023; van den End et al., 2021; Basten and Mariathasan, 2023; Eggertsson et al., 2024;

[18] This also created undesired side effects for banks and non-bank financial institutions, which are described in detail in **Section 2.2.3.**

and Arce et al., 2023). In line with this, Laine and Pihlajamaa (2024) find reduced effects of rate policies in negative territory on inflation. Yet, there is substantial evidence from a range of jurisdictions, including other currency areas, indicating that a broader transmission of NIRP remained effective at the macro level amid increased lending volumes and stable bank profits (Brandão-Marques et al., 2021; and Ulate, 2021). NIRP was particularly effective in regions where banks were able to offset the pressure on net interest margins by introducing fees on deposit accounts or via capital gains (Brandão-Marques et al., 2021). Likewise, Rostagno et al. (2021a) find no evidence of a reversal rate being binding for overnight rates as low as -1% for well-capitalised banks, which continued to increase lending and shift their loan books towards riskier loans.

Forward guidance

Time-based forward guidance, as used by the ECB in 2018, can be effective in easing the stance at the ELB. The ECB used *time-based* (or date/calendar-based) rate forward guidance in June 2018 to avoid speculation about an earlier lift-off of rates after announcing a tapering of asset purchases under the APP. Time-based guidance helped ease the stance at the ELB by aligning market expectations with the intentions of the Governing Council, thereby compressing benchmark rates at short to medium tenors, as well as shielding them from macroeconomic news (Altavilla et al., 2021a; Zlobins, 2022; Ehrmann et al., 2019; and Coenen et al., 2023). The easing effect of forward guidance is commensurate with the distance to the rate lift-off date expected by markets. This makes time-based forward guidance a potent tool in stable economic environments. By actively steering market expectations for the lift-off date, time-based forward guidance was potent in easing the policy stance through the Governing Council's sequencing commitments (Goodhead, 2024). However, time-based forward guidance is, by nature, inflexible with regard to unexpected changes in the inflation environment.

State-based forward guidance allows for more flexibility to react to changing macroeconomic circumstances at the cost of effectiveness (see Section 3.2). In contrast to *time-based* forward guidance, *state-based* (or data-based) guidance allows the monetary policy reaction function more flexibility to react to changing macroeconomic circumstances, as it comes with a less binding commitment and leaves rate lift-off criteria usually with some room for interpretation. As a result, *state-based* guidance is less effective in anchoring market expectations at a specific rate path. For instance, at the end of easing phases, the market may overreact to macroeconomic news, bringing forward the expected rate lift-off date, which may imply an unwelcome tightening of monetary policy. In the other direction, Carvalho et al. (2025) argue that, if state-based forward guidance came with such strong conditions that forward policy rates remained anchored at low levels for too prolonged a period, there could be a risk that this policy might destabilise inflation expectations.

A sequencing between time-based asset purchase guidance and state-based interest rate guidance, while increasing the latter's effectiveness at the ELB,

can come at a significant cost if circumstances change. Sequencing asset purchases and interest rate policies can further strengthen the overall easing effect by enhancing the commitment to policy intentions. For instance, it can support an existing forward guidance formulation (like the Governing Council's formulation from July 2021) in reducing uncertainty about the rate lift-off date. Yet, a consensus has emerged in the literature that sequencing makes monetary policy inherently time inconsistent and overly rigid, increasing the risk of delaying the normalisation of the stance when macroeconomic conditions change (RBA, 2022; English and Sack, 2024; Eggertsson and Kohn, 2023; Cieslak, 2024; Gopinath, 2023; Orphanides, 2023). Delaying normalisation would also lead to more forceful rate hikes than would have been required without the delay (Adrian et al., 2024). Similarly, English et al. (2024) argue that central banks without such sequencing commitments in place found it easier to hike rates earlier.

The July 2021 formulation of state-based forward guidance made the rate lift-off criteria more stringent, contributing to a further easing of the policy stance. The July 2021 rate forward guidance formulation was state-based and linked rate lift-off to (i) projected inflation reaching 2% well ahead of the end of the projection horizon and durably for the rest of the projection horizon; and (ii) progress in underlying inflation being sufficiently advanced to be consistent with inflation stabilising at 2% over the medium term. Thereby, it provided more stringent conditions for lift-off than its previous formulation (see **Section 2.1.1**), in particular in view of its outlook-based criteria. The additional condition was effective in aligning market expectations with the Governing Council's commitment to look through a transitory upside deviation of inflation from target. This was evidenced by an initial shifting out of the market-implied lift-off date by more than one year – from late 2023 to mid-2025. The new forward guidance formulation was reinforced by the existing pledge to continue net asset purchases of €20 billion per month under the APP and to raise rates only after the conclusion of net purchases (sequencing commitment). While the sequencing in its original form subordinated asset purchase guidance to rate forward guidance, the December 2021 Governing Council provided an extended schedule of net asset purchases. These were envisaged to stretch at least into the fourth quarter of 2022, with an additional proviso that asset purchases would be concluded before any increase in policy rates, adding a time-based element to the rate lift-off criteria.

Two factors made the ECB's rate forward guidance less flexible. First, the reliance on inflation forecasts over an extended horizon introduced inertia, as the forecasts were slow to adjust to the changing inflation environment. Second, the sequencing with another instrument (quantitative easing, QE) further reduced the agility of monetary policy (see **Section 3.2** for a detailed analysis). While QE guidance in July 2021 was subordinate to rate forward guidance, this changed in December 2021 with the announcement that net asset purchases under the APP would continue beyond October 2022 and "end shortly before [the Governing Council] starts raising the key ECB interest rates", excluding an earlier rate lift-off if the sequencing commitment and the purchase guidance were upheld. Indeed, the median SMA respondent expected lift-off to occur no earlier than December 2022 in the SMA round ahead of the March 2022 meeting, when the asset purchase

guidance was ultimately revised. This revision in purchase guidance, bringing forward the end of APP net asset purchases, paved the way for rate lift-off in July 2022.

With the benefit of hindsight, both these features of the communication around lift-off did not cater sufficiently for an abrupt change in the inflation environment on the scale observed. Any initial delay in policy normalisation was arguably compensated by a more forceful normalisation subsequently, e.g. in the form of an initial 50 basis point hike and two 75 basis point hikes thereafter. Counterfactual analysis by staff also suggests that an earlier rate lift-off (March 2022) and/or an earlier end to net purchases (December 2021) would only have had a small dampening effect on inflation (see **Section 2.3.3**). In addition, a rate lift-off and/or an end to purchases around the time of Russia's invasion of Ukraine might have added to investors' heightened risk aversion, with adverse consequences for wider financial stability (see **Chapter 4**). That said, the perception of a delayed lift-off – also compared with peer central banks – created communication challenges, with some observers seeing the ECB as being behind the curve in spring 2022 (see **Chapter 5**).

Targeted longer-term refinancing operations (TLTROs)

Most studies find that the TLTROs eased broader credit conditions as well as the overall monetary policy stance and supported the smooth transmission of monetary policy during the pandemic. The TLTROs significantly reduced funding costs for euro area banks and encouraged the transmission of these benefits to borrowers, benefiting both participating and non-participating banks. An update of the 2021 meta-analysis with more recent evidence confirms the robustness of the empirical results on TLTROs supporting lending to non-financial corporations (Altavilla et al., 2021a; Altavilla et al., 2023a; Andreeva and García-Posada, 2021). At the same time, a few papers suggest that these operations did not stimulate lending to the private sector, even if they did improve banks' liquidity positions. The drawback was that some riskier banks became reliant on central bank funding (Sigmund et al., 2024; and Afonso and Ferreira, 2024) or increased their exposure to sovereign bonds through carry trades, increasing the sovereign-bank nexus (Carrera de Souza, 2025 mimeo).

The advantageous TLTRO III pricing during the special interest rate period between June 2020 and June 2022 supported the effectiveness of the instrument, with implications for central bank profitability. The pricing of TLTRO III below the DFR supported high participation across jurisdictions and diverse bank characteristics (see **Section 2.2.3**), thus helping to avoid the risk of a credit crunch at a time of exceptional uncertainty. The spillover effects on non-bidding banks

further strengthened the impact of the stance.[19] In addition, the operations supported the smooth transmission of monetary policy by enhancing banks' ability to lower lending rates while maintaining lending margins but without encouraging overly risky lending practices (see **Section 2.2.3**). Moreover, banks secured funding on favourable terms through TLTROs until maturity, alleviating the need to seek alternative funding sources at higher rates or to increase deposit rates to attract or retain deposits. At the same time, the attractive conditions also implied a larger subsidy to banks relative to market pricing, at the expense of the Eurosystem, with the pricing below the DFR reducing monetary income.

While TLTROs provided bank funding cost relief during the easing cycle and did not hamper the transmission to marginal bank funding costs during the tightening cycle, the recalibration of conditions in October 2022 was required to ensure consistency with the broader monetary stance. In July 2022, when the tightening cycle started, the transmission of interest rate hikes to marginal bank funding conditions was not impaired by the stock of outstanding TLTROs, as the marginal funding cost relief was only possible as long as auctions took place (the last auction was allotted in December 2021). The anticipation of the phasing out of TLTRO III, with banks having to plan to access alternative sources of funding, instead contributed to a contained but steady downward pressure on loan supply. However, to ensure consistency with the broader process of monetary policy normalisation, the Governing Council decided to recalibrate the TLTRO III conditions in October 2022 by indexing the interest rates for borrowing to the average key ECB rates from then on, thereby increasing the opportunity cost of TLTRO funding and reducing the TLTRO benefit. This removed deterrents to early repayment of outstanding operations, and the actual voluntary repayments made from November 2022 until mid-2023 re-aligned with expectations for early repayments prior to the inflation spike. Overall, in line with the policy intention when recalibrating, some banks secured additional funding through bond markets and deposits, while a non-negligible part utilised their existing excess liquidity (Barbiero et al., 2025; and Burlon et al., 2025). This ultimately resulted in higher funding costs and reduced liquidity, and led to stricter credit standards and slightly lower lending volumes. Overall, the accelerated exit from the TLTROs was smooth following the recalibration, as banks managed repayments via excess liquidity or by raising funds through bonds and deposits. That said, the amplification from the phasing out of the TLTROs might have been stronger in the absence of a QE-related supply of reserves.

Asset purchases (stance-geared)

Asset purchase programmes contributed to easing the monetary policy stance during the ELB period, specifically by extracting duration risk and other risks from the market. By decreasing the free-float of outstanding public debt in euro

[19] Barbiero et al. (2024) argue that the overall stance impact of the TLTRO III, both direct and indirect, is due to the widespread participation of banks, which in turn is due to the beneficial pricing. Arguably, only after the recalibration announcement on 30 April 2020 of the pricing conditions to DFR minus 50 basis points, on 30 April 2020 did expectations of future TLTRO volume participation jumped, finding substantiation in the June 2020 operation, which turned out to be the largest single liquidity injection in the history of the ECB.

area countries by nearly 20% in ten-year-equivalent terms, the APP was the main driver underlying the reduction in the sovereign term premia[20] from its launch until mid-2019 (**Chart 1**, right panel; **Chart 6**, left panel; and Altavilla et al., 2021a).[21] During the pandemic, the Eurosystem again significantly expanded its footprint in sovereign bond markets. In late 2021, the combined PEPP and APP envelopes reached an expected peak footprint of about 30% of the available duration-equivalent bond supply in the euro area. As a result, the ten-year sovereign term premium was estimated to have been reduced by almost 175 basis points (**Chart 1,** right panel; **Chart 6**, left panel, red portion of bars).[22] Additionally, announcements of both asset purchase programmes, in particular the initial ones, have been found to significantly reduce the perceived deflation risk (Rostagno et al., 2021a; Goy et al., 2024; and Hubert et al., 2024). QE thus supported the anchoring of longer-term inflation expectations during episodes of unanchoring risk. It has been suggested that purchases at the ELB can also work through the signalling channel by shaping the path of expected interest rates, for example because financial markets implicitly assume a sequencing of instruments, in which the central bank first stops asset purchases before raising rates (Bernanke, 2020). While there is evidence of this in the signalling channel in the case of the United States (Bauer and Rudebusch, 2014), Lemke and Werner (2020), and Rostagno et al. (2025b) find limited evidence of rate signalling effects from QE in the euro area.[23]

Corporate bond purchases under both the APP and PEPP eased financing conditions of the non-financial corporate sector. These purchases reduced corporate bond spreads of both eligible and ineligible issuers (Todorov, 2020), induced flows into corporate bond mutual funds (Holm-Hadulla and Lembroni, 2025) and spurred corporate bond issuance (Arce et al., 2021; and De Santis and Zaghini, 2021). Moreover, firms without access to bond-based financing also benefited from private asset purchases, which freed up capacity in banks' balance sheets (Betz and De Santis, 2022), and this positive credit supply shock raised the real investment of these firms. That said, the non-financial private sector financing mix remains tilted towards loan financing and – as private bond markets remain rather narrow in the euro area – stance-geared QE programmes need to target primarily sovereign bond markets.

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20 In this context, we define sovereign term premia as the portion of sovereign bond yields – calculated as a GDP-weighted average across Germany, Spain, France and Italy – that is not related to current or expected short-term rate expectations. For a detailed breakdown of how bond purchases affect rate expectations, term premia (specifically those capturing only duration risk), expected default compensation and credit risk premia, please refer to Costain et al. (2025).

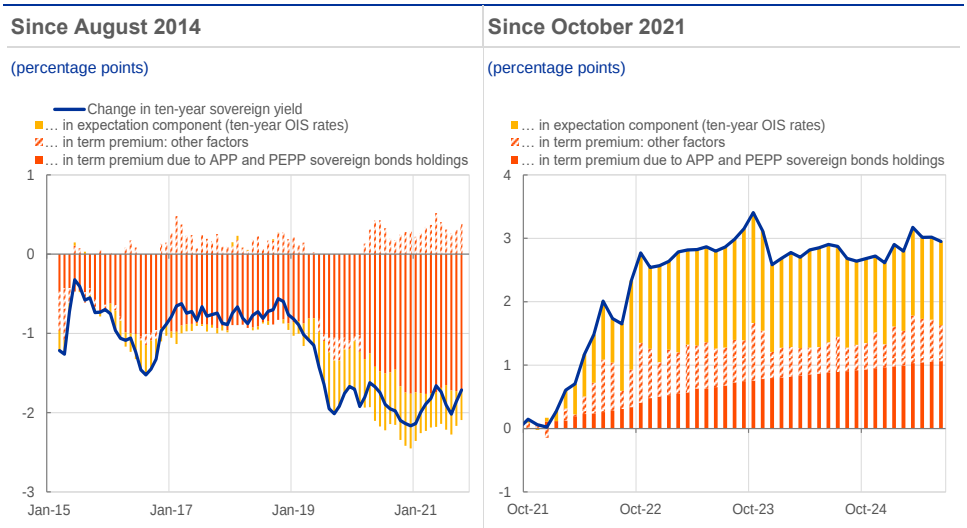
21 Estimates based on Eser et al. (2023) and a version of the model recalibrated to match the sovereign yield reaction to the initial PEPP announcement of March 2020. Underlying yield data are GDP-weighted averages of the zero-coupon yields of the four largest euro area jurisdictions (the "big four" of Germany, France, Italy and Spain) (DE, FR, IT, ES).

22 Estimates account for the larger yield impact of PEPP purchases, reflecting greater market distress and/or the greater flexibility embedded in the PEPP (see **Section 2.2.2**).

23 Considering the signals of asset purchases about the reaction function of the central bank, Hubert et al. (2024) find that market responses to the public sector purchase programme (PSPP) and the PEPP align with the stated objectives of each programme, emphasisingemphasizing the importance of transparent policy communication for effective monetary transmission.

Chart 6

Estimated impact of APP and PEPP sovereign bond holdings on ten-year sovereign yields



Source: Eurosystem staff calculations

Notes: Changes in the 10-year term premium are computed as changes in the ten-year GDP-weighted averages of the zero-coupon yields of the "big four" sovereign issuers (DE, FR, IT, ES) and changes in the average expected path of the risk-free short rates in the euro area based on OIS rates. These OIS rates are decomposed in average rate expectations and term premia based on three affine term structure models. Estimates for the impact of APP and PEPP sovereign bond holdings are based on an arbitrage-free affine model of the term structure with a quantity factor (Eser et al., 2023), estimated on GDP-weighted averages of the zero-coupon yields of the "big four" sovereign issuers. The latest observation is for May 2025.

The impact of asset purchases on yields depends on the prevailing macroeconomic and financial conditions. While duration and credit risk extraction are likely at play in most QE announcements (e.g. Eser et al., 2023; and Costain et al., 2025), overall effectiveness depends on which other channels are more or less active at each point in time. Most prominently, purchases are found to be particularly effective in stressed market conditions with heightened liquidity- and credit risk premia (see **Section 2.2.2** on transmission instruments for more details).[24] The dynamics in the structure of security sellers during the course of the programme – specifically the decreasing relative share of price-sensitive investors – should also alter the price impact of each unit of additional purchases (Anaya Longaric et al., 2023; Breckenfelder and De Falco, 2024; and **Chart 7**, right panel). In this context, Blanchard (2023) argues that the marginal yield effect of purchases increases with the size of central bank holdings, since predominantly price-insensitive investors (such as insurers and pension funds) remain among bond holders later on, and they demand higher prices from the central bank. The marginal effect of QE can also diminish when long-term yields are close to zero or even negative, amid limited scope for rate uncertainty (reflected in contained term premia levels) and limited scope for further rate cuts near the ELB (reflected in the expectation component) (van den End, 2018; Goodhart and Ashworth, 2012; Grande et al., 2019; Hubert et al., 2024), **Chart 7** left panel.[25] All in all, this evidence is inconclusive as to the relative effectiveness of successive deployments of QE in the euro area. While the

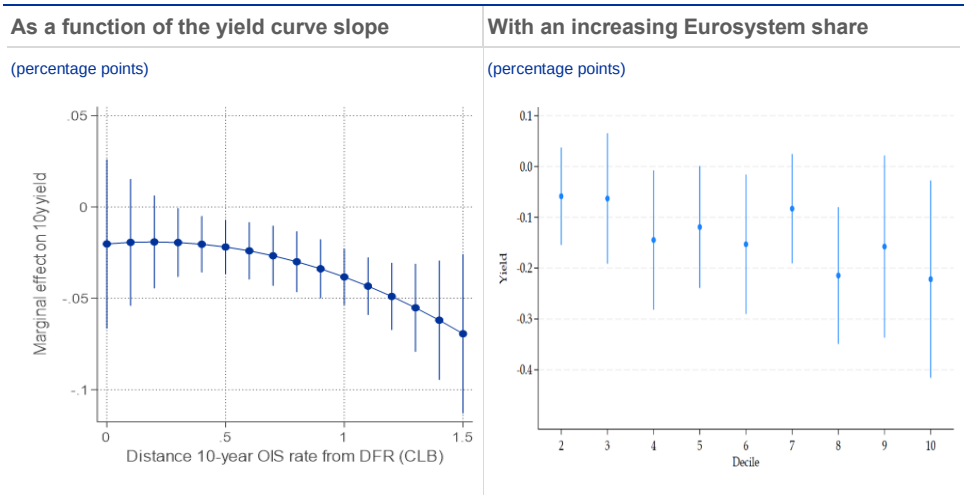
[24] See, for example, Gertler and Karadi (2013), who document that QE1 – the Federal Reserve's initial LSAP programme that was launched in 2008 – had a stronger impact than later programmesprograms, given its timing during the Great Financial Crisis and its inclusion of assets with private payoff risk.

[25] Goodhart and Ashworth (2012) also document diminishing returns in the Bank of England's QE2, as gilt rates had already fallen to historically low levels.

low levels attained by long-term yields after the January 2015 announcement may suggest later APP implementations were less effective, the opposite conclusion would be reached based on the observation that later implementations required sales from more price-insensitive investors. Indeed, Rostagno et al. (2021b) do not detect a statistically significant reduction in APP/PEPP effects over the years. D'Amico and Seida (2024) conclude that there is no state dependence for QE effects in the United States.

Chart 7

State-contingent impact of asset purchases on yields



Sources: Eurosystem staff calculations (right panel) and Breckenfelder and De Falco (2024), (left panel).
Notes: Left panel: Chart shows (y-axis:) the estimated marginal effect of stock and flow measures of asset purchases on 10-year bond yields as a function of (x-axis:) the gap between 10-year OIS rate and the Conditional Lower Bound (approximated by the DFR). The stock measure is defined as the ratio of total expected public sector purchases by the expected end of net asset purchases to total expected outstanding public sector debt, the flow measures is defined as the ratio of realised net purchases of public sector bonds to realised net issuances in month t. Monthly data covering January 2015 - March 2021. Right panel: Securities are sorted into deciles according to the share the ECB holds in the total amount outstanding of that security, with securities in the 1st decile are those the ECB holds least of, while securities in the 10th decile are those the ECB holds most of. Note that the 10th decile is within the maximum holding share set for each security. The relative price impact of ECB purchases on securities from the 2nd to the 10th decile, as compared with the 1st decile.

The effect of asset purchases on inflation may also vary for any given effect of purchases on yields, with evidence pointing to larger macroeconomic effects when the yield curve is steeper. QE may be more effective when financial shocks constrain bank balance sheets but less so in the case of non-financial shocks, even at the lower bound, as the banking channel is weaker (Karadi and Nakov, 2021; and Diamond et al., 2024). Its impact is also greater in deep recessions than in mild downturns, where it may accelerate rate lift-off, weakening its effect on long-term yields, growth and inflation (Adrian et al., 2024; and Gopinath, 2023).[26] A few studies suggest declining macroeconomic effects of monetary policy at low rates, with a steepening investment-saving (IS) curve accompanying a flatter Phillips curve (Ahmed et al., 2024; and van den End et al., 2025). Though not QE-specific, these findings apply to periods when QE was the primary policy tool. By contrast, an active fiscal channel may enhance the effectiveness of QE if the created fiscal space

[26] Considering the signals of asset purchases about the reaction function of the central bank, Hubert et al. (2024) find that market responses to the PSPP and PEPP align with the stated objectives of each programme, emphasising the importance of transparent policy communication for effective monetary transmission.

triggers expansionary fiscal policy during deep recessions, complementing the central bank's action to contain the economic fallout (Hofmann et al., 2021).

Some empirical evidence from other jurisdictions suggests that QE and QT effects might not be symmetric, but this ultimately depends on the strength of the relevant transmission channels and whether QT is active or passive. Asymmetric effects of balance sheet reduction and expansion policies for the same unit of risk may arise if prevailing financial and economic conditions differ. Another potential source of asymmetry between QT and QE impacts may arise from differences in the expected *speed* of changes in the current and future stock of bonds during the roll-down versus build-up phases (see, for example, Arazi, 2025). Specifically, passive QT – the run-off of bonds as they expire – has a more gradual impact, which makes the impact appear smaller than the impact of QE or of active QT, which involves sales of securities. Looking at a number of jurisdictions – including the United Kingdom, where active QT was deemed necessary to accelerate the decompression of the free float in light of the very long average maturity of the Bank of England's holdings and the gilt market in general – Du et al. (2024) document that active QT has a larger impact at longer-end maturities, matched by a stronger steepening of the yield curve than passive QT. At the same time, QT might have relatively smaller effects if the signalling channel is muted, i.e. if QT is not used to signal "higher rates for longer" in the same way as QE signalled "low for long" rates, and this is more likely to be the case when QT is active (see Du et al., 2024).

The Eurosystem's balance sheet reduction has proceeded passively, gradually and predictably, with empirical evidence thus far pointing to the overall impact of QT having been symmetric in the euro area. As of December 2021, market participants began to lower their expectations for net purchases under the APP and started to anticipate a shorter duration of APP reinvestments. Market pricing thus adjusted well before the ECB announced the end of net purchases in June 2022 and began the portfolio roll-down in March 2023. Effective communication by the Governing Council about the gradual winding down of the balance sheet led to smaller asset price surprises than those during quantitative easing shocks (see Akkaya et al., 2024b). A similar pattern has been documented for the balance sheet normalisation in the United States between 2017 and 2019 (Smith and Valcarcel, 2023). This notwithstanding, Akkaya et al. (2024c) find that the relationship between expected sovereign yields and the stock of bonds on the Eurosystem's balance sheet during the tightening phase is comparable in magnitude to the effects of balance sheet expansionary measures. Moreover, Laine and Pihlajamaa (2024) find about equally strong effects of contractionary and expansionary balance sheet shocks on euro area inflation.

Moreover, conducting the balance sheet reduction in a passive manner underscored QT's role as a background process in the rate hiking cycle and the subsequent rate-cutting cycle. The Eurosystem's reduction of the current and expected stock of sovereign bonds is estimated to have contributed gradually and steadily to a reduction in sovereign term premia compression. Assuming symmetry of the effects of risk extraction and injection of balance sheet tools, a third of the 300

basis point increase in ten-year average sovereign yields of the four largest euro area economies from late 2021 to May 2025 can be attributed to the impact of reducing the stock of bonds on the Eurosystem's balance sheet (**Chart 6**, right panel).[27] Moreover, the same channels are likely to continue exerting upward pressure on euro area bond yields over the coming years, albeit at a slower pace and in a predictable manner. A number of papers confirm passive QT to be less effective than rate hikes (see, for example, Wei, 2022a; Crawley et al., 2022; and Altavilla et al., 2024).

The additional net supply of bonds has been smoothly absorbed so far. As the portfolios run down, QT generates policy space for future asset purchases should they become necessary (see also **Section 2.2.3**). At the same time, sequencing balance sheet reduction with interest rate hikes has created conditions for the market to smoothly absorb duration risk, as rising rates and yields encourage investors to substitute for central bank demand (Anaya Longaric et al., 2023; and Ferrara et al., 2024). The market share of price-sensitive investors – domestic banks, foreign private investors and other private euro area investors such as households – relative to price-insensitive investors has increased and is expected to further increase as the absorption of the extra bond supply continues to rise. Current yield levels therefore already likely reflect expectations about price-sensitive investors augmenting their (relative) market share commensurate with their higher absorption capacity (**Chart 8**, right panel). However, a higher than anticipated increase in their market share could result in stronger upward pressure on yields from QT than currently envisaged, with the impact of this risk scenario diminishing over time in line with the reduction in portfolio holdings.

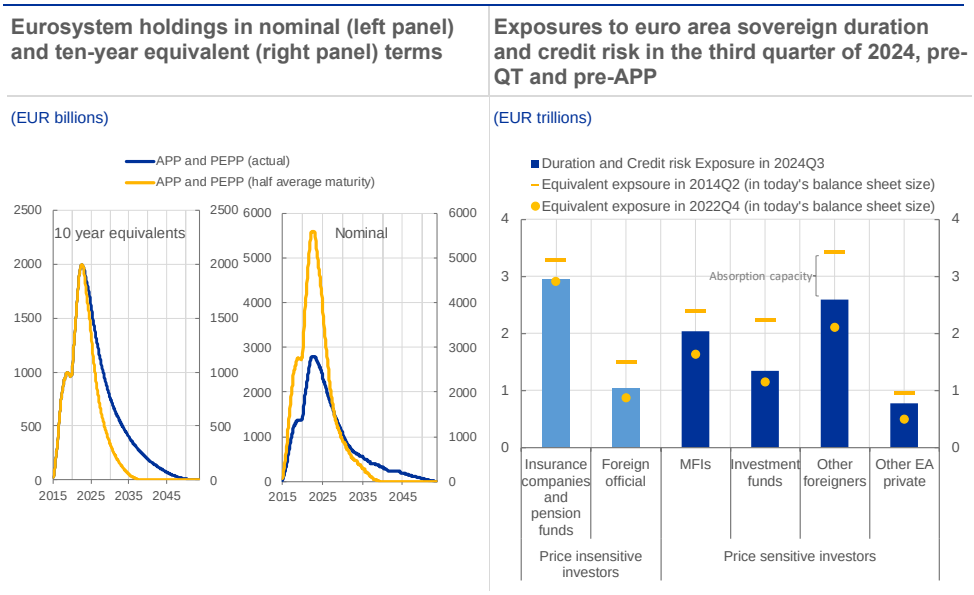
Owing to the long duration of the QE portfolio, its reduction through passive QT will take many years. A shorter-duration portfolio would have naturally run down faster but would have come at the cost of the effectiveness and efficiency of purchases. Specifically, the portfolio run-off pace, and hence the release of pressure on long-term yields, is inversely related to the weighted average maturity of a given portfolio. A weighted average maturity of seven years therefore implies a yearly one-seventh decline in the prevailing portfolio stock. Halving the weighted average maturity – by purchasing bonds with lower average maturities – would double the run-down speed of a QE portfolio. That said, extracting the same amount of duration from the market during the easing phase could have required double the amount of purchases in nominal terms (**Chart 8**, left panel). This counterfactual scenario was not feasible under the prevailing issuer and, notably, issue share limits. Beyond that, the faster run-down pace would also be priced into bond yields. This implies that even the very large nominal amounts purchased in a short-duration scenario would give rise to a considerably lower-term premium impact when needed to ease the stance (e.g. at the peak of the easing cycle: 100 basis points in the half-average maturity portfolio compared with estimated 175 basis points under the actual composition). This shortfall in the term premium compression would have to be compensated by other means, for example a very far-reaching

[27] Du et al. (2024) also point to a modest reduction (in absolute terms) in the convenience yields of government bonds as one component behind tighter financial conditions during the balance sheet reduction process (see also **Section 2.2.3**).

lengthening of the reinvestment period, which would run counter, though, to an intention of a faster balance sheet run-down after a QE episode.

Chart 8

APP/PEPP holdings in the "big four" public sector bond markets under different maturity regimes and exposures of different investor groups to euro area sovereign bonds



Source: Eurosystem staff calculations
Notes: Left panel: Blue lines represent actual and projected APP and PEPP holdings in ten year equivalent (left) and nominal terms. Yellow lines represent a counterfactual scenario in which the historical (APP+PEPP) holdings have been implemented with a weighted average maturity amounting to half that of the actual portfolio. Distribution of expected fall in lending to firms attributable to a 1 percentage point decline in the ratio of excess liquidity over assets..Right panel: Bars represent the third quarter of 2024 sector holdings of SHSS investors groups of the euro area "big five" (DE, FR, IT, ES, NL) sovereign bonds weighted by their sensitivity to duration risk (measured by the return of a combined long (short) position in a five-year (one month) OIS) and sovereign credit risk (measured by the return of a combined long (short) position in a five-year Italian (German) government bond). Yellow dashes (dots) represent Q2 2014 (the fourth quarter of 2022) levels corrected equivalent of today's (e.g. the third quarter of 2024) sectoral balance sheet size. Absorption capacity compares current exposures with pre-APP exposures. Other euro area private investors include households and non-financial corporations. The latest observation is for the third quarter of 2024.

2.2.2 Evaluation of transmission-oriented tools (PEPP (flexibility), TPI and OMTs)

During periods of financial sector or market distress, when market fragmentation is more acute, targeted asset purchases are particularly efficient in reducing risk premia and supporting market liquidity.[28] For instance, the initial PEPP announcement arguably had a larger effect on sovereign term premia per unit of prospective purchases than the APP (Altavilla et al., 2021a) (although, at

[28] Vast evidence of this was already available at the time of the Monetary Policy Strategy Review 2020-21 and is only briefly recalled. For for theoretical insights, see, for example, Vayanos and Vila (2021) and King (2019). Under high market distress, asset purchases tend to lead to a higher reduction in the compensation for risk. The same result holds in a general equilibrium setup (e.g. Karadi and Nakov (2021)). Regarding empirical evidence on the transmission channels of asset purchases in relation to financial distress, see Krishnamurthy and Vissing-Jorgensen (2011, 2015), D'Amico and King (2013) and Duffie (2023) for the United States, Altavilla et al. (2021b) for the euro area APP and Zinna (2016) for the United Kingdom. Evidence for the euro area points to a strong role of flow and local supply effects in segmented markets, which affect asset prices of purchased securities beyond their stock effects (Eser and Schwaab, 2016, for the Securities Markets Programme and De Santis and Holm-Haddulla, 2020, for the APP).

the outset, the PEPP explicitly also served a dual purpose: stance and transmission). Recent evidence also points to an active credit risk channel of asset purchase announcements, with the PEPP – together with the Next Generation EU post-pandemic recovery plan – compressing sovereign risk premia during the large fiscal expansion triggered by the pandemic (Costain et al., 2025). In addition, the expanded scope of purchases under the PEPP to target affected market segments, including through purchases of (short-term) corporate debt and commercial paper, together with the introduction of bridge longer-term refinancing operations (LTROs), helped to mitigate the effects of large outflows from mutual and money market funds at the onset of the pandemic, thereby contributing to financial stability and a smooth transmission of monetary policy (Breckenfelder and Hoerova, 2023; Breckenfelder and Schepens, 2025; Boucinha et al., 2020; and De Guindos and Schnabel, 2020). These measures were flanked by increasing the concentration limit for unsecured bank debt in collateral pools and expanding the eligibility of non-financial commercial paper to include securities with shorter remaining maturities. In addition, flexible purchases – over time, countries and asset classes – leveraged the benefits of asset purchases in stressed market conditions by reaping flow effects in market segments prone to widening risk premia or market freezes (Böninghausen et al., 2022; Bernardini and De Nicola, 2025; Bernardini and Conti, 2023; and Blotevogel et al., 2024). Other central banks also conducted asset purchases to tackle market dysfunction. For example, in September 2022, targeted purchases by the Bank of England restored market functioning after gilt bond yields rose sharply in view of fiscal concerns which were amplified by forced selling by pension and liability-driven investment (LDI) funds (Mosk et al., 2023; and Pinter, 2023). The Bank of England's intervention in autumn 2022 and the relatively short period of active use of PEPP flexibility in spring 2020 and summer 2022 also show that purchases for transmission motives may need to be more forceful, but also much more limited in their time horizon than stance-based asset purchases. Beyond the specific flow effects of flexible purchases under the PEPP, the mere possibility to deploy flexibility may have contributed to safeguarding transmission during the pandemic. This aspect made PEPP flexibility akin to a backstop tool (see the discussion on the TPI and outright monetary transactions – OMTs – below).

The PEPP offered flexible and targeted support linked to pandemic-related challenges and has been in full run-down mode since the end of 2024. When compared with the APP, the PEPP provided additional flexibility for the allocation and timing of bond purchases. While used to a limited degree, flexibility of actual purchases under the PEPP was paramount in countering the sudden portfolio flights (see above). In the future, the particular pandemic-related justification that backed the flexibility offered by the PEPP will no longer be available. Meanwhile, the APP will remain in the toolkit as an instrument for steering the policy stance, but as such it does not embed flexibility for purchases to deviate from the capital key for market stabilisation purposes.

The introduction of the TPI as a new backstop instrument has also been effective in protecting monetary policy transmission, without having had an immediate impact on the Eurosystem's balance sheet. Sovereign bonds serve as a key reference asset for pricing other bonds and are an important determinant of

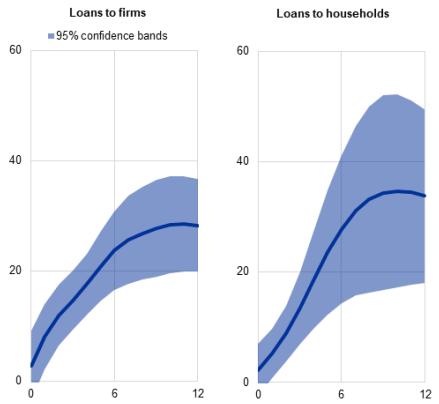
overall financial conditions within economies. Thus, elevated stress in sovereign bond markets can impair the transmission of monetary policy to financing conditions more broadly (**Chart 9**, left panel) and ultimately to inflation (Lane, 2024b; Hauzenberger et al., 2021). In the first half of 2022, sovereign spreads of several euro area countries with fiscal vulnerabilities surged in the context of market concerns over whether the countries could weather the imminent monetary policy tightening. The TPI introduced in July 2022 partly insulated sovereign spreads from monetary policy rate (tightening) shocks (**Chart 10**).[29] It is plausible that the remarkably smooth transmission of the forceful tightening cycle to the sovereign bond market would not have been possible to the same extent without the introduction of the TPI (Lane, 2024b). At the same time, the determined monetary policy tightening after June 2022 stands in contrast to claims of fiscal dominance (Schnabel, 2024b).

Chart 9

Impaired transmission of policy in times of sovereign stress and the TPI effect

Pass-through of sovereign spreads to lending spreads

(x-axis: months; y-axis: percentages)

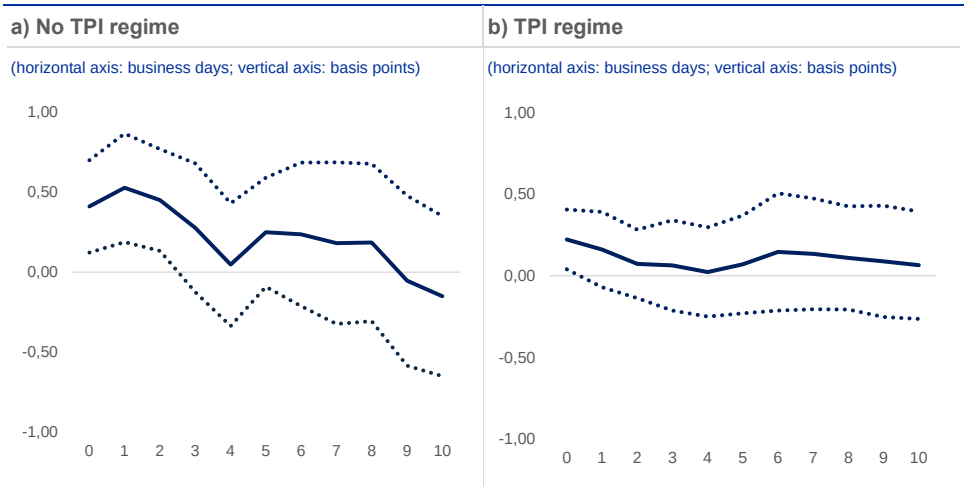


Sources: Eurosystem staff calculations
Notes: Left panel: The chart shows model estimates of the pass-through of a five-year sovereign spread shock using country panel local projections. For each month h, the coefficient on the regressor $SovSpreadt{+}h - SovSpreadt$ is plotted. The analysis is restricted to DE, FR, IT, ES, NL, BE, AT, and F;

[29] It could be argued that the effects from introducing the TPI and activating PEPP reinvestment flexibility could not be distinguished, given the joint announcement of both policies (on 21 July 2022). Yet, PEPP reinvestment flexibility was already in place prior to this date and played a prominent role in the Governing Council's communication, but this appeared insufficient in containing risks to transmission on its own.

Chart 10

Effect of a 1 basis point monetary policy surprise on a high-debt spread relative to low debt countries before and after the introduction of the TPI



Source: Eurosystem staff calculations
Notes: The charts show the additional reaction of sovereign spreads of high-debt countries relative to low debt countries before (left) and after (right) the introduction of the TPI using Panel Local Projections with time and country fixed effects and five lags of the endogenous variable. The shaded area represents the 90% confidence interval. Countries are being marked as high-debt countries if their debt-to-GDP level is higher than 90%, which is the case for Greece, Italy, France, Spain, Belgium and Portugal. Low debt countries include Austria, Croatia, Cyprus, Finland, Germany, Ireland, Latvia, Lithuania, the Netherlands, Slovakia and Slovenia. Sovereign spreads are calculated vis-à-vis the German Bund.

OMTs and the TPI have different safeguards and conditionalities and allow for different use cases. Neither OMTs nor the TPI have been activated to date. On the one hand, the OMTs are aimed "at safeguarding an appropriate monetary policy transmission and the singleness of the monetary policy" (ECB, 2012). As a necessary condition for activation, OMTs would be subject, inter alia, to strict and effective conditionality attached to a European Stability Mechanism (ESM) programme. This amounts to a strict form of ex post conditionality, indicating a use case that is intended to correct past policy mistakes or to address redenomination risk (Draghi, 2012). The Governing Council will consider OMTs to the extent that activation is warranted from a monetary policy perspective, as long as programme conditionality is fully respected, and will terminate them once their objectives have been achieved or when there is non-compliance with the macroeconomic adjustment or precautionary programme. On the other hand, the TPI can "counter unwarranted, disorderly market dynamics that pose a serious threat to the transmission of monetary policy across the euro area" (ECB, 2022b). As stressed in 2022, the TPI can help minimise threats to transmission in conditions in which monetary policy is tightened, such as during the recent inflation surge. TPI activation requires a prior assessment of a cumulative list of fiscal and macroeconomic criteria, including: (i) compliance with the EU fiscal framework; (ii) the absence of severe macroeconomic imbalances; (iii) fiscal sustainability; and (iv) sound and sustainable macroeconomic policies (ECB, 2022b).[30] These requirements, organised around ex ante eligibility

[30] Schnabel (2024b) elaborated on conditionality in the use of the TPI: "These precautions ensure that market discipline is preserved. Within the TPI there is no interest rate level that is targeted; this level remains fully determined in the market, with the substantial differences in sovereign bond yields across euro area countries reflecting different fundamentals. The TPI can only be used to tackle disorderly dynamics that temporarily prevent price determination in the market. These conditions preserve the incentive for sound fiscal policies."

criteria, indicate use cases in which the root cause of impaired transmission lies either in a common shock to the euro area economy that affects some countries more heavily than others, or in wider euro area contagion from negative developments originating in one or a small subset of jurisdictions. Purchases under the TPI would be terminated either on a durable improvement in transmission or based on an assessment that persistent tensions are due to country fundamentals. A key distinction between the TPI and OMTs is that the former can be activated at the discretion of the ECB, whereas activation of the latter depends on a country having requested ESM support beforehand. In any case, a decision by the Governing Council to activate either of these instruments will always be based on a comprehensive assessment and a judgement that the activation of purchases is proportionate to the achievement of the ECB's primary objective.

2.2.3 Evaluation of wider side effects of policies

This section evaluates the broader side effects of balance sheet tools, negative interest rates, TLTROs and forward guidance during the ELB episode and subsequent inflation surge and quantitative tightening period. The analysis builds on the Monetary Policy Strategy Review 2020-21 and assesses side effects on the basis of newer findings and the evidence accumulated since then. Overall, the updated analysis suggests that adverse side effects remained contained. This holds for most sectors of the economy (government and the financial and non-financial private sectors). At the same time, risks for central bank profits, going well beyond scenarios of rising policy rates documented in the previous strategy review (Box 15 in ECB, 2021c) materialised in a context of rapid tightening of interest rate policies in the presence of still ample excess liquidity.

Impact on government finances (beyond central bank profitability)

Public debt sustainability benefited from a favourable interest-growth differential during the inflation surge. Asset purchases affect government finances through various channels, including through its favourable stance effects on GDP and inflation. For instance, asset purchases under the APP and PEPP between 2016-22 are found to have reduced the Spanish debt-to-GDP ratio by between 5 and 22 percentage points (Aguilar et al., 2024a) in general equilibrium. Similarly, the unexpectedly high inflation significantly reduced real debt burdens, as a favourable nominal interest rate growth differential pushed down debt-to-GDP ratios (Bouabdallah et al., 2023; Bankowski et al., 2023; and **Chart 11**). Moreover, the impact of persistently high government deficits on debt levels was partly compensated by low public sector funding costs relative to nominal growth rates – also facilitated by the low level of the real equilibrium interest rate (Mian et al., 2023; and Blanchard, 2019). Beyond that, accommodative monetary policies during the lower-bound period incentivised governments to increase the average duration of their funding structure (Plessen-Mátyás et al., 2023), which made them less vulnerable to rising interest rates. Higher bond demand, on the back of central bank asset purchases and TLTRO III, led to a further decline in sovereign bond yields

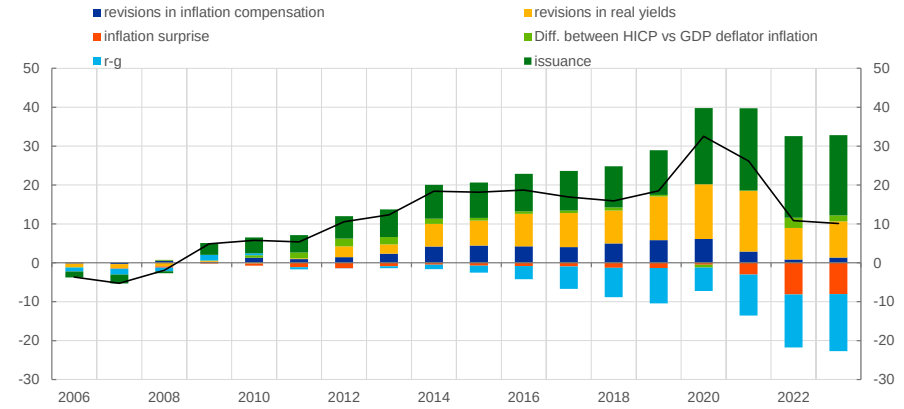
beyond the compression of term and credit risk premia (Schlepper et al., 2017; and Carrera de Souza, 2025 mimeo). If this favourable interest-growth differential reversed, risks to debt sustainability could become material in some jurisdictions (Bouabdallah et al., 2023). In recognition of such rebound effects, some studies warn about wrong incentives set by long stretches of accommodative monetary policy for "impatient" fiscal policy (Box 12 in Debrun et al., 2021). Central bank asset purchases also have significant implications for government finances through central bank profits and losses arising from the dynamics of interest income and costs on both sides of the balance sheet (see the section on side effects for the central bank's balance sheet).

Chart 11

Inflation and other determinants of public debt

Contribution to the cumulative change since 2005 in the six largest euro area countries' debt-to-GDP ratios

(market values, % of GDP)



Source: Boeckx, 2025.
Notes: The chart shows contributions to the cumulated change in the debt ratio between 2005 and 2023. The debt refers to the market value of debt issued by central governments of the six largest euro area countries. Issuance of new debt pushed up the debt ratio by some 20 percent of GDP. HICP inflation realisations deviating from the 1-year inflation swap at the start of the calendar year pushed the debt ratio down by some 8 percent of GDP, in particular after the pandemic. GDP deflator inflation was below HICP inflation and that led to a marginally higher debt ratio. Downward revisions of the inflation swap curve had pushed up the value of debt by some 6 percent of GDP in 2020 but the inflation surge thereafter almost erased these valuation gains. From 2012 onwards, ex ante real interest rates at the 1-year horizon stood consistently below the real growth GDP growth rate and reduced the debt ratio by almost 15 percent of GDP. Revisions in longer-term ex ante real yields led to a higher debt ratio, even though the post-pandemic repricing reduced the contribution from 15 percent of GDP in 2021 to 9% at the end of 2023.

Effects on productivity and firm credit risk

Prolonged periods of accommodative monetary policy can result in an excessive extension of credit to unproductive firms, although there is little evidence supporting this channel in the euro area. Recent studies highlight the unintended consequences of accommodative monetary policy with regard to the extension of credit to unproductive firms. Unconventional monetary policies can inadvertently encourage banks to lend to unproductive firms, leading to credit misallocation and a slower economic recovery (Acharya et al., 2019,) by crowding out investment from more productive firms (Asriyan et al., 2024). Prolonged ultra-easy policies may be conducive to this effect (Jafarov and Minnella, 2023). Moreover, the effect can become more pronounced when interest rates rise, as banks face incentives to restructure existing loans to avoid realising losses, impeding

efficient credit allocation and economic recovery (Albuquerque and Mao, 2023). That said, other studies find positive effects of accommodative monetary policies on credit allocation and aggregate productivity even in general equilibrium (e.g. González et al., 2023). Moreover, the recent cyclical decline in productivity was arguably amplified by several factors unrelated to monetary policy, such as strong employment growth and disruptions in the energy market (Workstream 1; and Arce and Sondermann, 2024). At the same time, bankruptcies and banks' non-performing loans picked up only moderately during the tightening cycle and by less than suggested by historical regularities, indicating that the previous build-up in the credit risk of the non-financial sectors was not excessive (af Jochnick, 2024).

Distributional effects on households and across regions

Accommodative monetary policy, including, in particular, central bank asset purchases, reduced income inequality but produced more uncertain effects on wealth inequality with some reversion during the tightening cycle. Some studies indicate that the accommodative effect of asset purchases can increase wealth inequality, benefiting richer households, for example through rising valuations of real estate and financial assets (Albert and Gómez-Fernández, 2022; Battistini et al., 20224; and IMF, 2018), with reverse effects during the tightening cycle (Burgert et al., 2024). However, Lenza and Slacalek (2024), find the effects to be small and insignificant. Rising house prices, in turn, also pushed up rents and the cost of living for lower income households (Roma, 2021). With respect to income inequality, several studies find that lower-income households are among the main beneficiaries of the accommodative effects of QE on account of economic stimulus and employment opportunities (Casiraghi et al., 2018; Mäki-Fränti et al., 2022; and Lenza and Slacalek, 2024). Research also points to some heterogeneity of the effects of asset purchases across regions, including a larger impact in areas with higher home ownership rates and loan-to-income ratios, and lower shares of fixed-rate mortgages and loan-to-value ratios, as well as lower labour income (Battistini et al., 2022; and Pica, 2023). Similarly, De Groot et al. (2023) find that the output response to monetary policy shocks is stronger and more persistent in poorer regions, with the difference becoming particularly pronounced in the tails of the distribution. Overall, as non-interest rate policy measures are unwound, their respective effects on inequality are likely to reverse to some extent. However, these effects are hard to disentangle from the general equilibrium effects of the policy rate hikes.[31]

Effects on real estate markets

QE arguably contributed to residential real estate price inflation, potentially increasing the sensitivity of house prices to subsequent monetary policy tightening. Battistini et al. (2022) demonstrate that accommodative monetary policy shocks have a positive effect on housing-related activities and prices, with a higher

[31] See De Guindos (2024) for a discussion of the effects of surging inflation and recent ECB rate hikes on income and wealth inequality.

sensitivity to “unconventional” monetary policy than to conventional monetary policy. Berg et al. (2024) provide evidence of banks’ portfolio rebalancing from corporate sector purchase programme (CSPP) eligible firms to the real estate sector and of considerable price effects from the expanded credit supply. At the same time, Tasev and Eroglu (2020) find that the impact of unconventional monetary policy on real housing prices depends on financial sector debt levels, with highly indebted sectors limiting transmission. Turning to the tightening cycle, Dieckelmann et al. (2023) find that an increase in real lending rates from ultra-low levels could have led to significantly greater downward pressure on real house prices than previously suggested in the literature. Consistent with this, Ryan et al. (2023) find that monetary policy tightening was one of the dominant factors behind the recent decline in euro area residential real estate prices.

Central bank profitability

After earning profits in each year between 2005 and 2022, the Eurosystem incurred losses in 2023 and 2024.[32] **This is mainly due to the increasing cost of funding of the securities portfolio held under asset purchase programmes compared with its average return.**[33] The Eurosystem has faced sizeable negative net interest income (NII) in 2023 and 2024 roughly equivalent to the cumulative positive NII between 2018 and 2022.[34] The LSAPs and (T)LTROs initially supported central bank net income. However, rising policy rates after 2022 triggered negative NII from LSAPs owing to a mismatch between the interest income generated by the large fixed-yield asset portfolio and the floating interest expenditures on remunerated Eurosystem liabilities – mainly excess reserves and government deposits.[35] In addition, borrowing rates below the DFR for TLTROs were temporarily introduced in response to the pandemic-related crisis between June 2020 and June 2022, reducing NII. In October 2022 the Governing Council decided to recalibrate the TLTRO terms and conditions to ensure that increases in the DFR were fully reflected in the marginal cost to borrowers, thereby ensuring consistency with the broader monetary policy normalisation process and also improving the efficiency of monetary policy along the monetary-income dimension.[36] International comparisons show that

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32 Consolidated profits and losses for the Eurosystem are not available before 2005.

33 The gross amount of losses stemming from default on private paper is negligible compared with that attributable to interest rate mismatch (less than 0.5% of NII losses for the years 2023-24).

34 Net interest income (NII) is interest on assets minus interest on liabilities. It includes interest income from non-monetary policy assets and liabilities (ANFA) but does not include revaluation write-offs or credit losses from the corporate LSAP portfolio. Profit/loss is the sum of NII, net result of pooling of monetary income, net result of financial operations and write-downs, operating expenses (staff costs and administrative expenses), other income/expense and transfers to/from provision for financial risk.

35 LSAPs also increase credit risk, including sovereign credit risk. Asset purchases account for such risk by being only conducted for investment grade securities, except for the special waiver on Greek sovereign bonds in the context of the PEPP.

36 The initial pricing formula implied that the interest rate on TLTROs was a weighted average over four sub-periods, with weights equal to the duration of each sub-period. After the third period, the applicable lending rate was linked to the DFR or the MRO over, crucially, the whole life of the respective operation. Consequently, as policy rates rose, the TLTRO III rate adjusted slowly, with a growing gap as rates increased. The October 2022 recalibration modified the last sub-period by splitting it into two, with the first part – until 23 November 2022 – keeping the original indexation to the average DFR/MRO over the operation's lifetime, while the second part – from 23 November 2022 – introduced a new rate computed as the average DFR or MRO over the sub-period.

other major central banks have experienced similar time profiles of profits and losses, often linked to LSAP policies (Bell et al., 2023).

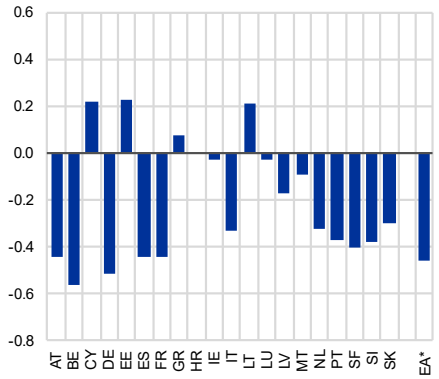
Profits and losses are unevenly distributed across euro area NCBs, as yields from LSAPs differ and the associated risks and returns are mostly not shared (Chart 12). The policy choice to share across the Eurosystem only 20% of the income and risks arising under the LSAPs of public sector bonds, with the remainder staying with individual NCBs, contributes to the heterogeneity of losses across NCBs. Although the floating interest expenses on remunerated excess reserves are consistent across NCBs, returns from securities portfolios vary among NCBs. Accordingly, NCBs in jurisdictions with lower average sovereign yields recorded lower interest income and, all else being equal, larger losses. In addition, the maturity composition of NCB asset holdings differs, implying varying sensitivities of NCB losses to the slope of the yield curve, with longer maturity low-yield bonds implying more persistent losses if all else is equal (Belhocine et al., 2023). Differences in investment portfolios and profit/loss distribution mechanisms due to varying national legislations, provisioning and capital policies, as well as to a lesser extent differences in operating costs and in the remuneration of government deposits, also matter for the different profit/loss situations of central banks (e.g. Bell et al., 2023).

Chart 12

Eurosystem profits/losses

Pre-provision pre-tax profits or losses of Eurosystem NCBs in 2023

(percentage nominal GDP)



Source: Eurostat, financial statements of euro area NCBs.
Notes: EA* refers to the sum of profits and losses of euro area NCBs and the ECB.

While central bank profits and losses are a relevant side effect, the central bank's achievement of its primary objective of price stability takes precedence. The objective of a central bank is to deliver effectively on its mandate, and profit and losses only matter in extreme situations where they might endanger the achievement of the price stability objective (see below).[37] A central bank can technically always serve its nominal debt denominated in domestic currency, as it has the right to issue legal tender. Central banks generate seigniorage revenue by

[37] Stable prices contribute significantly to economic growth and welfare, and therefore any profits or losses of a central bank should be seen in the context of the achievement of its mandate.

investing proceeds arising from the privilege of issuing non-interest-bearing liabilities, such as legal tender, in assets that yield a positive return. A central bank can therefore, in principle, operate even with negative capital without necessarily compromising its ability to fulfil its mandate (Bindseil et al., 2004). At the same time, accepting the risk of transitory losses and their materialisation can demonstrate a firm commitment to the price stability mandate.[38,39]

Financial strength and adequate capital nonetheless help to support policy credibility. If the central bank resorts to issuing legal tender in excessive amounts to cover expenses, it might affect public trust, depreciate the value of the currency and result in an increase in inflation.[40] Accordingly, an ever-deteriorating capital position could, in extreme circumstances, ultimately undermine the ability to achieve and maintain price stability, although the precise concretisation of that circumstance is uncertain.[41] In extreme circumstances, this risk could lead to trade-offs regarding the use of some monetary policy tools, whereby their positive contribution to price stability might need to be balanced against their potential negative implications for price stability as a result of cumulated losses.[42] While a temporarily weak financial position may not pose a fundamental risk, chronic financial weakness may increase the risks of a self-fulfilling loss of confidence in the currency (Bindseil et al., 2004; and Schnabel, 2024a). A strong balance sheet and adequate capitalisation therefore allow the central bank to conduct independent, credible and effective monetary policies more easily (Wessels and Broeders, 2022). Various mechanisms can support this, including pre-emptively building buffers for financial risks or retaining future earnings to cover realised losses.[43]

Constraining monetary policy because of loss concerns may adversely affect delivery of the inflation target and harm the credibility of the central bank. The profit and loss implications of monetary policy instruments depend on their design, the prevailing and future economic environment and market conditions. When the balance sheet is large and the duration of fixed-rate assets longer than that of liabilities, raising policy rates could lead to substantial losses. However, even if some

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38 Analysing central bank solvency from an intertemporal perspective is in line with the literature on central bank finances. For a literature review, see Cardoso da Costa (2022).

39 Rather than the capital position of the central bank, another important aspect is the soundness of the consolidated public fiscal position (Bell et al, 2024). The literature on monetary and fiscal interactions identifies two necessary conditions to ensure the central bank's ability to achieve its price stability objective: (i) monetary dominance, i.e. monetary policy is not used to ensure public debt sustainability, as this is the responsibility of fiscal policy; and (ii) fiscal support, i.e. the monetary authority benefits from financial support from the fiscal authority in case of need. See Del Negro and Sims (2015) and Box 2 in European Central Bank (2021a). One example of fiscal support is the agreement for loss indemnification between the Bank of England and HM Treasury. Such a framework, however, appears incompatible with the Eurosystem's governance framework.

40 In particular, the willingness of commercial banks to hold reserves at the central bank, i.e. central bank liabilities, might diminish. The resulting decline in the real value of reserves then implies inflation, as the real value of reserves is the inverse of the price level.

41 Large central bank losses can also create communication and reputational challenges, as discussed in **Chapter 5**.

42 "Determining when losses might accumulate to reach a tipping point in the financial strength of a central bank is not easy, but that does not diminish concerns about the effects of the losses", BIS internal report on central bank finances (2011), p. 1.

43 Different arrangements for dealing with losses each have their advantages and disadvantages, but having a system in place is essential (El Joueidi et al., 2024). As Sims (1999) puts it, "[A] truly independent central bank is one that can act, even under inflationary or deflationary stress, without any worry that the necessary fiscal backing for its actions will be forthcoming".

losses might be avoided, not raising policy rates when appropriate in view of the inflation outlook would conflict with the primary mandate of price stability (Gebauer et al., 2024b; and Karadi et al., 2024b) and might harm a central bank's credibility. Similarly, not conducting balance sheet policies or refraining from setting policy rates deeper into negative territory in the face of disinflationary trends, for fear of potential losses, would impede the delivery of the mandate.

Where two alternative instrument designs are judged to deliver the same effectiveness in terms of price stability, the preferred design should be the one that is more efficient including along the (projected) central bank income dimension. For example, the July 2023 decision to reduce the remuneration of minimum reserves preserved the effectiveness of monetary policy by maintaining the same degree of control over the monetary policy stance while, at the same time, improving the efficiency of monetary policy by reducing the overall amount of interest that needs to be paid on reserves to implement the appropriate stance. The TLTRO recalibration of November 2022 suggests that the pricing of future longer-term lending operations should cater ex ante for possible changes in the inflation environment. Regarding asset purchases, caution could be exercised in purchases of bonds whose yield is lower than the DFR owing to potential upfront losses and the fact that the potential for further yield compression is lower than when bond yields are high to start with.

Losses incurred in recent years do not undermine the Eurosystem's ability to fulfil its primary objective of maintaining price stability. Replicating the approach of Ize (2005) for the Eurosystem indicates that the net-worth stabilising inflation rate, i.e. the minimum inflation rate required for the Eurosystem to maintain non-negative net worth in the long run, remains well below the 2% inflation target in all scenarios considered, even withstanding deflationary scenarios (**Chart 13**).[44] The Eurosystem's balance sheet is thus structurally strong, yielding sufficient future seigniorage income so that profitability considerations should in no way impede its ability to achieve its primary objective of price stability. Similar conclusions are reached by Cardoso da Costa and Silva (2025), who conduct long-run simulations of Eurosystem monetary income using a model that integrates credit and interest rate risk and also accounts for uncertainty over the evolution of monetary policy.[45]

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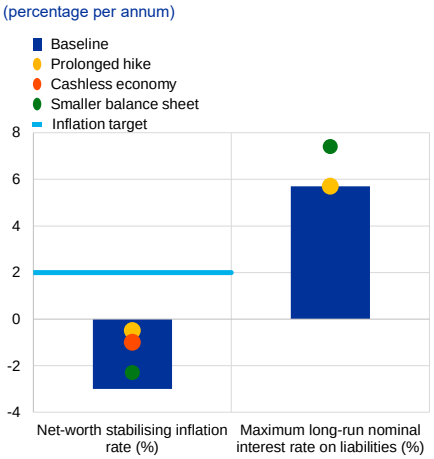
44 Net worth is defined as the net present value of inflation-adjusted profits. The baseline scenario is based on Eurosystem balance sheet projections for 2026, a neutral rate level consistent with the numbers reported in Brand et al. (2025) and an average portfolio maturity of seven years. Adverse scenarios include a higher interest rate paid on liabilities, zero growth of real currency and a smaller balance sheet size. An alternative baseline based on balance sheet projections for the end of 2028 yields similar results.

45 Cardoso da Costa and Silva (2025) conclude that monetary income would be sufficient to cover current and future losses without undermining the price stability objective. The expected present discounted value of future seigniorage from an intertemporal perspective remains sizeable even for a relatively high discount rate. At the same time, there are also other risks. For example, a substantial reduction in the holdings of banknotes could have a material impact on these estimates.

Chart 13

Net worth-stabilising inflation rate and maximum long-run nominal interest rate on liabilities



Sources: Ize (2005) and ECB calculations.
Notes: The net-worth stabilising inflation rate is the minimum inflation rate required for the Eurosystem to maintain non-negative net worth in the long run. The maximum long-run nominal interest rate on liabilities is the maximum rate the Eurosystem can afford to pay on its liabilities to maintain non-negative net worth in the long run. Both concepts are derived from the framework described by Ize (2005).

Banks and the non-bank financial intermediation (NBFI) sector

The side effects of NIRP on bank profitability remained limited until the policy was terminated in July 2022. Following the previous monetary policy strategy review, when NIRP was assessed to have a broadly neutral impact on bank profitability, banks gradually increased the pass-through of negative interest rates to some retail depositors, despite legal impediments in some jurisdictions. There is still legal uncertainty about compensatory measures taken by banks to pass through NIRP to customers.[46] While most overnight deposit accounts held by households retained non-negative remuneration, many banks introduced tiered remuneration of deposits, whereby negative rates were applied on volumes above certain thresholds. By the end of the NIRP period, the share of banks with an average negative deposit rate for households was slightly over 10%, while it was about one-third for non-financial corporations. By stimulating the economy as a whole, NIRP sustained bank profitability through increased lending volumes and reduced provisioning needs.[47] The ECB's two-tier system of reserve remuneration also cushioned the impact of NIRP on bank profitability by partly exempting banks' excess reserve holdings from

[46] In February 2025 the German Federal Court of Justice ruled that German banks could not and would not be allowed in the future to impose negative rates on existing savings accounts and term deposits. Negative rates are still in principle allowed on overnight deposits, which account for a large majority of banks' deposits. Most euro area countries do not impose explicit legal limits on negative interest rates, especially for corporate deposits.

[47] See Altavilla et al. (2021b).

negative remuneration at the DFR and further stimulated lending by incentivising a reallocation of central bank reserves.[48]

The side effects of NIRP on banks' risk-taking also seem to have been contained, as credit risk measures increased only moderately despite the strong and swift tightening of monetary policy. While the increase in risk-taking is one of the channels through which monetary policy easing is transmitted to the economy, excessive risk-taking by banks can ultimately lead to financial distress once interest rates rise again.[49] However, this has not been the case following the during the NIRP period. Risk materialisation and deterioration in the quality of banks' assets were well below historical regularities during the last tightening episode, despite the preceding prolonged period of low and even negative rates.[50]

The ECB's asset portfolios exerted broadly offsetting effects on banks' profitability during the tightening phase as the remuneration of excess liquidity and other bank assets turned positive, but this was accompanied by lower lending volumes, higher funding costs and the expectation of future higher provisions. The previous strategy review extensively documented a balanced impact of QE on bank profitability. In the more recent tightening phase the monetary policy asset portfolio also had a limited net impact on bank profitability, as reported by banks in the euro area bank lending survey.[51]

With strong regulation and supervision, there was no crystallisation of systemic risk induced by the legacy asset portfolios in the euro area when the tightening cycle started. Evidence for the United States, where several cycles of expansions and contractions of the central bank balance sheet are available, suggests that asset purchases may decrease systemic risk by reducing banks' ex ante incentives to venture into excessive maturity transformation, but increase the probability of liquidity stress during QT by increasing banks' short-term commitments (mainly overnight deposits and overdrafts), thus creating dependence on central bank liquidity.[52] While this may have been a factor, the March 2023 turmoil has been mainly attributed to weaknesses in US regulation and supervision.[53] In the euro area, the gradual and predictable reabsorption of liquidity, together with strong banking regulation and vigilant banking supervision, has avoided the emergence of banking sector instability during the balance sheet normalisation period and the propagation of the March 2023 turmoil to banks. The availability of ample central bank reserves also kept liquidity risk contained at the systemic level during large

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48 See Altavilla et al. (2025b), Boucinha et al. (2022) and soft data from the bank lending survey – BLS ("The euro area bank lending survey – First quarter of 2020"). In the case of Switzerland, in a different institutional setting, Fuster et al. (2024) find a negative impact on lending volumes from tiering, and Basten and Mariathasan (2023) show that tiering reduces the risk-taking induced by NIRP.

49 Jimenez et al. (2022) find an increase in interest rates after a longer period of declining or low rates to be highly predictive of financial crises throughout history. On the other hand, failing to stabilise high inflation might also lead to financial instability. Albertazzi et al. (2024) find that rises in inflation, even when controlling for this U-shaped interest rate pattern, have a similarly sized adverse effect on financial stability.

50 See BIS (2024).

51 See "The euro area bank lending survey – Third quarter of 2024".

52 See Acharya et al. (2024) and Acharya and Rayan (2024), as well as Greenwood et al. (2016). Kapoor and Velic (2022) show evidence for the United States that QE even contributed to reducing systemic risk by inducing risk-taking and a subsequent increase in bank profitability.

53 See https://www.federalreserve.gov/publications/files/svb-review-20230428.pdf.

TLTRO repayments following the unexpected recalibration and cushioned the euro-area banking system from a severe dislocation of credit supply during the period of market turmoil.[54] Moreover, the reduction in the share of sovereign bonds in banks' high-quality liquid assets (HQLA) brought about by the APP and the PEPP contributed to a partial weakening of the sovereign-bank nexus. Finally, the fast growth in nominal incomes and relatively mild increase in real interest rates during the inflation surge contained borrowers' real debt-service burden and the increase in the price level contributed to private sector deleveraging. Nonetheless, a less strong increase in nominal incomes would have triggered a more limited monetary policy reaction, all else being equal.

The side effects of TLTROs on bank profitability and risk-taking, as well as investors' pricing of bank risk, likewise appear to have remained contained.[55] The attractive pricing of TLTRO III during the pandemic is unlikely to have led to a mispricing of bank risk, as enhanced transparency on take-up promoted accurate risk assessment by investors of banks' dependence on central bank funding.[56] A potential side effect of TLTROs was the risk of a hysteresis effect, cutting off banks' access to market-based funding after ten years of reliance on large-scale borrowing from the central bank. Nonetheless, after October 2022 banks were quick to ramp up their issuance of bonds with the TLTRO III roll-off, alleviating this concern.[57] The Single Supervisory Mechanism's targeted review of TLTRO III exit strategies further mitigated vulnerabilities.[58] There is no clear evidence of a significant increase in sovereign bond holdings associated with TLTRO participation, despite favourable rate conditions. However, the decline in reserves associated with TLTRO repayments did increase the incentives for banks to replenish their HQLA buffers with government bonds. Furthermore, high participation rates across jurisdictions and banks' diverse characteristics, along with spillover effects on non-bidding banks, highlight the broad-based impact of these measures.[59] Subject to the fulfilment of lending targets, the TLTROs provided a funding cost relief in the low rate environment, partially offset by the lower return on new loans as loan supply expanded.[60] This support to intermediation margins reduced banks' incentives to engage in risk-taking, especially for banks with particularly compressed margins.[61]

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54 See the ECB's Financial Stability Review, May 2023 https://www.ecb.europa.eu/press/financial-stability-publications/fsr/html/ecb.fsr202305~65f8cb74d7.en.html.

55 See Corte Coi et al. (2025).

56 See ESMA (2021).

57 See Barbiero et al. (2025).

58 See the SSM Supervisory Priorities for 2023-25.

59 See Barbiero, Bouchina and Burlon (2021).

60 The TLTRO benefit, i.e. the differential between the remuneration of the excess liquidity associated with TLTRO III and the applicable TLTRO rate, was available during the extraordinary "pandemic period" and conditional on reaching the lending target. The radical change to price stability outlook following the energy crisis and the subsequent policy tightening, with an extent and speed that could not have been anticipated either by the ECB when setting the terms and conditions of TLTRO III or by counterparties when borrowing in these operations, determined an increase of the TLTRO benefit that induced banks to hold the operations until maturity. Therefore, with the aim of hastening the normalisation of the balance sheet, in October 2022 the Governing Council recalibrated TLTRO conditions, removing any benefit from November 2022 onward and triggering large early repayments before the end of 2022 through a further tightening of lending conditions.

61 See Barbiero et al. (2024).

Overall, the combination of monetary policy tools had a broadly neutral impact on bank profitability from a through-the-cycle perspective and did not generate material excessive risk-taking by banks, thanks also to interaction with supervisory and prudential policies. The monetary policy instruments employed during the pandemic rate easing cycle had counteracting effects on bank profitability during the subsequent inflation surge. Asset purchase programmes and the negative DFR put downward pressure on net interest margins, while the two-tier system and TLTRO III operations provided support for margins. From a through-the-cycle perspective, TLTRO III and asset purchases had a broadly neutral impact on bank profitability. During this phase, there were no indications of long-term dependence or a dramatic surge in provisioning needs, also thanks to transitory exceptional fiscal support through credit guarantees in some jurisdictions. These guarantees may have contributed to partially shift the risk away from banks' balance sheets at the height of the pandemic.[62] The role of an effective policy mix was evidenced ex ante by overall adequate risk premia in lending practices and confirmed ex post by the presence of only isolated pockets of asset quality deterioration concentrated in specific sectors and jurisdictions. Only limited vulnerabilities emerged following monetary policy tightening, mainly in the commercial real estate sector, which were partly imported from the United States.[63] Credit risk in this period did not deteriorate to the extent suggested by historical measures, in part due to a reversal in the risk-taking channel.[64]

Credit and duration risk-taking in the NBFI sector diminished somewhat during the tightening phase, but liquidity risk continued to increase and structural vulnerabilities from leverage remained elevated, underscoring the need to strengthen the resilience of the sector from a macroprudential perspective. The Monetary Policy Strategy Review 2020-21, while assessing very limited side effects for banks, acknowledged that the -LSAPs and the negative interest rate environment, especially with the compressed term premia, exerted pressure on the NBFI sector and sparked search-for-yield behaviour, amplifying liquidity, credit and duration risk-taking.[65] While credit and, to some extent, duration risks decreased during the tightening phase, there was no clear reversal in liquidity risk-taking, particularly among insurers.[66] Liquidity mismatches and inadequate liquidity preparedness remain critical concerns, as unexpected shocks could trigger substantial net outflows from vulnerable investment funds, with potential systemic spillovers to the wider financial system and economy.[67] The extensive use of long-maturity interest rate swaps also renders insurance companies and pension funds susceptible to margin calls during interest rate and volatility spikes, as was seen

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62 Altavilla et al. (2023b) find that, on average, between 10% and 14% of guaranteed credit was used to repay existing credit.

63 While the situation varied considerably across banks, in aggregate commercial real estate portfolios have experienced net inflows to NPLs since mid-2023. The deterioration was particularly severe in the United States, whereas the performance of euro area commercial real estate loans worsened only slightly. See the Financial Stability Review, May 2024. See also Daly et al. (2024) and Bierich et al. (2024).

64 See Barbiero and Dimou (2024); and BIS (2024).

65 See Giuzio and Rousová (2019); Cappiello et al. (2021); Giuzio et al. (2021); Kaufmann (2023); Kaufmann et al. (2024); and Bandoni et al. (2025).

66 See Kaufmann et al. (2023).

67 See Dunne et al. (2024).

during the UK gilt market crisis in September 2022.[68] According to the literature, rising interest rates also increase their liquidity risk owing to higher surrender rates.[69] Moreover, leverage in the NBFI sector also has the potential to amplify shocks. However, despite the swift and strong tightening of monetary policy in 2022 and 2023, these risks have not materialised so far. Nonetheless, the increasingly important role that the NBFI sector plays in monetary policy transmission, including by providing credit to corporates and sovereigns, highlights the need to monitor risks in the sector. In addition, the policy framework for the NBFI sector remains underdeveloped. It is therefore vital to strengthen the resilience of this sector, from a macroprudential perspective, to tackle its structural vulnerabilities and limit future side effects from the deployment of monetary policy tools, with a focus on liquidity mismatch, leverage and enhancing preparedness for margin and collateral calls.[70] The growing size and footprint of the NBFI sector in financial markets and its role in several recent crisis episodes has recently led the Bank of England to introduce a new instrument to provide liquidity to the NBFI sector during market stress.[71] In the euro area, monetary policy instruments, such as asset purchase programmes, have so far been effective in channelling liquidity to all parts of the financial system during crisis episodes, thereby also stabilising NBFI sector entities subject to liquidity stress.[72]

2.2.4 Market functioning through both the pandemic rate easing and post-pandemic rate hiking cycles

In the past decade, episodes of bond and money market dysfunction triggered the prompt action of major central banks, underscoring the case for instruments designed to tackle market functioning issues both at and away from the ELB. For instance, repeated spikes in the US repo markets prompted the creation of new facilities (e.g. the Federal Reserve System's Standing Repo Facility), and disruptions in the UK bond market in autumn 2022 led the Bank of England to launch a temporary gilt purchase facility and more recently a contingent NBFI repo facility.[73] In the euro area, flexibility in PEPP purchases and the TPI were introduced to support the effective transmission of monetary policy (see **Section 2.2**). At the same time, large central bank footprints associated with asset purchases for either stance or smooth transmission purposes can pose challenges for market functioning,

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68 See, for example, the special feature entitled "Stress associated with liability-driven investment strategies", EU Non-bank Financial Intermediation Risk Monitor 2023, No 8, ESRB, June 2023 and "Risks from leverage: how did a small corner of the pensions industry threaten financial stability?", speech given by Sarah Breeden at ISDA & AIMA, Bank of England, 7 November 2022.

69 See Alfaro et al. (2024) and Grochola et al. (2023).

70 For further discussion, see Giuzio et al. (2025).

71 Specifically, the Bank of England has established the Contingent NBFI Repo Facility (CNRF) for eligible insurance companies, pension funds and liability-driven investment funds. This facility allows the emergency provision of public liquidity support in response to sudden surges in liquidity demand by the NBFI sector during episodes of severe gilt market dysfunction that threaten financial stability.

72 See Breckenfelder and Hoerova (2023).

73 See, for instance, "Why central banks need new tools for dealing with market dysfunction", speech by Andrew Hauser, 7 January 2021, on the UK LDI crisis. For a description of the US Standing Repo Facility, see Ennis and Huther (2021). The case for "Market-function asset purchases" has been developed in the United States by Duffie (2023) and Duffie and Keane (2023).

both when instruments are deployed (e.g. cases of asset scarcity) and when they are reversed (e.g. absorption in times of QT).

Asset scarcity associated with the Eurosystem footprint during QE

The increase of the Eurosystem's footprint in bond markets during the QE period resulted in a reduction in the quantity of bonds available to market participants, causing a range of effects related to asset scarcity across markets. Scarcity is priced by a specialness premium in the repo market, where market participants compete for bonds obtained as collateral. During QE, a specialness premium largely driven by central bank asset purchases drove down repo rates.[74] This scarcity in the repo market also affects the cash bond market, as specialness is priced in bond yields (**Chart 14**).[75] By its nature, scarcity may affect the monetary policy stance differently, depending on the synchronisation of rate and balance sheet policies: collateral scarcity driven by asset purchases *reinforces* the monetary policy stance when coinciding with rate cuts, but it reduces the transmission of rate hikes, all else being equal, when rate hikes are not accompanied by a decrease in central bank footprint.[76]

While effective in lowering yields, a large and protracted increase in the central bank footprint has ambiguous effects on market functioning and been associated with deteriorating bond market liquidity and fixed income mispricing.[77] Central bank asset purchases inject liquidity and can provide a backstop to disrupted bond markets, thereby supporting market liquidity.[78] But over a longer-term horizon, after stress has subsided, the Eurosystem's footprint has been found to be associated with lower liquidity, especially in the secondary corporate bond market.[79] A greater footprint has also been accompanied with larger fixed income mispricing, for instance a widening in the cash-futures bond basis, indicative of increasing market frictions across cash bond, repo and futures markets.[80]

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74 See, for instance, D'Amico et al. (2018); Arrata et al. (2020); Corradin and Maddaloni (2020); Carrera de Souza and Hudepohl (2024); and Grasso and Poinelli (2024).

75 Jappelli et al. (2023). See also Linzert et al. (2024a) for a recent empirical investigation of the link between repo and asset swap.

76 Nguyen et al. (2024) show that the degree of pass-through of the ECB's first rate hikes in 2022 on the cross-section of bond repo rates was inversely proportional to repo scarcity.

77 For an overview of theoretical mechanism and a review of empirical evidence, see, for instance, Benigno et al. (2023).)

78 Bernardini and De Nicola (2025) show that purchases of government bonds under the PEPP helped to improve market liquidity at the height of the pandemic crisis in spring 2020.

79 Ferdinandusse et al. (2020) model this "price-liquidity trade-off". See, for instance, Blix-Grimaldi et al. (2021). Corporate bond illiquidity driven by the CSPP is documented for instance by Abidi and Miquel-Flores (2016), Todorov, K. (2020) and Boneva et al. (2024). See also Economic Bulletin, Issue 3, European Central Bank, 2018.

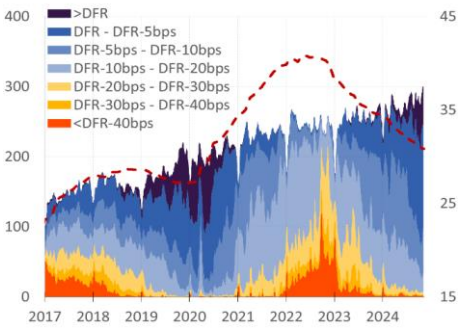
80 Pelizzon et al. (2024).

Chart 14

Eurosystem footprint and asset scarcity across repo and cash bond markets

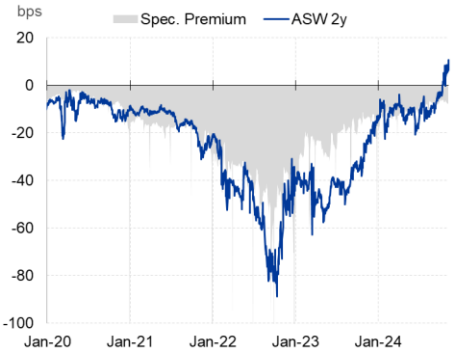
Distribution of repo volumes by specialness and Eurosystem footprint

(left-hand scale: EUR billions, right-hand scale: footprint as a percentage of eligible assets)



Specialness premium and German two-year asset swap (bond yield – overnight interest swap)

(basis points)



Left panel: Source: MMSR. ECB.
Notes: Eurosystem footprint in the EGB market is measured as the share of the Eurosystem's euro area government bond holdings and mobilised collateral compared to nominal amount outstanding. Outright holdings are euro area government bonds held by the Eurosystem via purchase programmes, adjusted with euro area government bonds lent back via the Securities Lending against cash programme. Mobilised collateral includes euro area government bonds mobilised as collateral for open market operations.
Right panel: Source: MMSR. Bloomberg.
Notes: Specialness premium is the weighted average repo rate spread against the DFR. Asset swap is computed as Yield-OIS. Specialness premium is a weighted average of German government bond repo rates spread against DFR. The latest observation is for 3 December 2024.

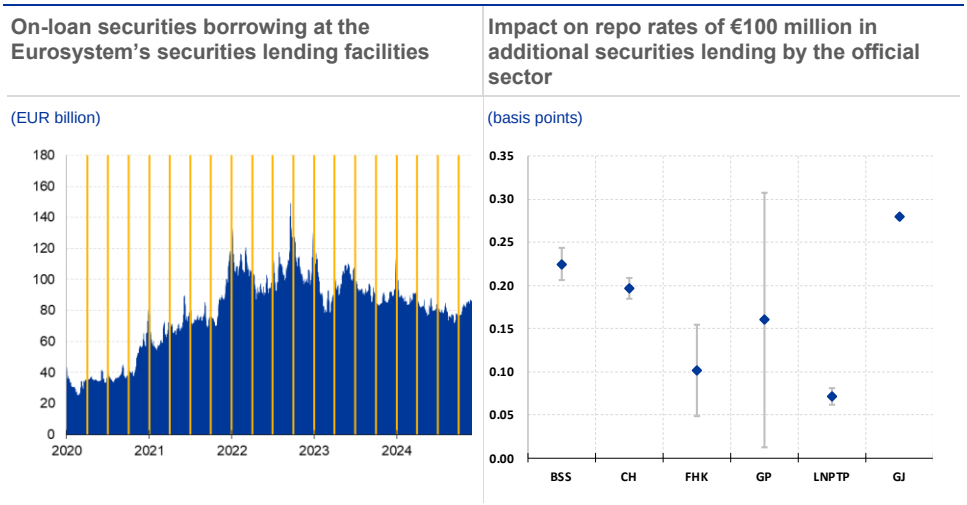
Adverse effects on market functioning can be partly counteracted by the design of central banks' instruments. For instance, while PEPP purchases have generally contributed to scarcity, flexibility in purchases has been found to limit the negative impact of asset purchases on the functioning of repo markets.[81] Securities lending facilities (SLFs) designed to lend bonds purchased under QE back to the market have been instrumental in alleviating the adverse consequences of repo market scarcity. This is particularly clear from the take-up of the Eurosystem's SLFs around the end of each quarter and each year, typically periods when intermediation capacity is constrained and collateral squeezed (**Chart 15**).[82]

81 Grasso and Poinelli (2024).

82 See, for instance, Baltzer et al. (2022); Greppmair and Jank (2023); Carrera de Souza and Hudepohl (2024); Grasso and Poinelli (2024); and Linzert et al. (2024b).

Chart 15

Securities lending take-up and effects on specialness



Source: ECB.
Notes: Left panel:Market value of on-loan daily balance of securities lent by the Eurosystem. Yellow lines represent end of quarter dates. The latest observation is for 30 November 2024. Right panel: BSS: Baltzer et al. (2022), CH: Carrera de Souza and Hudepohl (2024), FHK: Fleming et al. (2010), GP: Grasso and Poinelli (2024), LNPTP: Linzert et al. (2024a) estimate elasticities on SLFs run by debt management offices and central banks, GJ: Greppmair and Jank (2023). BSS and CH explanatory variables are rescaled from percentage of a bond's free float to EUR 100mn. GJ studies the impact of the implementation of a new pricing in the ECB SLF, and not transaction flows. All the papers study the Eurosystem's SLFs, except for FHK, who study the Fed's Term SLF.

Absorption challenges during the QT phase

QT in the euro area has proven to be smooth so far, both because it was implemented gradually and predictably and because it occurred in a context that supported final investors' absorption capacity and benefited from dealers' spare intermediation capacity. Increasing net supply during QT came primarily from governments but also from corporates and banks, with banks partly substituting TLTRO funding by issuing long-term debt. When Eurosystem net asset purchases and then reinvestment ended, traditionally elastic investors in the government bond market (e.g. the foreign sector) stepped in, while banks and insurance companies had a limited absorption role. Households, especially in some countries, were also major net buyers, as debt management offices actively tapped retail investors via tailored issuances (**Chart 16**).[83] Rising bond yields supported the demand for government bonds, with QT starting in the euro area when bond yields were reflecting the rate-hiking cycle underway and already at attractive levels compared with other investments (e.g. deposit rates).

The price impact of debt supply absorption crucially depends on the outstanding stock of marketable debt, the price elasticity of the marginal investor and the availability of risk-bearing capacity on investors' balance sheets.[84] Demand system approaches can be used to estimate the price elasticity of

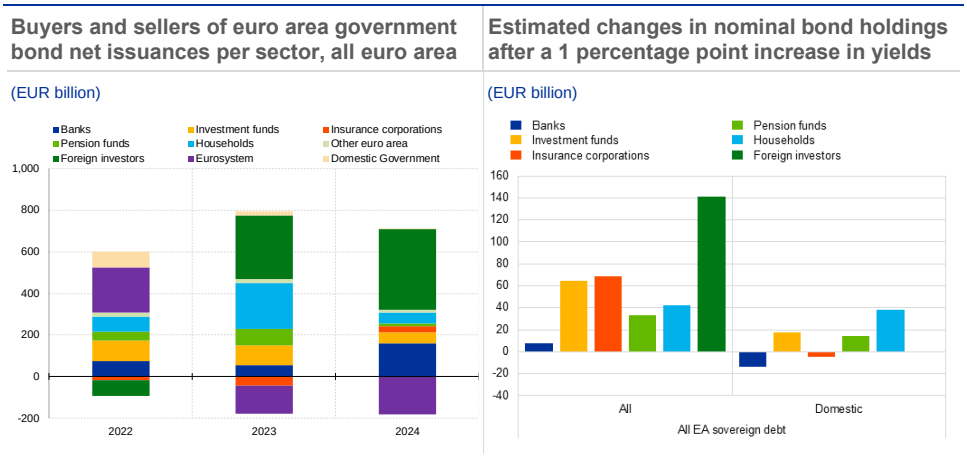
[83] For an international perspective, see Eren et al. (2023) and Du et al. (2024). For a similar analysis on the corporate bond market, see Mäkinen and Vaz Cruz, Economic Bulletin, Issue 5, European Central Bank , 2023a, which suggessts a similar absorption pattern, while bond issuance and holdings by banks also allowed a smooth redistribution of liquidity within the banking system.

[84] See, for instance, Koijen et al. (2021); Breckenfelder and de Falco (2024); and Fang, et al. (2024).

each investor sector and simulate the price impact of QT.[85] The observed change in yields since the start of QT has been broadly consistent with model-implied market-clearing yields, suggesting that QT has not triggered an abnormally high price impact compared with historical regularities.[86] Sensitivity analysis suggests that the absorption by foreign investors was key to limit yield increases (**Chart 16**). The price impact of QT is a function of both marginal investors' price sensitivity and their capacity to bear market risk. Analysis suggests duration risk offloaded during QE created available risk-absorption space during QT, despite rising rates.[87] Price-sensitive investors, such as investment funds and foreign private investors, reduced their duration and credit risk exposures more significantly during QE. By contrast, price-insensitive investors, such as insurance companies and pension funds, maintained exposures closer to historical levels. This dynamic created "risk-absorption space" for the QT phase, with price-sensitive investors taking on a larger share of sovereign bond adjustments. These absorption patterns are also likely to reflect significant differences in the growth rates of the different institutional sectors. For example, investment funds have grown significantly faster than insurance corporations in the euro area over the last decade.

Chart 16

Investor sector absorption of government debt net issuance and price elasticities



Sources: Left panel: ECB and SHS. Right panel: ECB Securities Holding Statistics by Sector (SHSS) and Eurosystem (SHSE), SEC, CSEC, Centralised Securities Database (CSDB) and ECB-DGMF calculations.
Notes: Left panel: the chart shows an estimate of the flows into euro area public sector debt securities based on SHS data, split between a range of euro area investors (banks, households, etc.) and foreign investors. Each bar adds up to net issuance. The latest observation is 30 September 2024. Right panel: the demand system is based on bond-level regressions for each euro area sector, where the dependent variable is the log of nominal bond holdings. The sample includes observations between the second quarter of 2014 and the third quarter of 2023. All regressions include a constant, security and holder area fixed effects, yield to maturity, US ten-year yields to proxy returns on alternative foreign assets and VSTOXX volatility index. Yield to maturity is instrumented by high-frequency yield data on ECB Governing Council meeting dates. For further details, see Box 1 "Sovereign bond markets and financial stability: examining the risk to absorption capacity", Financial Stability Review, ECB, November 2023.

Smooth absorption of QT also requires sufficient dealer balance sheet capacity to intermediate the increasing net supply. Dealers' intermediation constraints, especially in the United States, have been at the core of several market malfunctioning episodes, which caused illiquidity and stress in the Treasury market.[88]

85 For a thorough discussion on demand systems, see Koijen and Yogo (2019).

86 See the internal ECB analysis.

87 See, for instance J. Schumacher and A. Ventula Veghazy (2025).

88 See, for instance, Afonso et al. (2021).

Analysis of dealers' balance sheets, together with proxies developed in the literature, such as the liquidity/volatility relationship and the observed price deviation around auction cycles, do not currently indicate particularly high intermediation constraints in the euro area by historical standards, although they show that capacity is diminishing.[89] However, close monitoring of market developments indicative of limits to arbitrage and intermediation constraints is warranted to gauge the smooth unfolding of QT (**Chart 17**).[90]

Chart 17

QT has not yet brought dealers' balance sheet capacity back to pre-QE utilisation

Dealers' intermediation capacity: debt outstanding of "big four" euro area governments

(debt outstanding scaled by primary dealers' capital)

Sources: IBSI, ESMA, debt management offices websites, RIAD.
Notes: Ratio of Debt outstanding from DE, FR, IT, ES net of ECB holdings, scaled by capital of Primary dealers registered as banks in EA. The latest observation is for August 2024.

2.2.5 Proportionality considerations and secondary objective

Proportionality is a fundamental principle in the Eurosystem's formulation and implementation of monetary policy, whose assessment, in practice, involves a careful evaluation of the scale, scope and timing of policy interventions. The principle of proportionality requires that acts of the EU institutions should (i) be suitable for achieving the stated objectives and (ii) not go beyond what is necessary to achieve them. From an economic perspective, this includes checking whether a measure is efficient in the sense that the intended goal could not be achieved through less intrusive policies in terms of economic and financial footprint and potential side effects. In practice, efficiency is evaluated by comparing the inflation outcomes of different measures, while bearing in mind possible side effects or synergies that may arise from the deployment of a comprehensive mix of tools. As such, it is important to factor in the specific economic circumstances prevailing at the time the measure is considered and implemented.

89 See Duffie (2023); Duffie et al. (2023); Ferrara (2024).

90 Other studies confirm the importance of dealers' constraints. Kerssenfischer and Helmus (2024) exploit outages on the futures market as natural experiments and confirm that these exogenous shocks to dealer capacity cause dysfunction on the euro area bond market. Dealer banks can also act as important liquidity providers in government bond markets during episodes of market stress (see Abbassi et al., 2024).

Key Governing Council decisions that supported the transmission and efficiency of monetary policy during the recent tightening cycle were informed by a careful proportionality assessment. For example, to limit threats to the smooth transmission of monetary policy across the euro area at the onset of the latest rate-hiking cycle, the Governing Council announced the TPI in July 2022. The necessity for the new instrument rested on the potential future need to counter significant risks of unwarranted, disorderly dynamics in bond markets that posed a threat to monetary transmission as monetary policy normalised, which could not be achieved by other instruments, including OMT, that had been designed to address different contingencies. Among other design features, the targeted and limited nature of any potential intervention, the objective indicators informing the Governing Council's assessment of the risks to transmission and neutrality with respect to the monetary stance made TPI proportionate to counter these unwarranted disruptions in bond markets. Another example relates to changes in the remuneration of minimum reserves. To improve the efficiency of monetary policy implementation, the Governing Council reduced the remuneration on minimum reserves in October 2022 from the main refinancing operation (MRO) rate to the DFR, and further, in July 2023, from the DFR to 0%. Doing so reduced the overall amount of interest that needed to be paid on reserves to implement the appropriate stance, while ensuring the full pass-through of interest rate decisions to money markets. Proportionality considerations also informed the calibration of the pace of QT. In particular, the December 2023 decision to advance the normalisation of the balance sheet by tapering reinvestments under the PEPP earlier than had been previously indicated was motivated, among other elements, by proportionality considerations. As the impact from the pandemic was gradually fading, it was no longer necessary to maintain full reinvestments.[91]

Financial stability remains a precondition for achieving price stability, and vice versa. In this regard, the resilience of the financial sector is a necessary condition to prevent a potential conflict between price and financial stability. Financial turmoil can impair monetary transmission in the short run and the associated economic fallout poses risks to price stability in the medium term. Conversely, very accommodative monetary policy can lead to a build-up of financial stability risks, while a very sharp tightening of monetary policy can crystallise those risks. In recognition of this relationship, and following the conclusion of the last strategy review, the Governing Council conducts an in-depth biannual assessment to evaluate how financial stability considerations might affect monetary policy decisions. By systematically analysing their interplay, the ECB aims to ensure that its policy measures are not only effective in controlling inflation but also supportive of a stable financial environment and guided by the implications of financial stability risks for medium-term price stability. The conclusions from these discussions are also reflected in the Monetary Policy Statement twice a year. In the most recent period, potential financial stability risks from the rapid tightening of monetary policy did not materialise, reflecting several

[91] See the Account of the December 2023 monetary policy meeting.

factors, most notably the strong capitalisation and solidity of the banking sector, which in turn reflected micro and macroprudential policies.[92]

Assessing the impact of monetary policy measures on the secondary objective is also an important dimension of proportionality.[93] When faced with multiple policy options that can achieve similar outcomes in terms of price stability, the ECB has to choose the approach that best supports the general economic policies in the Union. For example, between October 2022 and December 2024, the ECB steered its reinvestments in corporate sector securities towards issuers with a better climate performance. This aims to better account for climate-related financial risks on the Eurosystem balance sheet and, in alignment with the ECB's secondary objective, to support the green transition, consistent with the EU's climate neutrality goals.

Output and employment are also key elements that the ECB considers when deciding on policy measures. By maintaining price stability, the ECB creates an environment conducive to economic stability and growth, which indirectly supports employment and output. In addition, economic slack also affects future inflation through the Phillips Curve relationship. Avoiding unnecessary volatility in output and employment is also one justification for aiming to achieve the inflation target over the medium term, which can mean looking through shocks that cause a temporary trade-off between inflation and output (as discussed in detail in **Section 3.1**). In the most recent period, the trade-off between inflation and output/employment was less pronounced than could have been expected based on historical regularities, enabling the ECB to forcefully tighten monetary policy without causing the unemployment rate to rise.

2.2.6 Lessons learned for the future use of instruments

Drawing on previous discussions (Sections 2.2.1-5), this section summarises the lessons learned for the future use of instruments. It starts by extracting a set of high-level key takeaways that are relevant to the monetary policy strategy. These largely confirm the findings of the Monetary Policy Strategy Review 2020-21, but with some qualifications. Subsequently, the section provides an overall assessment of each individual instrument with the aim of distilling specific lessons learned regarding their design.

Overarching key takeaways

The set of monetary policy instruments deployed by the ECB at the ELB has proven effective in countering deflationary risks close to the bound and in

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92 In this context, see also Gouverning Council Statement on macroprudential policies (2024) the importance of the complementarity between monetary and macroprudential policies that has already been stressed in the in the context of the Monetary Policy Review 2021 and has been extended by the focus on resilience of recent macroprudential policies (see, for instance, Hempell et al., 2024 and Detken et al., 2025 mimeo).

93 See Box 8 of the Annual Report 2023 for a detailed overview on how the secondary objective is considered in the conduct of the ECB's monetary policy and reporting activities.

safeguarding monetary policy transmission, so all of them should remain in the ECB's toolkit. The evidence reviewed above confirms the unique role of each instrument in that toolkit. Some instruments aim to ease the monetary stance in recognition of the ELB for policy rates. In exceptional circumstances, both in principle and in practice, as shown by the experience of the ECB and other major central banks, there is also a role for transmission tools also outside the ELB to tackle episodes of market dysfunction, including to counter unwarranted, disorderly market dynamics that threaten the smooth transmission of monetary policy. Among the purchase programmes with an element of safeguarding transmission built into their design, instruments differ as to whether they entail actual purchases (like the PEPP, or the Bank of England's temporary gilt purchases in autumn 2022) or constitute backstops with their activation conditional on several eligibility criteria (like the TPI or OMTs). Overall, the establishment or deployment of new tools (like the TPI), as well as changes in the calibration of existing tools (like TLTRO III and the PEPP) on account of the pandemic, has shown that the ECB's toolkit is adaptable in the face of new challenges.

The sequencing of policy instruments once the primary tool's policy space is exhausted depends on the real-time assessment of the marginal cost and benefits. When policy rates reached zero during the low inflation period, the ECB initially deployed stance-oriented instruments in a staggered fashion, reflecting uncertainties regarding their effectiveness and side effects. Experience confirms that the policy rate is the primary instrument away from the ELB, while other stance-oriented instruments should be used only once the space for policy rate action above zero is exhausted. There is, however, no a priori optimal sequencing for the remaining set of policy instruments. Sequencing ultimately needs to be assessed in real time based on the marginal cost and benefits.

The analysis in the previous sections confirms the advisability of deploying a mix of instruments near the ELB, rather than the intensive use of single instruments. The empirical and theoretical evidence suggests that the side effects of a single instrument tend to increase with the intensity of its use and, in some cases, the marginal effectiveness of a single instrument declines as it is used more extensively. Moreover, when combined, balance sheet tools, forward guidance and NIRP tend to reinforce one another. For example, NIRP, forward guidance and asset purchases primarily work through different tenors and components (term and other risk premia, as well as the rate expectations component) of benchmark curves. These arguments underline the importance of diversification near the ELB to minimise side effects for a given macroeconomic effect. At the same time, depending on specific design features, an active blending of instruments can also risk creating undesired effects. For instance, unconditional time-based guidance on asset purchases over a pre-determined and extended horizon may interfere with state-based rate forward guidance – if coupled with a sequencing commitment whereby purchases have to end before rates can be raised – thereby reducing policy flexibility to respond to inflationary shocks in an agile way.

More generally, the analysis suggests that there is a clear trade-off between commitment and flexibility if macroeconomic and financial circumstances

change unexpectedly and substantially. As underlined during the recent inflation surge, the design of stance instruments creates a trade-off between binding one's hands at the ELB (desirable to combat deflationary risks) and flexibility (desirable if the inflation environment changes abruptly). While a strong commitment usually implies larger stance effects, a flexible policy design limits the need for ex post adjustments arising from unexpected changes in the economic environment. Therefore, the choice, design and implementation of instruments needs to recognise the constantly evolving financial and macroeconomic conditions and enable an agile response to new shocks.

The updated assessment confirms the importance of continuously monitoring side effects and pockets of vulnerability in the economy and the financial sector, while concluding that side effects have remained broadly contained. In 2021, the previous monetary policy strategy review concluded that the side effects of monetary policy tools on banks were generally contained. While these tools exerted pressure on the NBFI sector, fostering increased risk-taking and search-for-yield behaviour, the overall assessment on side effects for the broader financial system was reassuring (see **Section 2.2.3**). More recently, the change in the interest rate environment since the start of the tightening cycle has provided a tailwind for bank profitability, and the deterioration in asset quality observed in recent years has been below historical regularities, confirming the robustness of banks' balance sheets. Effective regulation and supervision of the euro area banking system has played a key role in this regard and also helped limit spillovers from the March 2023 banking sector turmoil in the United States and Switzerland. The NBFI sector saw some reduction in credit and duration risk-taking during the tightening phase, but structural vulnerabilities from liquidity mismatches and leverage remain elevated and have the potential to amplify shocks and undermine wider financial stability. The increasingly important role that the NBFI sector plays in monetary policy transmission, including by providing credit to corporates and sovereigns, and the less stringent regulations applicable to the sector highlight the relevance of monitoring sectoral risks. It also underscores the importance of enhancing the resilience of the sector from a (macro)prudential perspective, with a focus on liquidity mismatch, leverage and enhancing preparedness for margin and collateral calls. The expansion of the Eurosystem's footprint in bond markets during the QE period contributed to collateral scarcity, although the adverse impact was partly mitigated by measures such as the Eurosystem's SLF and faded with balance sheet normalisation. Broader side effects on real estate markets, productivity and borrower credit risk, and distributional effects on households and across regions, have also remained generally contained in recent years, with the increase in the price level having contributed to private-sector deleveraging.

Side effects on central bank profitability turned out to be more severe than expected in 2021, as the policy tightening required to counter the inflation surge resulted in significant losses, although these do not threaten the Eurosystem's ability to maintain price stability. Risks for central bank profits, related to rate hikes in the presence of still ample excess liquidity, materialised in much more pronounced losses than even those envisaged in the adverse scenarios of the previous strategy review documentation of 2021. However, these losses do

not undermine the Eurosystem's ability to fulfil its primary objective of maintaining price stability. It is also important to put these losses into perspective, as QE had previously exerted favourable effects on monetary income and government finances at large, as sovereigns locked in low funding rates at longer maturities and QE improved macroeconomic outcomes That said, financial strength and adequate capital, including from pre-emptively building buffers for financial risks, help to support monetary policy credibility. Where two alternative instrument designs are judged to deliver the same effectiveness in terms of price stability, the preferred design should be the one that is more efficient including along the (projected) central bank income dimension.

Overall, the general lessons from recent experience suggest that all tools should remain in the toolkit – with their use subject to a comprehensive cost-benefit analysis to ensure proportionality – while their choice, design and implementation should embed sufficient flexibility to allow for an agile response to changes in the inflation environment. The analysis underscores the need to continuously monitor side effects of monetary policy measures, including those that, like financial imbalances, may take time to build up and only materialise with a lag. In this context, it is important to continue performing careful proportionality assessments when deploying or adjusting additional monetary policy instruments, with a view to minimising their side effects without compromising price stability.

Negative interest rate policy (NIRP)

Negative interest rates remained effective in easing financial conditions during the ELB period, as the reversal rate was not reached. NIRP had a sizeable downward effect on the benchmark forward curve and caused financial asset prices to rise across the board. Its effects were amplified by the easing bias, whereby the policy opened up the possibility that interest rates could fall even further, and by large levels of excess liquidity subject to negative rates generated by QE and TLTROs. The empirical evidence on the effects past the first layer of transmission (financial conditions), including on bank loan growth and inflation, largely confirms the effectiveness of the policy, even though challenges in setting deposit rates below zero, especially for households, dampened the impact to some degree. Moreover, most of the evidence suggests that the reversal rate – the rate at which further rate cuts could become contractionary – was not observed in the euro area during the period in which NIRP was in place. Nonetheless, the *reversal rate* is possibly time-varying and depends on the design of negative rates (including, for example, tiering or sequencing between QE and NIRP) and other factors, including outside options for depositors.

The side effects of NIRP on bank profitability remained contained owing to tiering and other factors. Banks' hesitation to pass on negative rates to depositors, and even legal limitations in some jurisdictions, compressed margins while boosting loan volumes. Some factors, however, helped to contain adverse effects on bank profitability, including: (i) the gradual steps made into negative territory; (ii) the ability of some banks to limit NII compressions by passing on the cost to large (and

immobile) deposits; (iii) the exemption of borrowed funds from the NIRP tax through favourable TLTRO III pricing; and (iv) the two-tiered system of reserve remuneration. This confirms the earlier rationale for a gradual implementation of future NIRP at *unprecedented* negative levels. At the same time, the experience in the pre-pandemic rate easing cycle suggest that cuts into negative territory could rely on standard 25 basis point steps rather than 10 basis point steps in the future, until the DFR reaches -0.5%. Nonetheless, possible side effects of NIRP warrant close monitoring.

Rate forward guidance and sequencing with asset purchase guidance

When the ability to adjust policy rates is constrained in the vicinity of the ELB, rate forward guidance can be an effective tool if calibrated appropriately. Rate forward guidance helps to ease the stance when the economy is faced with one-sided, persistent disinflationary shocks that push it towards the ELB. This it does by compressing benchmark rates at short to medium tenors, thus shielding them from macroeconomic news, as well as by aligning market expectations with policy intentions. At the same time, it is important to be clear in communication that persistence is a means to overcome the ELB rather than a promise to keep rates permanently low. Rate forward guidance can also be useful when shocks become two-sided following a long time at the ELB. In this case, it can help lay out the conditions for rate lift-off in a way that hedges against false positives and prevents a premature tightening (type-1 error), and thereby reduces uncertainty about the future path of rates. However, such guidance can become less helpful when uncertainty about the persistence of inflationary shocks is high, as under such conditions the risk of delayed lift-off (type-2 error) may rapidly increase.

State-based rate forward guidance preserves more flexibility by allowing for endogenous adjustment to changes in the macroeconomic environment. State-based guidance has the advantage of leading to an effective, endogenous adjustment in market expectations when economic circumstances change (see **Section 3.2** for a detailed discussion). It thus anchors rate expectations to a state-contingent path, while embedding the ability to adjust to changes in the environment. However, the increased flexibility may come at the cost of effectiveness if market pricing becomes overly sensitive to individual data points. Flexibility may, at times, result in excess volatility in financial markets if market participants misjudge the central bank's reaction to new data. Moreover, the underlying conditions can never cover all possible contingencies and, if unforeseen contingencies materialise, state-based guidance can delay – what can in hindsight be viewed as – a timely lift-off.

While state-based rate forward guidance is preferable in principle, in exceptional situations time-based rate forward guidance could be considered if the likelihood of an abrupt change in the environment is assessed to be low. Such time-based guidance, if perceived as credible, is arguably more effective than state-based guidance in anchoring market expectations to a predetermined rate path. If state-based rate forward guidance proves insufficiently effective in easing the stance, if deflation threats are particularly severe, or if the cessation of another

easing measure, such as asset purchases, necessitates a stronger rate path commitment, carefully calibrated time-based rate forward guidance could offer a pragmatic solution. However, the stronger commitment comes at a cost of being inflexible if economic conditions change unexpectedly.

Putting less emphasis on point forecasts and paying more attention to risks around the baseline outlook in the design of lift-off criteria could reduce the vulnerability of state-based rate forward guidance to large projection errors (see Section 3.2 for a more in-depth discussion). By linking the outlook condition exclusively to the baseline projection, the formulation was not robust enough to forecast uncertainty, which was exceptionally large in the first half of 2022. A broader notion of the outlook, encompassing uncertainty and the balance of risk, could increase flexibility to enable a more agile response to changes in the inflation environment (see also **Chapter 4**). For example, while the baseline projections before June 2022 foresaw inflation below 2% over the medium term, the Governing Council assessed risks to the inflation outlook to be tilted to the upside in February 2022 and continued to emphasise upside risks at the March and April 2022 monetary policy meetings.

Escape clauses could be considered in the design of future rate forward guidance, carefully weighing the benefits of increased policy optionality against the cost attached to a perception of discretion, which could reduce effectiveness at the ELB (see Section 3.2 for a more in-depth discussion). While escape clauses expand optionality and may look desirable in an ex post evaluation, they come at a cost of complexity and potentially the effectiveness of rate forward guidance in countering deflationary risks. In particular, the stance purpose of committing in advance under forward guidance is specifically to reduce optionality – in other words to limit discretion and to reduce upside risk to the forward rate path. In principle, escape clauses are more natural for time-based forward guidance, which by nature lacks flexibility to react to changing circumstances, but such clauses may also be useful if state-based forward guidance is linked to stringent lift-off criteria and time-based commitments for asset purchases. In the future, consideration could also be given to specifying less stringent state-based rate forward guidance conditions for exiting from NIRP than for increasing the DFR above zero. Such a “bifurcated” formulation, although more complex, could strike a balance between providing more flexibility to exit NIRP faster if needed while still exerting the desired easing in an environment of low inflation and macroeconomic uncertainty.

Stance-geared asset purchases close to the ELB

Through its transmission across a variety of channels, QE remains an effective instrument to ease the monetary stance near the ELB. The analysis presented in **Section 2.2.1** confirms the assessment of the Monetary Policy Strategy Review 2020-21 that purchases of both sovereign and corporate bonds are an important instrument for stimulating the economy at the ELB and reducing deflation risks, primarily through duration extraction. In particular, announcement effects of large QE programmes, such as from the initial introduction of the APP and the PEPP, were

sizeable because the “shock and awe” strategy underlined the ECB’s commitment to price stability and reduced perceived deflation risk. At the same time, through the duration extraction channel, the stock effects of asset purchases eased the stance by persistently compressing term premia, thereby lowering financing costs. Moreover, the corporate sector purchases directly reduced yields on corporate bonds, stimulated their issuance and further supported bank lending by freeing up capacity on banks’ balance sheets.

The effects of QE are, however, state-dependent and their marginal impact from a more intense use may diminish. A broad body of literature shows that the effectiveness of stance-based QE increases with the depth of economic recession and associated deflationary risks, the degree of financial market stress (which may also link to transmission-based elements of QE – see below), the relative share of price-insensitive investors, the degree of coordination with fiscal policy, the proximity of short-term rates to the ELB and the steepness of the term structure. Some of these conditions, including the steepness of the yield curve, suggest that the marginal effects of QE diminish and there is some empirical evidence of diminishing effects from a more intensive use. At the same time, other studies, especially those that take into account anticipation effects related to QE announcements, do not find effects diminish as QE programmes are expanded.

Potential side effects of QE should continue to inform the design of stance-based QE programmes in the future. Even though side effects have so far generally remained contained, asset purchase programmes can have unintended consequences, such as posing challenges to market functioning, possible increased moral hazard by sovereigns, and potential negative effects on future central bank profitability upon a sharp reversal in policy rates. In particular, depending on its duration and nature, QE may eventually result in sustained losses in bond portfolios, especially if purchases are made when interest rates are already negative and bonds are therefore well above par value at the time of purchase. Such losses can be very pronounced in the event of a sharp interest rate reversal and can take years to recover if the proceeds and profits from the use of QE in its early phases are not set aside to compensate for potential future losses. Persistent losses also bring the risk of reputational costs. In line with the proportionality principle, future stance-based QE programmes need to take into account the experience of the past decade when their benefits are weighed against their side effects. For instance, the ECB’s Securities Lending Programme supported bond and repo market liquidity without unduly curtailing normal repo market activity, thus reducing safe asset scarcity associated with QE.

Careful consideration should always be given to the monetary policy case for conducting asset purchases, assessing their effectiveness and efficiency, including any side effects, as well as their complementarity relative to alternative policy instruments. For example, these considerations suggest caution in purchasing bonds with yields below the DFR owing to a reduced effectiveness and potential upfront losses. More broadly, consideration should be given to the state in which purchases are to be conducted and to the effectiveness and efficiency of purchases relative to alternative policy instruments. As such, the activation or re-

sizing of purchases should be decided on a case-by-case basis, depending on the prevailing circumstances.

While the design and calibration of QE ultimately depend on the circumstances, purchases should target sufficiently long maturities when the aim is to ease the monetary stance, and private sector purchases can complement sovereign bond purchases. The ECB has experimented with different designs for its asset purchases. Conceptually, envelopes that are flexibly allocated across time, but not necessarily used in full, may be more effective than a possibly open-ended, monthly purchase pace. This is because a flexible allocation allows frontloading of purchases when flow effects are largest and financial market stress may be high. Envelopes can also reap beneficial announcement effects and provide a means to avoid purchases of bonds with yields significantly and persistently below the DFR. Regarding the duration of bond purchases, sufficiently long maturities should be targeted when the aim is to ease the monetary stance Limiting purchases to bonds with a lower average maturity would accelerate a future passive QT, thereby allowing the central bank footprint in bond markets to decrease more quickly. The concomitant smaller amount of duration risk on the central bank's balance sheet would also reduce future losses in the bond portfolio in the event interest rates rise again rapidly. However, by construction, it would also extract less duration per euro spent, implying that larger purchase volumes would be required to achieve the same stance effects. This, in turn, would reduce or even exhaust the available policy space, possibly leading to larger capital key deviations and market functioning problems. Finally, the types of asset purchased may also depend on the specific situation. For example, private sector purchases have a more direct bearing on real economy financing conditions and, once introduced, their design can be adjusted to support the EU's climate targets, without prejudice to price stability. That said, private sector purchases are arguably more intrusive with respect to private credit allocation and come with higher credit risk for the central bank balance sheet, although broad-based bond purchases can mitigate the first concern and credit risk should, in all expectation, be compensated for by the (higher) yield on corporate bonds.

Asset purchases to safeguard smooth transmission (also away from the ELB)

Conditional backstops, namely the TPI and OMTs, effectively and efficiently safeguard monetary transmission, also away from the ELB. By committing to, in principle, unlimited purchases ex ante, the backstops provide insurance against – and thereby effectively remove – volatility in sovereign risk premia not warranted by fundamentals, without necessarily the obligation to purchase bonds ex post. For example, the TPI helped to limit unwarranted fragmentation risk as policy was normalised, ensuring an even transmission of monetary policy and enabling more forceful rate tightening in response to the inflation surge than would otherwise have been possible. At the same time, the comprehensive set of ex ante eligibility criteria of the TPI and the ex post conditionality of OMTs ensure that dynamics in sovereign risk premia continue to reflect country, area-wide and global fundamentals. A key

distinction between the TPI and OMTs is that the former can be activated at the discretion of the ECB, whereas activation of the latter depends on a country having requested ESM support beforehand. In any case, a decision by the Governing Council to activate either of these instruments will always be based on a comprehensive assessment and a judgement that the activation of purchases is proportionate to the achievement of the ECB's primary objective.

High sovereign debt levels may create perceptions that backstop measures undermine incentives for sound public finances, but markets understand that backstop measures are not unconditional, thereby preserving a high degree of market discipline. While backstop measures are, in principle, unlimited ex ante – a feature needed for them to work credibly – they are not unconditional. As a case in point, eligibility under the TPI depends, inter alia, on sound and sustainable fiscal and macroeconomic policies. At the same time, backstop measures might create moral hazard concerns at a time of already high sovereign debt levels. Nevertheless, recent movements in sovereign bond spreads suggests that some market discipline for sound fiscal policy is still at work.

Quantitative tightening (QT)

The passive reduction of the Eurosystem's balance sheet has gone smoothly, providing a gradual and predictable tightening impulse. The balance sheet normalisation has proceeded smoothly to date and has been well absorbed by financial markets. It was well anticipated and thus accompanied by smaller shocks upon announcement than QE. While the effects of QT might not always be symmetric to QE, depending on the relative strength of the different transmission channels, empirical evidence so far points to a rather symmetric impact of passive QT in the euro area. Moreover, the evidence suggests that gradual QT had a much lower – though reinforcing – impact than rate hikes early in the tightening cycle, given that QT was conducted under non-stressed market conditions. Even though the gradual decompression of term and sovereign risk premia has been and will continue to be very persistent, consistent with a slow unwinding of the duration extraction channel, rate policy can be used to deliver the intended stance. However, the gradual shrinking of the balance sheet also implies a slower recovery of the policy space for potential future asset purchases.

Active QT would have caused a faster term premium decompression, albeit at the risk of creating market tensions and pronounced credit restrictions; it could nevertheless be considered in the future for purchases geared exclusively towards safeguarding transmission. Passive QT tightens the stance gradually and avoids excess volatility in rate expectations and premia, while other instruments, such as the TPI, can safeguard transmission. However, active QT could be considered if purchases are made solely with a focus on safeguarding monetary transmission. In particular, shrinking the balance sheet once there is sufficient confidence that the market stress which justified the initial intervention has been alleviated can limit any actual or perceived interference with the policy stance while minimising other potential side effects from a central bank footprint in bond markets.

With the benefit of hindsight, reinvestments under the PEPP could have been tapered somewhat more quickly, even though this might have created market volatility and posed credibility challenges given previous guidance on the duration of reinvestments. The transition from net asset purchases to full passive QT was very cautious: the announcement to stop net asset purchases under the PEPP was accompanied by a one-year extension of the time-based (full) reinvestment guidance and a temporary increase in monthly APP net purchases. With the benefit of hindsight, passive QT could have started somewhat earlier in light of generally small QT surprises and smooth absorption by price-sensitive investors, favoured by rising rates. In addition, the TPI limited unwarranted risks to the transmission.

Targeted longer-term refinancing operations (TLTROs)

TLTROs have supported credit intermediation by providing significant funding cost relief for banks, with the pricing of operations generally balancing effectiveness and side effects. The third series of operations offered banks long-term funding at very attractive conditions, with a strong easing impulse. The resulting broad participation of banks from all euro area countries supported bank lending conditions and allowed banks to accommodate the increase in credit demand triggered by the pandemic. At the same time, the attractive conditions also implied a larger subsidy to banks relative to market pricing, at the expense of the Eurosystem, with the pricing below the DFR directly reducing monetary income.

The recalibration of the TLTROs led to a fast unwinding of operations, which created a close alignment with the tightening of policy amid challenges to credibility. The initial design of the pricing scheme proved insufficiently robust to changing circumstances. Against extraordinary inflationary pressures, the October 2022 recalibration of the lending rate to align the costs of outstanding TLTROs to the DFR/MRO rate removed deterrents to early repayment, which led to a fast unwinding of the operations and contributed to a tightening in credit conditions alongside short-term rate hikes. In line with the intended direction of monetary policy, it resulted in higher funding costs, reduced liquidity, stricter credit standards and slightly lower lending volumes. While, taken in isolation, the ex post changes to loan conditions might have weakened the credibility and hence the attractiveness of future TLTROs, not changing the conditions would arguably have been more harmful for the credibility of the overall resolve of the central bank to maintain price stability.

TLTRO III was a powerful easing tool, but market participants widely regarded the pricing as complex, suggesting scope for simplification. The last series of TLTROs saw three thresholds in a cascading fashion, each giving specific rates over a given period. The fact that modalities of this tool were modified six times after the first announcement of TLTRO III only added to the complexity, although the adjustments were the response to unprecedented shocks and resulted in an increasing easing power. Future operations could be designed more simply, resisting the temptation to micromanage banks' incentives, also to reap announcement effects that might be absent if markets do not fully understand the instrument.

The design and pricing of future TLTROs should be robust to exceptional changes in circumstances. Owing to their highly favourable conditions, the third series of TLTROs boosted liquidity during the pandemic by avoiding stigma and supporting stability. However, unanticipated and exceptional developments meant that the sluggish adjustment in their pricing and long duration became counterproductive to the desired monetary stance during the inflation surge, requiring the ex post recalibration. The robustness of future operations could be increased by introducing an escape (or review) clause. Alternatively, and more specifically, operations could have a shorter duration and/or pricing formula that endogenously and proportionally adjusts to changes in the policy rate, bringing about an automatic alignment with the monetary stance, as was the case after the 2022 recalibration. Although a shorter duration would come at the cost of reducing the initial effectiveness of the tool, a dynamic pricing formula would have been (almost) as effective, as most banks did not expect a rate lift-off during the remaining TLTRO period when borrowing funds.

2.3 Assessment of the key ECB interest rates as the primary tool during the inflation surge

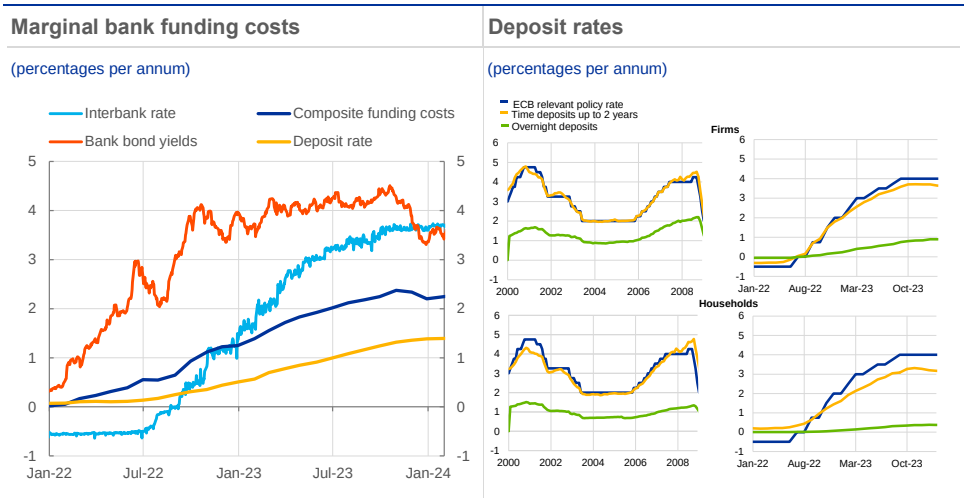
2.3.1 Factors shaping the strength of transmission at different steps of the chain.

The transmission of rate hikes cycle to unsecured money market rates during the 2022-23 tightening cycle was smooth and immediate. The overall low volatility observed in money market rates also played a role in this (Holm-Hadulla and Pool, 2025). Fragmentation in the unsecured overnight money market – the basis for deriving the reference rate for the euro (€STR) – remained contained, although certain measures increased for some countries as interest rates rose (Forti Grazzini and Soares, 2024). At the very start of the rate hiking cycle in 2022, some repo rates increased by somewhat less than the DFR. This was due partly to localised collateral scarcity, mainly for transactions collateralised by German government bonds (Nguyen et al., 2023; and Schneider, 2024; see also **Section 2.2.3**).[94] In late 2022, short-term secured money market rates gradually converged towards the DFR and, from then on, moved in lockstep with the DFR.

[94] An event study of October 2022 finds evidence that the specialness of German repo rates might affect the yield curve (Linzert et al., 2024a).

Chart 18

Transmission to bank funding costs, with a focus on deposit rates



Sources: ECB (BSI, MIR, FM, CSDB, MMSR), Markit iBoxx and ECB calculations.
Notes: Marginal funding costs are computed by weighing rates on new business costs of each component by outstanding amounts. Composite funding costs are a weighted average of deposit rates and average monthly bond yields and interbank rates, with outstanding amounts as weights. The ECB relevant policy rate is the MRO for the 1999-2008 panels and the DFR for the panels starting on 2022. The latest observation is for January 2024.

Financial markets rapidly internalised the ECB's pattern of reaction to changes in the inflation outlook. The gradual upward shift in the €STR forward curve throughout the tightening cycle was more than proportional to that in the inflation outlook as, for example, embedded in market-based measures of inflation compensation. This contributed to maintaining longer-term market-based inflation expectations close to 2%. Risk-free rates continued to have an anchoring role for sovereign bond yields and and sovereign bonds served as a key reference asset for pricing other bonds and as an important determinant of overall euro area financial conditions. Monetary policy was transmitted smoothly to sovereign bond markets and homogeneously across euro area corporate bond market borrowers, irrespective of their country of origin.

The cost of bank funding instruments increased substantially over the monetary policy tightening cycle, initially driven by the increase in bank bond yields and interbank rates, and progressively also by the increase in bank deposit rates (**Chart 18**, left panel).The response of overnight deposit rates was sluggish, while time deposit rates followed the ECB's policy rate more closely, as is usually the case, although the response was somewhat delayed and slightly weaker for households than for firms (Volk, 2023; and Mayordomo and Roibás, 2023) (**Chart 18,** right panel). There were several reasons for these patterns. First, deposit rates were above the policy rate during the period of negative policy rates that preceded the tightening cycle, with banks' deposit margins compressed or even inverted (**Chart 18, right panel**). Second, banks exhibited low funding needs in the context of weak lending. Third, banks faced less competition in some segments of the deposit market (Adalid et al., 2023), also due to slightly higher concentration in the banking sector than in the past (Kho, 2023; Mandler, et al., 2021; and Mayordomo and Roibás, 2023) and an abundance of overnight deposits following the period of negative policy rates. At the same time, banks faced pressure to

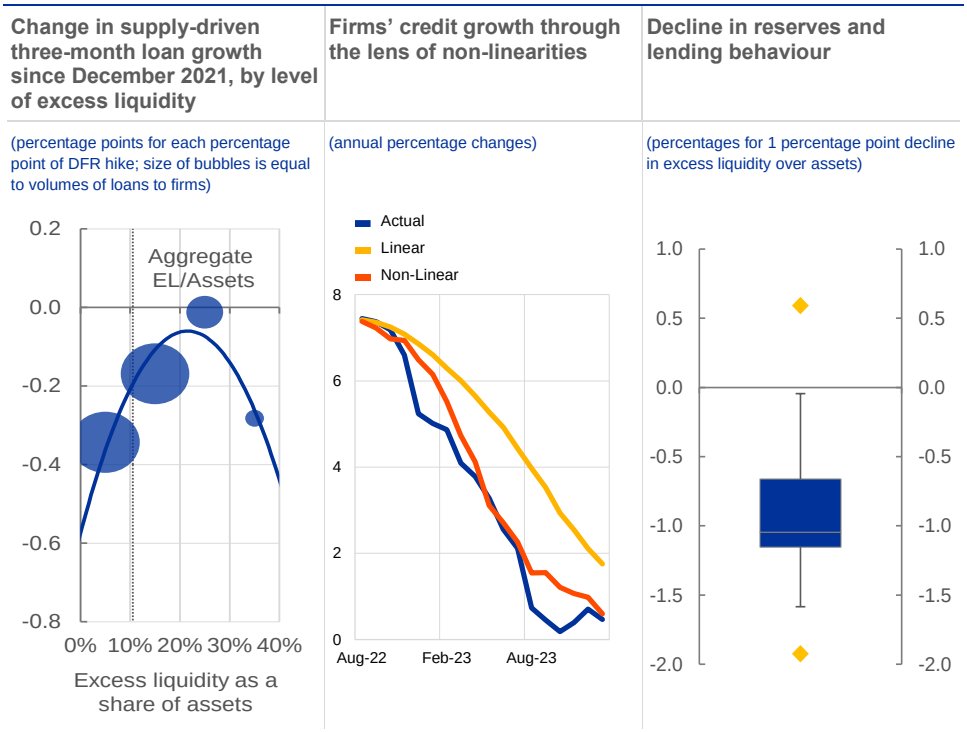
increase deposit rates from the issuance of targeted retail bonds by some governments. Finally, in the mature phase of the cycle, the inversion of the yield curve played a role, as the yields linked to maturities more relevant for pricing time deposits fell to levels significantly lower than the policy rate (see also **Section 2.2.3** on the side effects of QE on banks).

Portfolio rebalancing also contributed to higher funding costs for banks and reduced their deposit base. The deposit channel of monetary policy was particularly strong in the 2022-23 tightening cycle. This led firms and households to move a significant share of their unusually large stock of overnight deposits – accumulated during the long period of low interest rates – to time deposits, thus increasing bank funding costs. Depositors also moved part of their funds to bonds (Adalid et al., 2023). In parallel, the repayment of TLTRO funds after October 2022 also meant a reabsorption of liquidity and led banks to increase the issuance of bank bonds, an intrinsically expensive source of bank funding (Barbiero et al., 2024; and Burlon et al., 2025). These effects ultimately weighed on credit supply.

High excess liquidity did not impede the transmission of the monetary policy tightening impulse to bank lending. High levels of excess reserves, especially at the start of the tightening cycle, could have weakened the transmission for reserve-rich banks through a wealth effect, where the remuneration of reserves could have augmented capital buffers and led to expand the supply of lending (Fricke et al., 2024). While the wealth effect may explain the cross-sectional variation in lending behaviour among banks with differing levels of excess liquidity, the substitution effect – namely the high attractiveness of remunerated and safe reserves with respect to other investments – dominated, resulting in a strong transmission of monetary tightening to aggregate bank lending, which decelerated sharply. An analysis based on the approach in Amiti and Weinstein (2018) shows that banks with ex ante high levels of excess reserves reduced loan supply growth almost as much as banks with low ex ante excess liquidity, for which the wealth effect was arguably nil (**Chart 19,** left panel). Ample liquidity, together with effective regulatory and supervisory pressures, also helped prevent liquidity stress for euro area banks, thus avoiding an unwarranted tightening of credit conditions.

Chart 19

Transmission to credit growth



Sources: ECB (BSI, AnaCredit, iBSI, MOPDB), iBoxx, Acharya et al. (2023), Altavilla et al. (2025a), Altavilla et al. (2025b), Burlon et al. (2025), Fricke et al. (2024), Kandrac and Schlusche (2021), Rodnyansky and Darmouni (2017), Diamond et al. (2024), Kumhof and Salgado-Moreno (2024) and ECB calculations.
Notes: Left panel: The bubbles report coefficients of a diff-in-diff set-up where the bank-level loan supply shocks 3-months ahead (identified based on Amiti and Weinstein (2018) methodology) are regressed on the level of excess liquidity interacted with the change in the DFR three months ahead, distinguishing between observations before and after December 2021 and with excess liquidity (as a ratio over main assets) between the levels indicated on the horizontal axis. The specification includes bank and country-time fixed effects and controls for the (log of) bank assets. The size of the bubbles measures the outstanding amounts of loans to firms for banks belonging to each category. The vertical line displays the aggregate ratio of excess liquidity (EL) to total assets. Central panel: The estimates are based on local projections that are non-linear in the shock sign and magnitude. Right panel: Distribution of expected fall in lending to firms attributable to a 1 percentage point decline in the ratio of excess liquidity over assets. Estimates based on a meta-analysis. The latest observations are for December 2022 for aggregate assets, January 2023 for aggregate excess liquidity and January 2024 for credit.

Euro area banks entered the latest tightening cycle with strong capital positions, but regulatory requirements and pressure to maintain buffers also increased. Micro and macroprudential regulatory and supervisory practices progressively became more demanding and market scrutiny also pressured banks to maintain capital ratios well above minimum requirements (Buch, 2024). This may have contributed to the credit growth deceleration in the past rate hiking cycle, as among the cross-section of banks, there is evidence that those with smaller capital leeway are more likely to tighten their credit standards (i.e. their "loan approval criteria" according to the euro area bank lending survey – BLS) on loans to non-financial corporations (García-Posada and Paz, 2024). At the same time, stringent regulation and supervision, as well as phased-in macroprudential policies,[95] helped to avert banking sector stress during the tightening cycle, thus supporting the overall stability of credit supply (ECB, 2023) and the smooth transmission of monetary policy.

[95] See also Hempell et al. (2024).

Higher risk perceptions and, to a lesser extent, lower risk tolerance were the main drivers of the tightening in credit standards since the start of the hiking phase. The worsening state of the economy led to a gradual deterioration in credit quality, albeit from high levels (see also **Section 2.2**). In accordance with the risk-taking channel of monetary policy, banks partly rebalanced their asset portfolios towards safer and more liquid assets (Barbiero and Dimou, 2024). According to the BLS, banks took a cautious approach towards lending to firms. Banks' risk perceptions, an important factor for banks' credit standardsin the BLS, help to explain the increase in lending rates and the contraction in credit during the hiking phase (Bottero and Conti, 2023; Auer and Conti, 2024; and Conti et al., 2024).

The tightening phase led to a sharp rise in lending rates and a decline in credit growth, which dropped close to zero for both households and firms in 2023 and part of 2024. With the economy experiencing positive nominal growth, the close to zero growth in credit implied a substantial deleveraging in real terms.[96] The transmission to lending rates and growth in credit to firms was somewhat stronger than implied by historical regularities (Lane, 2024a and 2024c; and Beyer et al., 2024).[97] Banks' risk perceptions might be more relevant for credit supply to firms than to households because most loans to households are mortgages, which are collateralised and tend to have relatively low risk weights.

The transmission to household credit growth was in line with historical regularities and largely driven by higher debt servicing costs. The share of homeowners with mortgages and the level of household debt were slightly higher in many countries than during previous rate hiking cycles. At the same time, the share of adjustable-rate mortgages in the euro area had declined in the previous decade, especially in those countries that initially had the highest shares (Di Casola, 2023), and households also held significant excess savings after the pandemic.[98] These factors, which are important determinants of the strength of the cash-flow channel of monetary policy (Corsetti et al., 2022; Pica, 2023; and Di Casola and Grothe, 2025), might have offset one another (Dossche et al., 2025), resulting in a transmission broadly in line with historical regularities (Beyer et al., 2024) (see **Box 1** for a discussion on the heterogeneity of the pass-through to lending rates for households[99]).

The strong reduction in the growth of credit to firms reflected weak demand and supply in the context of a stronger than usual transmission of policy rate hikes. The recent tightening cycle, with stronger and faster policy rate hikes than usual, saw weak demand for loans, possibly also related to internal funds available after the pandemic. However, tight credit supply also played a role (this is visible in

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96 For evidence on the transmission of the Federal Reserve System'sFed monetary policy to lending through the banking channel, see Siegel (2025).

97 For an analysis comparing the pass-through of the recent monetary policy tightening to firms' debt servicing costs in the euro area, United States, United Kingdom and Canada, see Kitsul et al. (2023). For the case of Malta, however, the pass-through to lending rates was weaker than in the aggregate euro area, as documented in Debono (2024).

98 Ferreira et al. (2024) discuss the role of pandemic savings in the euro area for the transmission of monetary policy.

99 Mayordomo and Roibás (2023) also find that the pass-through of the hiking cycle to mortgage rates was in line with historical regularities.

banks' responses to the BLS and related analysisis presented in **Section 2.3.2**). Indeed, the Survey on the Access to Finance of Enterprises in the euro area (SAFE) shows that the financing gap of firms – the estimated difference between the change in needs and the change in the availability of bank loans – widened during the more mature phase of the tightening cycle, driven mainly by a decline in the availability of external financing (see Ferrando et al., 2024). Mayordomo and Roibas (2023) report a stronger than usual pass-through of interest rate hikes to firms' lending rates. In the case of Slovenia, unrealised losses on banks' balance sheets may also have brought about a stronger than usual transmission of interest rate hikes to lending rates for firms (Volk, 2024). An empirical model imposing a linear impact of interest hikes can only explain part of the actual decline in credit growth, while a model allowing for potential non-linearities yields a closer fit to the observed data (**Chart 19**, middle panel). The contemporaneous reduction in Eurosystem balance sheet size and, in particular, the TLTRO recalibration in October 2022 with the following large reabsorption of liquidity, provided an additional layer of tightening (Burlon et al., 2025). Moreover, as in the past, monetary policy tightening is found to have stronger effects than easing, among other things because large contractionary shocks have a significant adverse impact on firms' expectations (Ferrando and Forti-Grazzini, 2023) and can transmit through the external finance premiums firms, especially fragile firms, pay to borrow from banks (Altavilla et al., 2024). The weakness in the growth of loans to firms also reflected sectoral differences, with the industry sector faring worse than services – in contrast with developments in previous tightening cycles – amid strong headwinds to industry in the euro area.

While the bank lending channel remains crucial for the transmission of monetary policy to corporate credit in the euro area, all sources of financing for firms weakened substantially in the recent tightening cycle. The average share of bonds in firms' debt financing in the euro area has increased in recent decades (Cera et al, 2025) and a larger share is usually associated with stronger monetary policy transmission (Holm-Hadulla and Thurwachter, 2021; and Alder et al., 2024). However, loans remain the dominant source of financing for firms, in particular for smaller firms with limited access to bond markets (Holm-Hadulla et al., 2022) and bank credit replaced bond funding to some extent at the beginning of the tightening cycle (Giuzio and Lenoci, 2023). Over the latest tightening cycle, all sources of financing for firms weakened substantially, including debt securities issuance and loans from non-banks (Adalid et al., 2024).

QT may have implications for the transmission of policy easing through higher bank funding costs and the reserve availability channel. A growing body of empirical and modelling studies that focus on the relationship between central bank reserves and bank lending in the euro area and in the United States finds that: (a) banks with higher excess reserve holdings grant more credit lines and take on more risk; (b) banks that increased their reserve holdings with QE increased lending, as opposed to reserve holdings connected with short-term refinancing operations; (c) the reallocation of central bank reserves towards banks with higher liquidity needs fosters credit supply; (d) the credit supply of reserve-rich banks is less sensitive to monetary policy tightening than that of other banks; (e) the rapid decline in reserves associated with the voluntary early repayments of TLTROs was associated with a

tightening of credit supply (**Chart 19,** right panel).[100] Hence there is evidence that growth in bank loans may be negatively affected by a reduction in reserves. That said, the ECB's gradual and predictable pace of balance sheet normalisation and its flexible operational framework, which will ensure that reserves will not be scarce, should avert any impediments to smooth monetary policy transmission.

More recently, despite the smooth transmission of monetary policy easing to financial markets, there are signs of factors holding back credit growth (Lane, 2025). While credit to firms and households is expanding in parallel to the interest rate cuts, it remains subdued relative to historical norms. In part, this is due to some pipeline pressure remaining from past tightening. Moreover, uncertainty has risen significantly since the beginning of 2025 and may also affect the transmission of monetary policy (Di Casola et al., forthcoming). According to survey data, credit standards on loans to households eased somewhat up to the first quarter of 2025. By contrast, for firms, credit standards showed some renewed tightening, driven by banks' risk perceptions about the economic outlook and a lower tolerance for credit risk.

Box 1

Monetary policy transmission to household loans under the microscope – early insights from a ChaMP cross-country collective project

The empirical evidence on how monetary policy transmission affects households through banks is still somewhat limited for the euro area. This is mostly due to a lack of granular and harmonised data on household lending.[101] The ChaMP research network is advancing in this area through a collective research effort conducted by the European System of Central Banks (ESCB),[102] which uses deep local institutional knowledge in a coordinated way. Eight euro area NCBs (those of Belgium, Ireland, Spain, Italy, Latvia, Lithuania, Portugal and Slovakia) and the Hungarian central bank are exploring their national credit registries on household loans to understand the role of household heterogeneity in the transmission of monetary policy during the recent tightening cycle. The analysis in this box offers early insights stemming from this collective project and is based on interest rates on household loans in the eight participating euro area countries in June 2022 and June 2023.

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100 See Lane P. (2024). For (a), see Acharya and Rajan (2022) and Acharya et al. (2023); for (b), see Rodnyansky and Darmouni (2017); Kandrac and Schlusche (2021); Kumhof and Salgado-Moreno (2024); Altavilla et al. (2025); for (c), see Altavilla et al. (2025); for (d), see Fricke et al. (2024); for (e), see Burlon et al. (2025). Similar evidence exists for the United Kingdom (Chavaz et al., forthcoming). Given the limited experience and sample evidence with QT, the meta-analysis also includes papers focusing on QE. Additionally, and for completeness, it also includes an analysis done for the United States suggesting that the reserves injected by QE can raise loan rates and reduce bank lending. That analysis stands as the sole evidence in the literature implying that QE liquidity can result in tighter credit conditions (see Diamond et al., 2024). However, the case of TLTRO repayment is particularly revealing in this regard because it featured a situation where the fast reabsorption of excess liquidity was partially compensated by a corresponding release of HQLA (mainly sovereign bonds) that were previously used as collateral, thus minimising changes in balance sheet costs. Hence, the reabsorption of reserves alone did create downward pressure on credit supply.

101 This is in stark contrast to widely available loan-level data for corporate loans, such as AnaCredit in the Eurosystem or the Y14 data in the Federal Reserve System.

102 The ESCB Research Network's "'Challenges for Monetary Policy Transmission in a Changing World'" (ChaMP) aims to improve the understanding of how monetary policy transmits to the European economy.

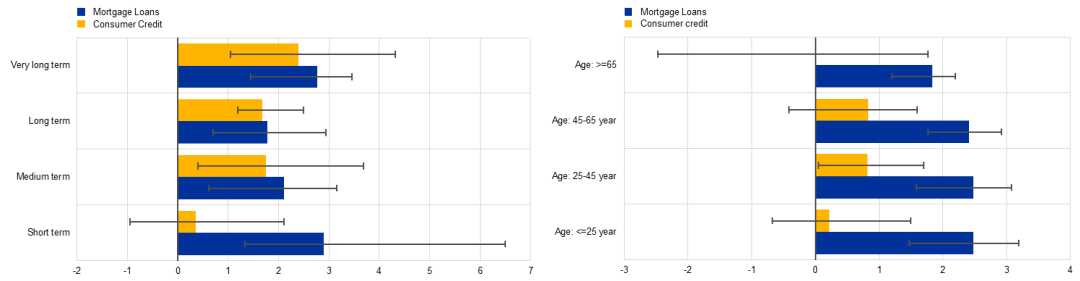
The data reveal that the increase in interest rates in the recent hiking cycle was stronger for loans with variable interest rates than for those at fixed rates, in the case of both new mortgages and consumer credit. The granular data uncovers additional heterogeneous dynamics by loan maturity, degree of collateralisation and borrower's age. By way of an example, preliminary descriptive analysis suggests that interest rates on mortgage loans for house purchase with short or very long maturities increased more during the recent tightening cycle than for intermediate maturities (**Chart 20**, panel a). For consumer credit, the rate increase was largest for longer maturities. Younger borrowers saw the strongest increase in interest rates across age groups for mortgages but the weakest increase for consumer loans (**Chart 20**, panel b). This heterogeneity underscores the importance of using granular data to understand the speed and strength of monetary policy transmission to different segments of the economy.

Overall, interest rate dispersion widened over the period. In particular, heterogeneity across banks, rather than within banks across new contracts, increased. This may reflect differences among intermediaries in terms of market power, balance sheet constraints and demand composition. The ChaMP network will explore these factors in future analyses, studying, when possible, the specificities of the past tightening cycle.

Chart 20

Heterogeneities in the change of interest rates for household loans

(percentage points, change in levels between June 2022 and June 2023)



Notes: The chart shows the differences in loan rates on new mortgages for house purchase and new consumer credit by maturity and age buckets between June 2022 and June 2023, on average across countries. The black lines indicate minimum and maximum values across countries. For maturity, "short term" corresponds to < 12 months and < 10 years for consumer credit and mortgages, respectively; "medium term" to between 1-3 years and between 10-20 years; "long term" to between 3-10 years / between 20-30 years and "very long term" to >= 10 years / >= 30 years. The observations are unweighted within and across countries.

2.3.2 The interplay between the speed of hiking and transmission to inflation and inflation expectations

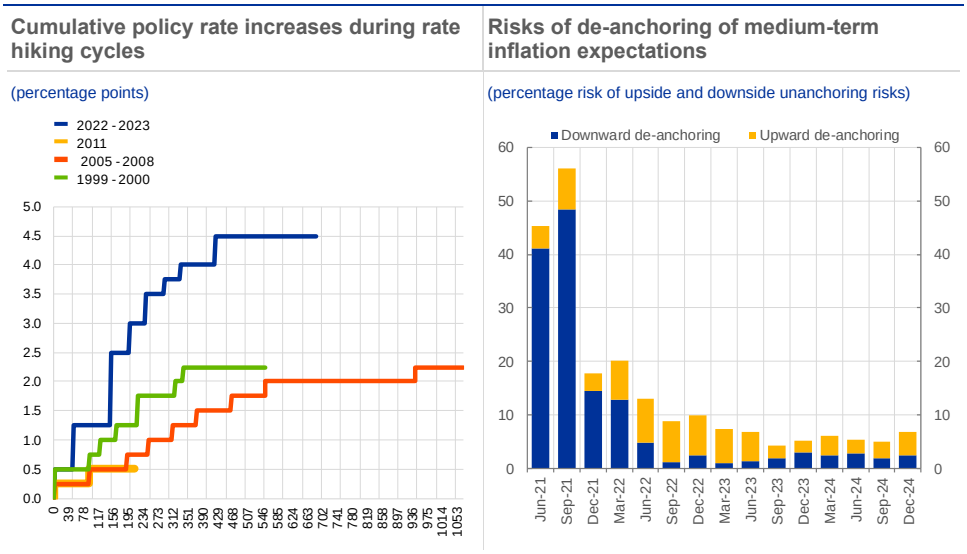
The forceful interest rate hikes min 2022 and 2023 helped to contain risks of upward inflation de-anchoring. The rapid increase in interest rates, consistent with the surge in inflation, outpaced previous tightening cycles (**Chart 21,** left panel). The forceful policy response during 2022 and 2023 effectively curtailed and subsequently reduced the risks of an upward de-anchoring of medium-term inflation expectations. While risks of upward de-anchoring increased in the initial phase of the inflation surge, those risks remained contained overall thanks to determined policy action (**Chart 21**, right panel).[103] At the same time, risks of a downward de-anchoring of

[103] The important role of policy action in anchoring inflation expectations is discussed in more detail in **Chapter 3**.

expectationswhich had been considerable during the ELB period, rapidly declined to low levels.

Chart 21

Policy rate changes and the risk of inflation expectations de-anchoring



Sources: Left panel: ECB calculations, Right panel: ECB calculations based on Christoffel and Farkas (2025).
Notes: Left panel: The x axis show the days since the beginning of the hiking cycle. The latest observation is for June 2024. Right panel: The chart shows the risk of de-anchoring for the staff projections from June 2021 to December 2024. The simulations are based on a regime switching version of the NAWM I (Christoffel et al., 2007), where the credible regime is defined as the estimated version of the NAWM I, with a fixed inflation target, while the de-anchored regime is characterised by a time varying inflation target. Upward de-anchoring is defined as a situation in a de-anchoring episode, where the perceived inflation target is above 2%. The share of de-anchoring is based on 1,000 simulations over a ten-quarter evaluation horizon. The latest observation is for December 2024 Eurosystem/ECB staff macroeconomic projections.

Evidence suggests non-linearities in the transmission of monetary policy, with large shocks having a greater impact on inflation than smaller ones. While monetary policy shocks have generally been small during the recent rate hiking cycle – consistent with the evidence discussed in **Section 2.1** – there have been occasions on which shocks have been more sizeable **(Chart 22,** left panel**)**.[104] Analysis suggests that when monetary policy shocks are large, their impact on headline inflation is both greater and faster than that of smaller shocks, although less persistent, reflecting non-linear and size-dependent responses in the euro area (**Chart 22,** right panel).[105] These findings align with models of state-dependent pricing, where larger inflation shocks prompt more immediate price adjustments by

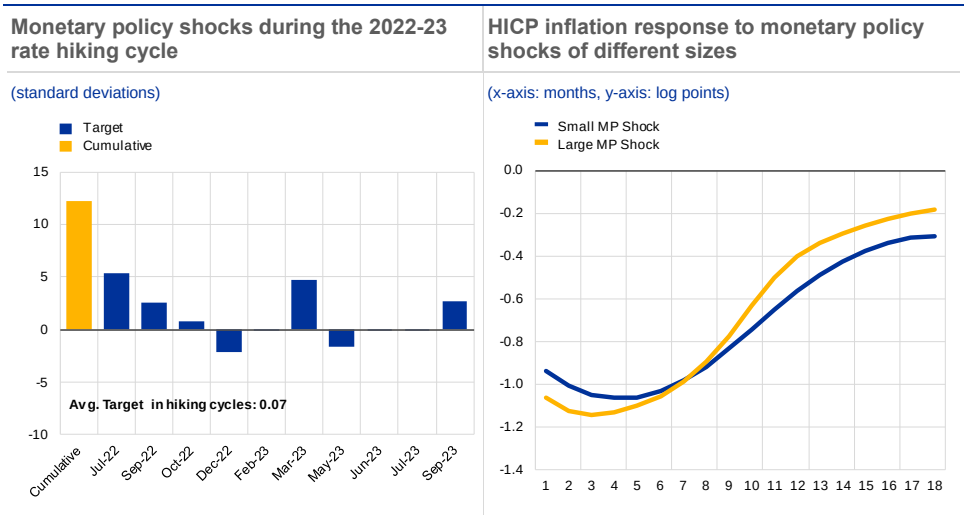
[104] Nearly all of these surprises are attributed to four key Governing Council announcements: the initial 50 basis mrate hike, the September 2022 hike of 75 m, the March 2023 hike of 50 basis points following financial market tensions, and the last hike of 25 basis points in September 2023. See **Chapter 5** for further discussions on the impact of monetary policy announcements during the tightening cycle.

[105] This simulation exercise only provides a partial assessment, as it refrains from the explicit investigation of other sources of non-linearities that can act in parallel and possibly alter the presence of size-dependencies. For example, existing research on US monetary policy (e.g. Tenreyro and Thwaites, 2016) has documented that recessions feature large negative shocks, which complicates the identification of all these potential sources of non-linearities that often co-exist. The relevant distributions of shocks identified for the euro area do not point to such concerns in a prominent way, as the distributions across recessions and expansions are broadly balancedm, both in terms of sign and size.

firms.[106] This evidence also points to the potential value of a forceful policy response to large, sustained deviations of inflation from target.

Chart 22

Monetary policy shocks and their standardised size-dependent impact on HICP inflation



Sources: Left panel: Akkaya, et al. (2024a) Right panel: Allayioti (forthcoming)
Notes: Left panel: The chart shows the cumulative Target factor identified by using a statistical decomposition. The model decomposes movements in OIS (1m, 3m, 6m, 1y, 2y, 5y, 10y) and 10-year sovereign yields (DE, FR, IT and ES) into four policy factors: downward-sloping (Target), hump-shaped (Path), upward-sloping (QE) and spread-widening (Transmission) as documented in Section 3 of Akkaya et al. (2024a). The movements can be interpreted as similar to a 1 standard deviation movement in the reference asset for that factor (OIS 1m, OIS 1y, OIS 10y, IT-DE 10y spread, respectively). Average target represents the average target shocks identified during the 2022-23, 2011, and 2005-08 rate hiking cycles. The latest observation is for October 2023. Right panel: The non-linear local projection method regresses HICP on the monetary policy shocks from Akkaya et al. (2024a) and controls for IP, unemployment, 1-year German bund yield, PMI delivery times index, EBP spread, commodity prices and labour market indicators. The sample covers the period 2002-23. The figure depicts the impulse response for a 25 (blue) and a 150 (yellow) basis point shock, rescaled by dividing by the size of the shock, originating from a non-linear local projection that allows for a linear response and size non-linearities via the introduction of a cubic term.

During the hiking phase and following the TLTRO recalibration in October 2022, credit dynamics weakened very significantly in line with the protracted signals of credit tightening in the BLS.[107] The BLS distinguishes between credit supply and credit demand dynamics. Credit supply conditions can be assessed through banks' credit standards, controlling for macroeconomic conditions. A tightening of credit supply conditions reflects factors such as decreases in banks' risk tolerance, increases in risk perceptions and balance sheet constraints. The rapid monetary policy adjustments during the tightening cycle contributed to the drop in credit growth on the demand side, by increasing borrowing costs and raising the interest rate burden and refinancing risk for borrowers (see **Section 2.3.1**). In addition, the economic slowdown driven by higher rates reduced corporate profits and increased the risk of bankruptcy, fuelling banks' risk perceptions and lowering their risk tolerance. This resulted in a tightening of credit supply, which further weighed on loan dynamics. The recalibration of TLTRO III, announced in October 2022, triggered large-scale early repayments of TLTRO funds, entailing a rapid and

[106] The specification is similar in spirit to Ascari and Haber (2022) who provide corresponding evidence on the United States for the period 1969-2007. Most recently, Ascari et al. (2025) also offer evidence in support of state-dependencies in the euro area, whereby price inflation reacts more strongly to large cost-push shocks, but with lower persistence.

[107] See Köhler-Ulbrich et al. (2023).

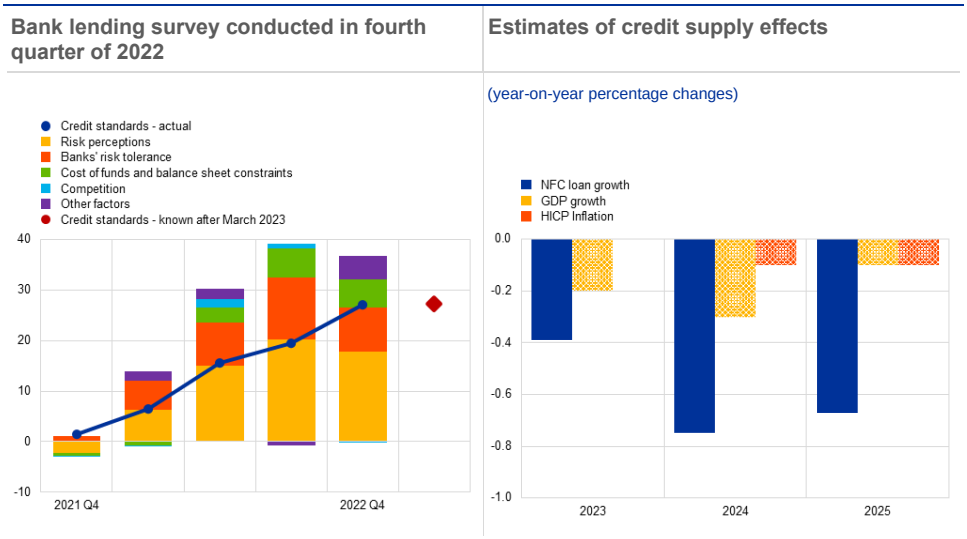
large reabsorption of excess liquidity and a further weakening of credit dynamics.[108] Simulations based on BVAR and DSGE models suggest that the credit channel played a significant role in reducing inflation during the tightening cycle (Conti et al., 2024).

The effects of a tightening credit supply, estimated using a suite of models, informed the baseline projections for inflation and GDP growth during the tightening cycle. BLS data for the fourth quarter of 2022 showed a strong tightening of credit standards, led by banks' risk perceptions and risk tolerance (**Chart 23**, left panel). These factors continued to determine tight credit standards also during 2023 and the beginning of 2024. To account for this decrease in credit supply, which is not captured by the traditional projection tools used in the Eurosystem/ECB staff macroeconomic projections, a suite of macro-banking models explicitly featuring a role for this channel was used to estimate the additional impact of credit supply restrictions on GDP and inflation. This assessment was then used to inform the judgement included in the projection exercises over the period from the first quarter of 2023 to the first quarter of 2024. Internal model-based results produced at the time of the March 2023 projection exercise indicated that these restrictions were sizeable, contributing approximately -0.2 percentage points to GDP growth in 2023 and -0.3 and -0.1 percentage points in 2024 and 2025 respectively (**Chart 23**, right panel). Effects on inflation were estimated to be delayed, and to have started in 2024.

[108] Burlon et al. (2025) find that the recalibration induced a tightening impact on credit supply. The tightening originated from the sudden relative convenience for banks that were previously accustomed to large liquidity holdings to adapt more rapidly to the new environment. They also find that the associated reduction in credit supply had real economic effects.

Chart 23

Estimates of credit supply effects obtained from a suite of models



Sources: ECB calculations

Notes: Left panel: The last observation is for the first quarter of 2023. Right panel: Estimates of credit supply effects based on the economic outlook projected in the March 2023 Eurosystem/ECB staff macroeconomic projections using a suite of macro-banking models. A large-scale BVAR model with macro, financial and banking variable as in Altavilla et al. (2019) and Rostagno et al. (2021) augmented with BLS information is used to identify credit supply restrictions. A Bayesian VAR identifies credit supply shocks using sign and/or time restrictions in line with predictions from theoretical models and two DSGE models with New-Keynesian features and financial intermediation frictions are used quantify the impact of credit supply effects into changes in real GDP growth and HICP inflation. These estimates informed the March 2023 Eurosystem/ECB staff macroeconomic baseline projections. The last observation is for 2025.

2.3.3 Model-based counterfactuals to assess the historical performance of the ECB's monetary policy stance since the strategy review 2020-21

Model-based optimal policy counterfactuals, constructed using a large number of Eurosystem macroeconomic models, can help provide an assessment of the appropriateness of the policy stance. While the model-based assessment of the policy stance carried out in **Section 2.1.3** on the basis of historical decompositions can trace out deviations of monetary policy from the policy feedback rule embedded in a model, policy counterfactuals can help assess whether the policy stance is "optimal", as defined below. More specifically, the counterfactuals are constructed following the methodology of De Groot, Mazelis, Motto and Ristiniemi (2021), which amounts to finding the policy rate path that, conditional on the baseline projections from the quarterly Eurosystem/ECB staff projections exercise, delivers the best outcome. The latter is evaluated using a loss function, penalising deviations

of inflation from target, the output gap and changes in the interest rate.[109] The last element reflects the empirical observation that central banks tend to avoid abrupt changes in the policy instrument, which may also act as a proxy for non-modelled elements such as financial stability, uncertainty or credibility considerations (see Lowe and Ellis, 1997, and Sack and Wieland, 2000). To increase the robustness of the results, the analysis is carried out using a large number of Eurosystem models.[110] The robustness of the findings is further assessed in **Chapter 4** by considering uncertainty and risk around the Eurosystem/ECB staff baseline projections, to account for large projection errors in the inflation surge period.

Conditional on the Eurosystem/ECB staff baseline projections available in real time, deviations of monetary policy from optimality have not been large and show no systematic pattern (Chart 24). For the purpose of this model-based analysis, the policy stance is defined as a combination of current and expected short-term policy rates over the projection horizon. This is motivated by the notion that the policy stance cannot be proxied solely by the overnight interest rate but needs to take into account at least the risk-free curve over several meetings.[111] **Chart 24** operationalises this notion by showing the quarterly average of the interest rate path over the projection horizon. The model-based optimal policy prescriptions are represented in the chart by the blue shaded areas, which are computed from the perspective of each quarterly Governing Council meeting for which projections were available. The graph provides a stylised real-time assessment of the stance, assuming that the information available at each respective round can be fully summarised by the Eurosystem/ECB staff baseline projections. An important caveat – discussed in detail below and in **Chapter 4** – is that the inflation surge period was characterised by exceptionally large projection errors. The darker segment in the middle of the range is the interquartile range of optimal policy estimates across different models. At each quarterly round, the optimal policy prescriptions can be compared with the corresponding measure based on market expectations for the €STR (adjusted for the spread with the DFR) on the day after the respective

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109 Specifically, the methodology to construct optimal policy counterfactuals rests on three ingredients: (1) baseline evolution of the policy rate path, inflation and the output gap, which are taken to be the baseline projections from the quarterly Eurosystem/ECB staff projections exercise; (2) impulse responses to contemporaneous and expected monetary policy shocks derived from a set of Eurosystem macroeconomic models; (3) loss function. Optimal policy paths are derived by minimising the loss function conditional on the (B)MPE baseline projections. The analysis is based on the Computing Constrained Optimal Policy Projections (COPPs) toolkit of De Groot et al. (2021). Barnichon and Mesters (2023) and McKay and Wolf (2023) have proposed similar methods. See Coenen et al. (2025), Dengler et al. (2024) and Darracq Pariès et al. (2025) for applications. The loss function specification is common practice in academia and policy evaluations ($\sum_{t=0}^{T}\beta^{t}(w_{\pi}(\pi_{t}-2)^{2}+w_{x}x_{t}^{2}+w_{dr}(\Delta r_{t}^{a})^{2}$). The loss function weights are assumed to be the same across models and estimated using the MMR model (Mazelis, Motto and Ristiniemi, 2023). The weight on inflation is 1, on the output gap 0.2 and on the change in annualised interest rate 1.4. The results are broadly robust to using alternative weights (see details in footnote 114). A caveat of using common weights is that a given model's micro-founded welfare-theoretic loss function might differ from this specification.

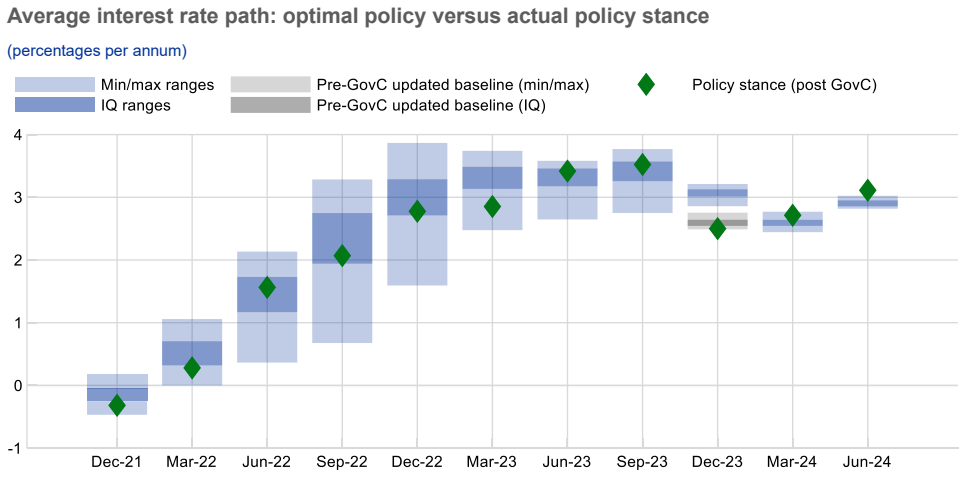
110 For this analysis, thirteen models are used (see **Table 6** in the Annex) and cover various types of models, spanning structural VARs, semi-structural models and structural models (see also the WGEM-WGF Expert Group on Monetary Policy Transmission (in prep.)). A common protocol is followed for comparability across models. Key factors in explaining the heterogeneity in results across models are differences in the inflation output trade-off, transmission lags and the degree of forward-lookingness. The model simulations do not suffer from the forward guidance puzzle, mainly because they include inattention in the expectation formation process. The focus here is on the policy rate path as the main policy instrument.

111 Measuring the policy stance not only from the current short-term policy rate but also from its expected path is in line with a large body of empirical literature (see, for instance, Gürkaynak, Sack and Swanson, 2005).

Governing Council meeting (green diamonds). Although there is no guarantee that markets interpreted the policy decision and related policy communication as intended by the Governing Council, the €STR curve provides a quantitative measure of the policy stance as understood by markets in real-time. This approach clarifies that, even though the policy rate at the time of the decision and its expectations for the next couple of quarters were occasionally below the interquartile range, they were offset by rates expected to be above the range further into the horizon, making the overall stance in terms of average interest rate close to the optimal average rate.

Chart 24

Optimal policy counterfactuals based on real-time Eurosystem/ECB staff baseline projections



Source: Eurosystem staff calculations.
Notes: Average interest rate path over the (B)MPE projection horizon of the optimal policy counterfactuals computed in real time for the (B)MPE projection vintages from December 2021 to June 2024. The light (dark) blue shaded areas denote the min-max (interquartile) range across model estimates. The light (dark) grey shaded areas denote the min-max (interquartile) range across model estimates for the optimal policy counterfactuals based on the updated baseline. Specifically, the baseline is updated with respect to the (B)MPE baseline by (i) taking the policy rate path as of the day before the GovC meeting and (ii) adjusting the inflation path by the change in inflation compensation (constructed from inflation fixing contracts excluding tobacco) from the cut-off date of the (B)MPE until the day before the respective GovC meeting. The green diamonds refer to the actual post-GovC policy stance which is defined as average of the short-term policy rate (DFR) and its expected path over the projection horizon. The latter is measured by the MP-dated €STR forward curve from one day after the GovC meeting and is mapped into DFR space by applying a spread of 8 basis points, which is the average spread during 2024.

The results from these model-based optimal policy counterfactuals reveal the presence of three phases in the monetary policy stance since late 2021. In the first phase, from December 2021 to March 2022, the policy stance was at the lower end of – or even below – the interquartile range of optimal policy prescriptions.[112] In the second phase, up to March 2023, a rapid and forceful tightening brought the stance in close alignment with the interquartile optimal range. It is noteworthy that the optimal ranges during this period vindicate a forceful policy response as opposed to a more gradual approach.[113] In the third phase, starting in June 2023, the policy

[112] The finding that the optimal interest rate path would have been tighter from the perspective of March 2022 is in line with external evidence provided by Barnichon and Mesters (forthcoming). Unlike in their set-up, the exercise in this section does not only include the overnight interest rate but the path over the full Eurosystem/ECB staff projection horizon, hence it also allows for a role for policy communication to shape expectations of the policy rate path.

[113] The main rational for gradualism in monetary policy normalisation, as communicated during the first half of 2022, was the heightened uncertainty stemming from the ongoing effects of the pandemic and Russia's invasion of Ukraine (see Monetary Policy Accounts, 9-10 March 2022 and 13-14 April 2022).

stance moved to the upper end of the interquartile optimal range.[114] When looking at the results during these three phases, two aspects are particularly relevant. First, even though the lift-off only occurred in July 2022, the average interest rate path had already started moving upwards in late 2021 driven by a steepening of the market curve in anticipation of future policy tightening. Second, the analysis is conditional on the projection baseline, which in the projection rounds before June 2022 foresaw inflation to remain below target in the second year of the projection horizon (i.e. t+5 to t+8). This coincides with an acceleration in the upward movement of the average interest rate path, as it was indeed announced in June 2022 that rates would be increased at the following meeting (see also **Section 3.2**). The width of the optimal policy ranges can be linked to how far inflation and the output gap are away from target and to what extent their deviation from target creates a trade-off for policy-setting. In particular, as of early 2024, inflation over the projection horizon was projected to be significantly closer to 2% than in previous years, thereby requiring less policy adjustment such that the width of optimal policy estimates across different models is smaller. In some episodes there has been big news in the period between the cut-off date of the projections and the respective Governing Council meeting. To illustrate the role of such news, the chart displays, for the case of December 2023, also the optimal prescriptions on the basis of an updated baseline that tries to reflect, albeit probably imperfectly, such news (grey areas).[115] When making this adjustment to the projection baseline, the policy stance is within the optimal range. The existence of three phases aligns well with complementary evidence based on historical decompositions in **Section 2.1.3** and on market-based feedback rules in **Section 3.1.3**. Finally, in interpreting the results, it should be recalled that they abstract from the impact of LSAPs on the stance. Additionally, most models are linear, hence they abstract from the implications of ELB considerations prevailing in 2020-21, de-anchoring risks and other possible non-linearities. Lastly, the analysis

[114] The results that actual policy was at the lower, middle and upper end of the optimal policy range during the three phases are qualitatively robust to some alternative weighting schemes in the loss function. For instance, taking December 2021, the IQ range for the optimal policy prescriptions for the interest rate is -0.25 to -0.05 under the baseline weights, while considering a loss function with half/twice the weight on output gap stabilisation relative to the baseline weights would result in a range of 0.31 to -0.09 and of -0.25 to 0.02 respectively. Using a loss function with half the baseline weight on the interest rate change would move the IQ range and give -0.26 to 0. Thus, the green diamond would still remain slightly below the IQ range. Taking June 2022, the IQ range is 1.17-1.73 under the baseline weights with the green diamond lying within this range. Considering a loss function with half/twice the output gap weight or half the weight on the interest rate change would move the IQ range such that the green diamond still lay within or even slightly above the range. Taking March 2024, the IQ range is 2.54-2.64 under the baseline weights and the green diamond lies with 2.71 above the range. Considering the same alternative weights as before would move the IQ range such that the green diamond lay either still above or, in the case of a lower output gap weight, at the upper end (the range would be 2.63-2.72).

[115] Specifically, three episodes are noteworthy. First, in assessing the March 2023 optimal prescriptions, it is important to recall the abrupt occurrence of financial market tensions following the collapse of Silicon Valley Bank, which took place after the cut-off date of the March 2023 ECB staff projections and is hence not incorporated in the optimal policy counterfactuals. Second, as regards December 2023, it should be recalled that the HICP inflation release that took place after the cut-off for the projections saw a lower than expected print. As a proxy for its implications, the fixings for inflation compensation, on average over a one-year horizon, declined by 38 basis points from the cut-off date of the December 2023 Eurosystem staff projections to the day before the December Governing Council meeting. In the chart, the optimal policy prescriptions for this date are shown also under the assumption that the baseline projections are adjusted by the change in fixings for inflation compensation from the cut-off date of the Eurosystem/ECB staff projections until the day before the respective Governing Council meeting. Third, as regards March 2022, it should be recalled that the cut-off date of the ECB staff projections was a couple of days after the Russian invasion of Ukraine. This episode is discussed in **Chapter 4** in the context of policy robustness.

abstracts from risks and uncertainty around the baseline projections. These aspects are discussed in **Chapter 3** and **Chapter 4**.

A natural question is whether an earlier policy rate lift-off or an earlier end of net asset purchases would have made a significant difference to the inflation profile. Building on the evidence that, in the first phase, the monetary policy path was below the optimal predictions made by many of the models considered in this section, it is natural to ask what would have happened had the central bank followed a different course of action. Two counterfactuals that can be considered are: (i) an earlier policy rate lift-off (**Chart 25**), and (ii) an earlier end of net asset purchases already in December 2021 (**Chart 26**). The relative effects of an earlier policy rate lift-off can be computed by comparing two alternative simulations: a constrained counterfactual assuming the optimal interest rate path is constrained not to increase until the ECB rate lift-off in the third quarter of 2022 (actual policy), and an unconstrained counterfactual assuming an unconstrained optimal policy allowing for an earlier lift-off. The scenario in which net asset purchases end already in December 2021 is shown in the left panel of **Chart 26** (yellow line).[116] In order to obtain the relative macroeconomic effects of this earlier end of net asset purchases, this scenario is compared with the actual evolution of holdings in which net asset purchases ended only in July 2022 (red line). The difference between the scenario and the actual evolution amounts to around €300 billion in June 2022 and is assumed to very gradually diminish over time, with the gap closed by around 2030.

Conditional on the projection baseline, simply bringing forward the rate lift-off by three months would not have materially changed the overall policy stance and would therefore not have materially dampened the inflation surge. **Chart 25** shows the results of the earlier rate lift-off counterfactual based on the Eurosystem/ECB staff baseline projections available to policymakers at the March 2022 Governing Council meeting.[117] The left panel shows the range of optimal interest rate paths across different models, where the shaded areas correspond to the constrained counterfactual and the upper and lower boundary lines to the unconstrained counterfactual. The middle and right panels present the outcomes of the unconstrained relative to the constrained counterfactual for inflation and the output gap respectively. According to these estimates, an earlier tightening – as implied by the unconstrained counterfactual – would have reduced inflation by up to

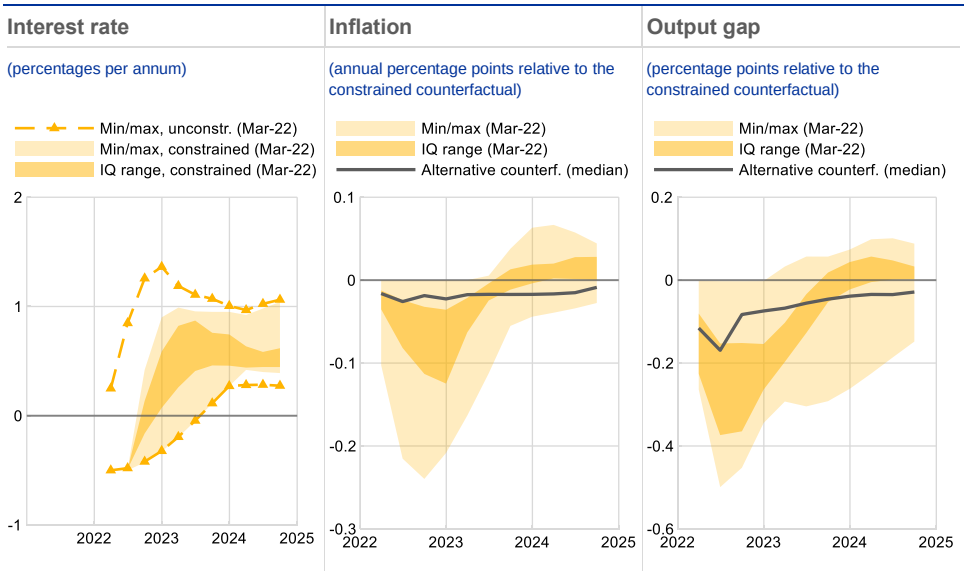
[116] The counterfactual assuming an earlier end of net asset purchases is constructed using the ECB's main policy models (the NAWM II, MMR and ECB-BASE), including two different versions of each model that differ with respect to the expectation formation process. For the NAWM II and MMR models, the effect of asset purchases is captured directly through the inclusion of the central bank's balance sheet. In the ECB-BASE model, asset purchases are captured indirectly as a result of their effect on long-term rates, which are computed using a term-structure model (see Eser et al., 2023). It is assumed that the effects of QE and QT are symmetric (see **Section 2.2.1**).

[117] This earlier tightening counterfactual differs from the one conducted with the benefit of hindsight (see **Chart 27**), as in the latter, the interest rate increase is commensurate with the inflation developments that were only known ex post.

0.2 percentage points at the peak.[118] Compared with the scale of the inflation surge, this analysis highlights that the precise timing of lift-off is less relevant than the overall trajectory of monetary policy.[119]

Chart 25

Earlier policy rate lift-off counterfactual



Source: Eurosystem staff calculations.
Notes: Ranges indicated by the lines with a marker on the left panel correspond to the min/max ranges of the optimal rate paths computed with no constraint, as in **Chart 24**, for the March 2022 baseline. The shaded areas are based on the optimal policy counterfactual with the same (B)MPE outlook as in the unconstrained counterfactual but constraining the lift-off date to match the actual one (the third quarter of 2022) and letting policy evolve optimally afterwards. The ranges on the right panels are the impact on year-on-year inflation and the output gap, plotted as the deviation between the unconstrained counterfactual and the constrained one. The grey lines show the median estimate from an alternative early-tightening counterfactual which imposes the realised interest rate path from the lift-off in the third quarter of 2022 onwards but allows the interest rate to evolve optimally before the third quarter of 2022 based on the real-time (B)MPE baseline as of March 2022.

Similarly, ending net asset purchases earlier, in December 2021, would have only marginally improved the inflation path. The counterfactual scenario of an earlier end of net asset purchases, both under the APP and the PEPP, is shown in

[118] An alternative way to measure the effects of an earlier lift-off would be to construct a counterfactual that imposes the realised interest rate path from the lift-off date in the third quarter of 2022 onwards and, before the third quarter of 2022, it allows the interest rate to evolve optimally based on the Eurosystem/ECB staff baseline projections available to policymakers in real time (see the range indicated by the yellow lines with a marker before the third quarter of 2022). **Chart 25** shows the median estimate (solid grey line) for this alternative counterfactual conditional on the Eurosystem/ECB staff baseline projections available at the March 2022 Governing Council meeting. The inflation and output gap differences – in this case relative to the realised inflation and output gap – are again rather small.

[119] In the constrained counterfactual, the later lift-off is partly compensated by a more rapid tightening thereafter, relative to the unconstrained counterfactual, which implies an earlier lift-off and then a more gradual tightening path. Since, for the inflation outcomes, the overall policy stance – as determined by the entire interest rate path – matters, this can explain the rather small differences in inflation outcomes. Nevertheless, in both counterfactuals, inflation is lower than in the baseline projections from March 2022.

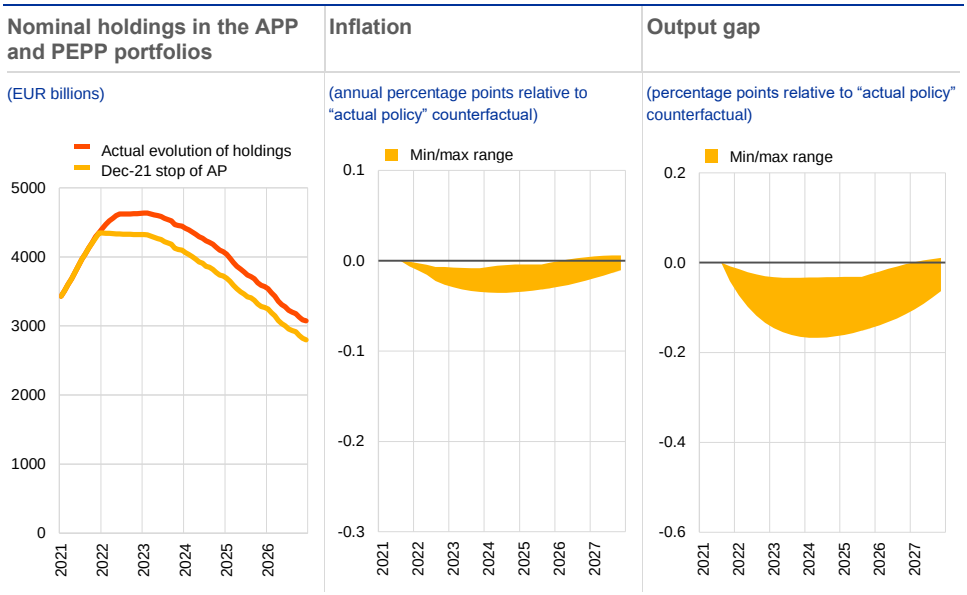
Chart 26.[120] The middle and right panels present the inflation and output gap outcomes of an earlier end of net asset purchases relative to the actual evolution of holdings. The set of models used in this exercise suggests that ending net asset purchases at the end of December 2021 instead of at the end of June 2022 would have reduced inflation by less than 0.05 percentage points per year over the 2022-27 period.

Taken together, the estimated effects on inflation of an earlier rate lift-off and an earlier end of net asset purchases are small. It has to be stressed that these counterfactuals abstract from financial stability considerations and possible impairments to monetary policy transmission, such as those witnessed after the June 2022 Governing Council meeting, leading to the activation of PEPP flexibility and the establishment of the TPI. Specifically, a rate lift-off and/or an end of purchases at around the time of Russia's invasion of Ukraine could have potentially added to investors' heightened risk aversion over the period, thereby leading to adverse consequences for wider financial stability. At the same time, the later lift-off – also in comparison with peer central banks – still created communication challenges, with some observers seeing the ECB as being behind the curve (this is further discussed in **Chapter 5**).

[120] The counterfactuals are based on simulations involving changes to expectations regarding the ECB's balance sheet between October 2021 (to account for anticipation) and the two paths on the (expected) evolution of holdings shown by the left-hand side of **Chart 26**. In one case, net asset purchases are assumed to end in December 2021 (yellow line) and in the other case net asset purchases are assumed to follow the actual evolution of holdings (red line). Both paths imply a tightening relative to the balance sheet expectations in October 2021 and hence lead to a reduction in inflation and the output gap. The relative macroeconomic effects – shown in **Chart 26** – are obtained by taking the difference between the effects under the earlier end of net asset purchases and the effects under the actual evolution of holdings.

Chart 26

Ending net asset purchases earlier, in December 2021



Sources: ECB calculations based on the NAWM II model (Coenen et al., 2018), the MMR model (Mazelis et al., 2023), and the ECB-BASE model (Angelini, et al., 2019) and SMA.
Notes: Left panel: Nominal Holdings in private and public sector assets. Red line: actual. Yellow line: Scenario as of October 2021 where all net purchases end after December 2021 and otherwise equal (full and partial) reinvestment horizons. Middle and RHS: The charts show a counterfactual in which net purchases under APP and PEPP are assumed to end in December 2021 (yellow line in left panel chart) rather than in July 2022 as in actual evolution (red line). The range represents the relative inflation and output gap effects as min/max across six models (MMR, MMR with no anticipation, NAWM II, NAWM II – adaptive, ECB-BASE and ECB-BASE reactive). Holdings are displayed until end-2026 and inflation and output gap until end-2027.

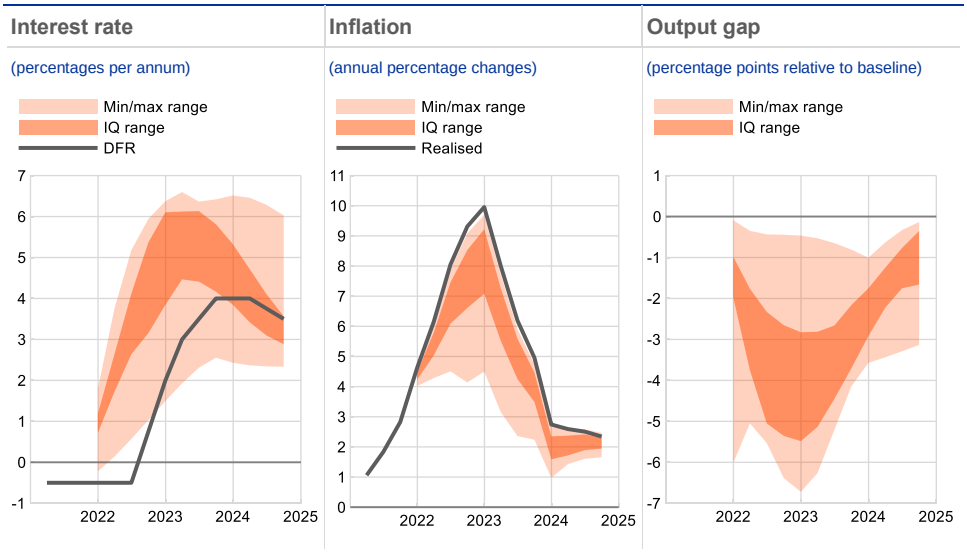
At the other end of the spectrum, a "benefit of hindsight" perspective can be simulated by assuming that the Eurosystem/ECB staff projection errors had been zero; in this case optimal policy would have suggested raising interest rates earlier and more aggressively, resulting in a lower inflation peak but also lower output growth. The euro area faced exceptionally large shocks in 2021 and 2022, leading to significant projection errors (see also Workstream 1 report, Section 4.2). If the exact nature and size of the shocks that were about to hit the economy had been known back in December 2021, optimal policy would have recommended earlier and more forceful rate increases (**Chart 27**, orange shaded areas versus black line). According to most model estimates, the implied inflation path would have peaked at 7-9% instead of 10% in late 2022 and would have returned to 2% by the end of 2023. The output gap would have been – 3-5 percentage points lower than the baseline assumption.[121] Again, the analysis does not account for possible non-linearities, such as the implications of a possible steeper Phillips curve (which, all else being equal, improves the inflation output trade-off) or financial market stress

[121] Under half (twice) the output gap stabilisation weight relative to the baseline weights, the interquartile range for the optimal interest rate path would start from 1-1.5% (0.5-1%) and reach a peak of 5-7% (4-5%). Instead of inflation peaking at 7-9%, as under the baseline weights, the implied inflation peaks would be 6.5-8.5% for half the weight and 8-9.5% for twice the weight respectively. Relative to the 3-5 percentage point output costs under the baseline weights, these alternative weights would imply 4-7.5 percentage points for half the weight and 2-4 percentage points for twice the weight respectively. Under half the weight on the interest rate change, the interquartile range for the optimal interest rate path would start from 1-1.5% and reach a peak of 4.5-7%. Inflation would peak at 6.5-8.5% and the output gap would be 4-6 percentage points lower than the baseline assumption.

(as witnessed in mid-June 2022 before the establishment of the TPI and the activation of PEPP flexibility).

Chart 27

Optimal policy counterfactuals with the benefit of hindsight



Source: Eurosystem staff calculations.
Notes: "With the benefit of hindsight" refers to the optimal policy counterfactual from the perspective of December 2021 assuming that, at that time, the realised data up to June 2024 and the projections from June 2024 are known. The light and dark orange shaded areas denote the min-max range and interquartile range across model estimates, respectively.

The results in this section highlight the important role of projection errors for the assessment of policy appropriateness during the inflation surge period. The optimal response would have been more aggressive had the Eurosystem/ECB staff projection for inflation been revised more quickly to reflect the persistent nature of the inflation surge. However, conditional on the projection baseline, deviations of policy from optimality have not been large and show no systematic pattern according to the model simulations. The analysis remains highly stylised and therefore only provides an incomplete assessment. In particular, the analysis abstracts from risk and uncertainty around the baseline projections, which are analysed in **Chapter 4**.

3 An assessment of the ECB's medium-term orientation and asymmetric reaction function

The strategy review 2021 concluded that price stability is best maintained by aiming for 2% inflation over the medium term, with the Governing Council's commitment to this target being symmetric. The symmetric 2% target provides a clear anchor for longer-term inflation expectations, which is essential for maintaining price stability. The strategy review 2021 emphasised two key features. First, the medium-term orientation provides flexibility when reacting to deviations of inflation from the target, depending on not only the context but also the origin, magnitude and persistence of the deviation. Second, the asymmetry in the reaction function addresses the implications of the effective lower bound (ELB) for nominal interest rates.

The events since the strategy review 2021 have provided a stress test of at least three dimensions of the ECB strategy: first, the scope and limits of "looking through" supply shocks; second, whether "especially forceful or persistent" policies adopted close to the ELB have unduly delayed the monetary policy response to the inflation surge; third, the role granted to the baseline inflation projections and the risk assessment in shaping the design of rate lift-off criteria. These three aspects jointly influenced both the ECB's reaction to the change in the inflation environment and the trade-off that emerged between avoiding a premature exit from ELB policies and avoiding a delayed response as the inflationary shocks became increasingly persistent. The first two dimensions are discussed in **Sections 3.1 and 3.2**, respectively, and the third in **Chapter 4**. The main conclusions regarding the first two dimensions are set out below.

- **Recent experience, Eurosystem analyses and economic literature since the strategy review 2021 confirm the validity of the medium-term orientation, while providing additional insights on transmission channels that can help to determine when a policy of looking through supply shocks is appropriate.** The medium-term orientation allows for inevitable short-term deviations of inflation from the target, as well as lags and uncertainty in the transmission of monetary policy to the economy and inflation. The 2021 strategy review emphasised that the medium-term orientation provides flexibility to look through temporary shocks that may dissipate on their own accord, avoiding unnecessary volatility in activity and employment. At the same time, the strategy also stressed that large, sustained deviations of inflation from target can destabilise longer-term inflation expectations, thereby imposing limits to "looking through". In the period following the strategy review 2021, the ECB initially looked through the inflationary shock as it was initially assessed in the baseline staff macroeconomic projections as being transitory, with little impact on the medium-term inflation outlook. However, as inflationary pressures

increased and became more persistent, threatening the anchoring of inflation expectations, the ECB aggressively tightened monetary policy. The analysis presented below underlines the importance of factoring in risks of de-anchoring when setting monetary policy. This chapter looks in depth at a number of channels not typically included in forecasting and policy models, but relevant for calibrating policies in the face of supply shocks. In one direction, channels related to de-anchoring of inflation expectations and state-dependent firm pricing can be shown to call for stronger policy actions, thereby weakening the case for "looking through". In the other direction, channels related to household heterogeneity, endogenous growth and non-linearities due to financial frictions can be shown to create aggregate demand amplification in response to adverse supply shocks, reinforcing the case for "looking through" if inflation expectations are well anchored. No analysis integrating all the different channels is available so far, but all channels are worth monitoring because circumstances change. Recently those channels limiting "looking through" seem to have been more relevant than usual, but other channels may prevail in the future.

- **The costs of future possible ELB episodes are estimated to remain substantial, as the likelihood of hitting the lower bound remains elevated – suggesting that forceful or persistent policies remain necessary to meet the symmetric 2% inflation target over the medium term in the face of deflationary risks when key ECB rates are close to the ELB.** The expected frequency of future ELB episodes continues to be estimated as elevated because the level of r* remains low in the euro area, even though it may have increased somewhat recently (Workstream 1 report, Section 3.6). Additional factors shaping the likelihood of hitting the ELB do not challenge this conclusion, as these largely cancel each other out at present. On the one hand, on its own the increase in the variance of shocks observed in recent years points to a higher future frequency of ELB episodes. On the other hand, the frequency of price adjustments temporarily and sharply increased during the inflation surge, also pointing to possible nonlinearities in the price setting process. These nonlinearities, if they persist, could enhance the potency of monetary policy, as policy actions are relatively more effective, thereby reducing the likelihood of hitting the ELB. In both cases, it is unclear whether recent changes will persist. Both factors warrant close monitoring. A crucial element in the assessment of the likelihood of the ELB is the degree of anchoring of inflation expectations.

- **While the recommendation for policies to be forceful or persistent close to the ELB remains valid, the recent inflation surge suggests that its operationalisation needs to be sufficiently robust to cope with abrupt changes in the inflation environment.** Such robustness can be achieved, for example, by formulating forward guidance in a data-dependent, state-contingent way. In principle, this was the intention behind the ECB's forward guidance of July 2021, which had rate lift-off criteria linked to both the inflation outlook (according to baseline projections) and outcomes for underlying inflation. The inflation surge period, though, showed how difficult it is to assess changes in the inflation environment in real time. For example, the inflation

surge was initially characterised by exceptionally large projection errors, reducing the information content of the baseline projections at the turning point. Looking ahead, more robustness could be achieved by supplementing the baseline projections with the assessment of the balance of risks (see also **Chapter 4**). Stringent lift-off criteria, coupled with commitments on the sequencing of policy rate changes and time-based asset purchase guidance, reduced the data dependency of rate forward guidance and meant that the guidance on the end date for purchases had to be brought forward in March 2022 in order to pave the way for the rate lift-off in July 2022.

- **Escape clauses offer an alternative or complementary way of ensuring policy can react in a flexible and agile manner to abrupt changes in the inflation environment.** Escape clauses are particularly relevant when the conditions for triggering rate lift-off are not based on inflation. For instance, the Federal Reserve System and Bank of England threshold guidance was in terms of unemployment. The ECB's 2021 rate forward guidance was instead based on inflation. However, escape clauses may also be useful if state-based guidance is linked to stringent lift-off criteria and time-based commitments for asset purchases. Escape clauses may be especially valuable if the guidance is time-based and represents policy commitment over longer horizons. At the same time, escape clauses need to be designed in way that does not unduly weaken the effectiveness of forward guidance at the ELB.

- **The experience during the recent inflation surge suggests that forceful or persistent monetary policy action is also warranted when responding to serious threats to the inflation anchor in either direction, to avoid those deviations becoming entrenched.** The 2021 strategy statement called for "especially forceful or persistent" action close to the ELB to avoid negative deviations from the inflation target becoming entrenched. Arguably, in the early phase of the inflation surge, ECB policy tightening was forceful, with 350 basis points of cumulative policy rate hikes over the six meetings between July 2022 and March 2023 – including two 75 basis point hikes in the second half of 2022. In the following phase, between April and September 2023, policy rate hikes became smaller and attention increasingly turned to how long rates needed to be kept at sufficiently restrictive levels, thereby shifting the emphasis from the forcefulness to the persistence dimension. Taken together, the initially forceful and then persistent policy response helped to contain risks of upside de-anchoring. While in principle there is no upper bound on policy rates, the risks and side effects associated with tightening increase as rates move further into restrictive territory. These side effects range from deeper declines in output and employment – with potential hysteresis effects – to the risk of financial instability. Thus, there can be instances when it is optimal to shift the focus from forcefulness to persistence as the tightening cycle proceeds (see **Box 4**). Accordingly, there is a temporal dimension to choosing between forcefulness and persistence also when dealing with large, sustained upside deviations of inflation from target.

3.1 Looking through supply shocks in the context of the ECB's medium-term orientation

The medium-term orientation has been an integral part of the policy strategy since the ECB's inception in 1998 and its validity was confirmed in the strategy review 2021. Official communication has motivated the medium-term orientation in terms of: the inevitability of short-term deviations of inflation from target; lags and uncertainty in monetary policy transmission; and catering for other considerations. Such considerations include avoiding unnecessary volatility in activity and employment by looking through shocks that cause temporary trade-offs (e.g. supply shocks).[122] The flexibility of the medium-term orientation takes into account that the appropriate monetary policy response to a deviation of inflation from the target is context-specific and depends on the origin, magnitude and persistence of the deviation.

ECB communication has consistently emphasised the limits to looking through supply shocks.[123] The 2021 overview note, for example, pointed out that the flexibility of the medium-term orientation made it possible to "look through temporary shocks that may dissipate of their own accord". The term "looking through" is potentially ambiguous, since it may be interpreted by observers either as no policy reaction or as a milder reaction than would otherwise be the case. Policymakers' communication has frequently emphasised that there are limits to looking through supply shocks because persistent deviations from the inflation target may create a risk of de-anchoring of long-term inflation expectations. These considerations have featured in communication since the early days of the ECB and were reflected in the 2021 overview note as follows: "Temporary and moderate fluctuations of actual inflation both above and below the medium-term target of 2% are unavoidable; however, large, sustained deviations can destabilise longer-term inflation expectations. […] Accordingly, it is important for monetary policy to respond forcefully to large, sustained deviations of inflation from the target in either direction."

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122 See, for instance, the 1998 strategy: "It also acknowledges the existence of short-term volatility in prices which cannot be controlled by monetary policy"; the 2003 strategy (background studies): "Monetary policy can only have an effect on the price level with long and uncertain lags […] embodies a commitment to avoid overly ambitious attempts to fine-tune inflation outcomes. […] Moreover, the appropriate forward-looking horizon […] depends on the nature of the shocks…". See also the 2021 strategy: "… lags and uncertainty in the transmission … appropriate monetary policy response […] depends on the origin, magnitude and persistence of the deviation. It also allows […] to cater for other considerations…".

123 See, for instance, Trichet, 2006: "...'look through' the immediate disturbance and change policy only to the extent needed to offset the anticipated more permanent effects of the shock…", Stark, 2008: "…monetary policy can and must play a role in preventing second-round effects…", Lagarde 2021: "Monetary policy should normally 'look through'through temporary supply-driven inflation, so long as inflation expectations remain anchored",." Schnabel 2021: "The standard prescription for monetary policy is to 'look through' temporary supply-side shocks and to only take policy action if inflation expectations and wage bargaining give rise to second-round effects …", and Panetta 2022: "…for as long as inflation expectations remain anchored, monetary policy should adjust but not overreact".

3.1.1 The conventional wisdom prevailing at the time of the strategy review 2021 – and earlier

Policy affects inflation with long and variable lags, which cautions against responding strongly to temporary shocks. This policy implication applies regardless of whether a shock is driven by demand or supply. If a shock is short-lived, the transmission lag of policy (**Section 3.1.2**) may mean that by the time policy has an impact on inflation, the impact of the shock has already faded. Conversely, a persistent shock has a more prolonged effect on inflation, allowing monetary policy to address corresponding deviations despite the transmission lags, requiring a more active policy response.[124]

Mainstream macroeconomic models typically imply that looking through supply shocks is welfare-enhancing. They typically feature linear relationships, forward-looking agents, model-consistent expectations, small shocks and well anchored long run inflation expectations. The appropriate policy response differs between supply and demand shocks. Simulations using a standard textbook model illustrate that, for the same initial increase in inflation, a typical Taylor rule would suggest a smaller interest rate increase in response to a supply shock than to a demand shock (**Chart 28**). Optimal policy analysis supports an even stronger response to demand shocks and a more muted response to supply shocks. The differing policy prescriptions for supply and demand shocks arise because in response to demand shocks monetary policy can simultaneously stabilise both inflation and the output gap, whereas supply shocks create a temporary policy trade-off. Accordingly, aggressive policy tightening in response to a supply shock could exacerbate the negative impact on economic activity.[125] Therefore, even in a hypothetical scenario without transmission lags, optimal policy does imply looking through supply shocks to some extent.[126]

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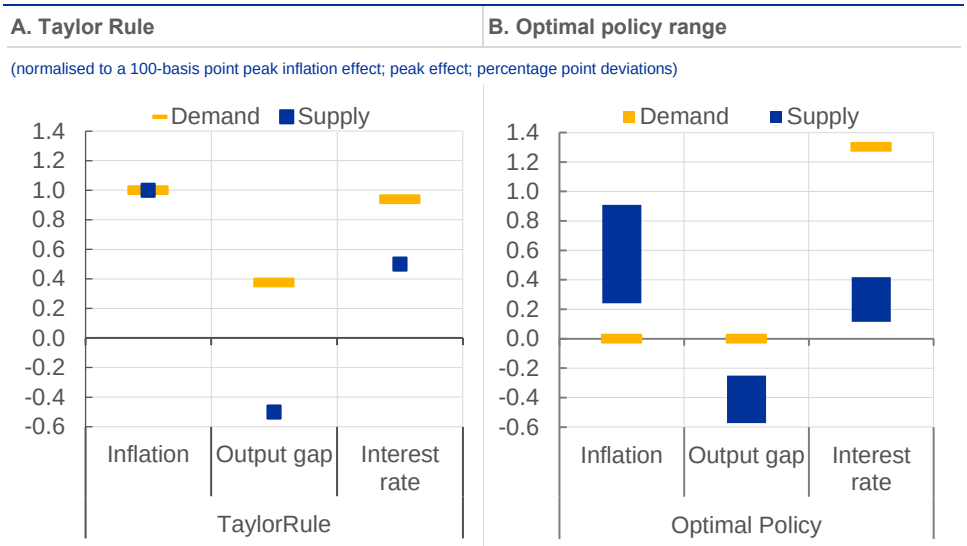
124 Policy prescriptions and their macroeconomic implications may still differ in reaction to a "very persistent" cost-push shock lasting years or decades (e.g. due to geopolitical fragmentation or armed conflict). In such cases, Nuño et al. (2024) find that under an optimal commitment policy, policymakers adopt a "bygones are bygones" approach: they aim to bring inflation back to target without enforcing a below-target period to restore the pre-shock price level, leading to a permanent increase in the price level. This contrasts with the simple New Keynesian model (Galí, 2015, Chapter 5), where policy typically seeks to reverse price level changes. As a consequence of this "bygones are bygones" policy, once the inflation gap is closed, the output gap remains persistently negative throughout the duration of the shock.

125 In theoretical models, it is useful to distinguish between efficient supply and trade-off shocks which generate a policy trade-off by moving inflation and output in opposite directions. However, in practice – especially in real-time analysis – potential output is unobservable, which complicates the interpretation of such shocks. Since the output gap is not directly observable outside of models, identifying whether a shock is trade-off inducing requires careful assessment.

126 The appropriate response to supply shocks depends on the weight assigned to the output gap in the central bank's loss function. Woodford (2003) and Galí (2015) indicate that, based on the welfare maximisation consistent with household utility, the optimal monetary policy should place a very small weight on the output gap. However, recent work by Eggertsson and Woodford (2024) suggests that a small weight is based on the assumption that the elasticity of substitution among goods determines both the market power of individual suppliers as well as the degree to which the sectoral composition of demand is shifted by a misalignment of prices in different sectors. Generalising this assumption by separating these parameters leads to an output gap weight that may be significantly (possibly an order of magnitude) larger than previously thought. Eggertsson and Woodford (2024) find that a substantial weight on output may be appropriate even if firms have little market power. This suggests there can be reasons to place more emphasis on stabilising economic activity, even in response to shocks that would typically lead to efficient variations in output. Moreover, there may be justification for countering declines in output more aggressively when they are expected to be more persistent.

Chart 28

Response to demand and supply shocks in standard models: an illustration



Sources: Eurosystem staff calculations based on Galí (2015).
Notes: The markers in the left panel chart display point estimates following the Taylor rule specified in Galí (2015). The bars in the right panel chart display the response range under optimal policy, varying the output gap weight in the loss function between a microfounded weight of 0.02 and a weight of 0.25.

3.1.2 Do recent experience and economic literature challenge conventional wisdom?

Recent evidence does not allow firm conclusions to be drawn about whether there have been lasting changes to the length of policy transmission lags and the persistence of shocks. First, there is tentative evidence that the persistence of shocks has increased, particularly with respect to price mark-up shocks.[127] The more persistent a shock is, the less compatible a "looking through" strategy becomes with medium-term objectives. However, it remains unclear whether these changes are lasting. Second, the frequency of supply shocks seems to have increased in recent years, a trend that may persist in the future (see also Workstream 1 Sections 2.2 and 3.3), underscoring both the need to consider them collectively and the pertinence of discussing "looking through" strategies and their limits. Third, while policy transmission has become faster and stronger for credit granted to firms, it has either remained unchanged or stretched out for consumption via flow effects of interest payments (**Section 2.3**). Overall, transmission lags do not appear to have changed significantly (Zlobins, 2024). Looking at subcomponents of inflation, policy transmission has remained relatively unchanged at horizons of up to one year (Allayioti et al., 2024).

Recent literature, as illustrated by a Eurosystem model-based exercise, emphasises various economic channels that may affect the desirability of

[127] Estimating a Smets and Wouters (2007) standard medium-term DSGE model on euro area data and allowing for a regime switch in the parameters of the price Phillips curve indicates an increase in the persistence of the shock process in recent years.

"looking through" and are typically absent from standard models.[128] To assess the implications of these additional channels in a consistent manner, Eurosystem staff has carried out a comprehensive harmonised exercise. The models and channels that have been considered are shown in **Table 2**.[129]

Table 2

Channels recently emphasised: models included in Eurosystem harmonised exercise

Channels	Model
Household heterogeneity	Gnocato (2025), Kase and Rigato (2025a)
Endogenous growth	Abbritti et al. (2021), Elfsbacka-Schmöller and Spitzer (2022), González et al. (2023)
Financial frictions	Darracq Paries et al. (2023), Karadi and Nakov (2021), Van der Ghote (2021)
Production networks	Aguilar et al. (2024b), Gerke and Röttger (2025), Kase and Rigato (2025b)
Inflation de-anchoring	Dupraz and Marx (2023), Gerke and Röttger (2025)
Non-linearity in the Phillips curve	Karadi et al. (2024a)
Financial imbalances	Van der Ghote (2021)

Some of these additional channels call for strong limits to the "looking through" approach to supply shocks, while others lend support to an even stronger "looking through". The left panel of **Chart 29** provides an overview of these channels and illustrates qualitatively how they influence predictions regarding the appropriate degree of "looking through". The right panel of **Chart 29** estimates how each specific channel may affect the elasticity of the policy rate to inflation following a negative supply shock based on the models shown in **Table 2**.[130] The elasticity of the nominal interest rate to inflation captures the responsiveness of policy to price pressures. The results are presented in terms of the difference between the "full model", in which the channel under investigation is present, and the "standard model", from which it is absent. For instance, the inflation de-anchoring channel amplifies the inflation response to an inflationary shock, leading to higher policy rates under optimal policy.

The analysis concentrates on individual channels, but abstracts from hypothetical changes in the technological, economic and geopolitical environment that may have wide-ranging repercussions for monetary policy. While the remainder of this section discusses specific channels, changes in the economic and geopolitical environment – such as AI adoption, climate change and

128 See also the discussion in Lagarde (2025).

129 Most models exhibit a symmetric impact of supply shocks, meaning that the effects of a positive supply shock can also be applied to a negative supply shock scenario. However, models featuring a financial frictions channel tend to display a somewhat asymmetric effect. Although the policy predictions remain qualitatively similar for negative supply shocks, the differences are less pronounced under a negative supply shock due to reduced amplification. For instance, in Darracq Paries et al. (2023), the positive cost-push shock, when compared to the negative one, has a higher amplification in the economy. This is because the worsening of financial conditions due to non-linearities further amplifies the negative impact, leading to a pronounced worsening of financial conditions and a large increase in banks' probabilities of default.

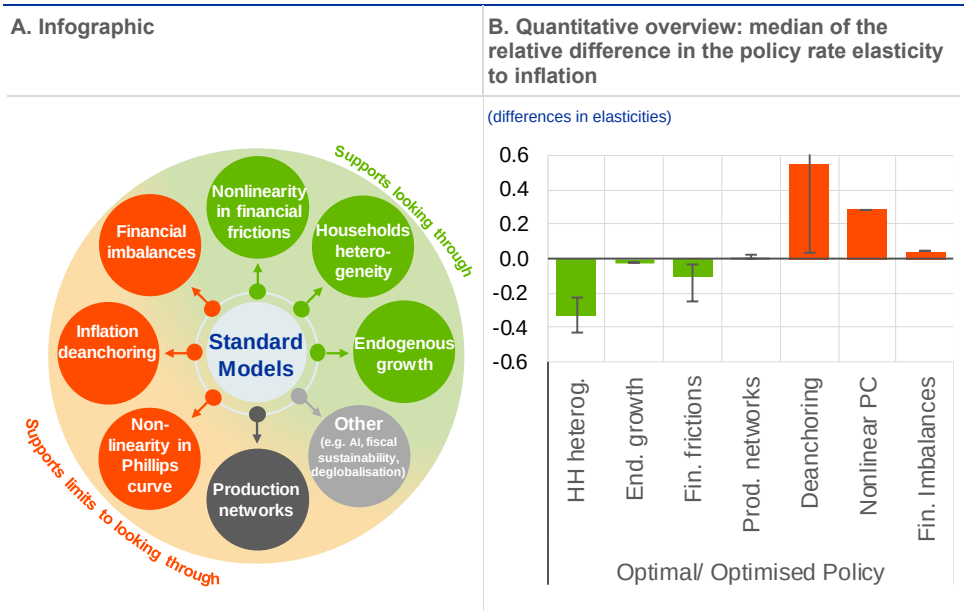
130 Detailed analyses are presented in the following sections.

deglobalisation – require a focused treatment not included in this report.[131] One example of a major shift has come in the form of a fragmenting global trading system, as highlighted in the report of the International Relations Committee Workstream on Trade Fragmentation (Attinasi et al., 2024). Trade fragmentation leads to larger and more frequent supply shocks, making sectoral price changes more significant for aggregate inflation – particularly in the presence of price and wage rigidities. Energy and global supply chain disruptions accounted for about half of the core inflation surge in the euro area, illustrating the profound impact fragmentation can have on inflation. Monetary policymakers must carefully assess whether these inflationary effects are transitory or indicative of medium-term trends – the latter being critical for the medium-term objective. The degree to which "looking through" remains a robust strategy during such developments requires further analysis. Lechthaler and Mileva (2025) shed some light on this question using a dynamic general equilibrium model to show that trade fragmentation shocks act similarly to negative supply shocks. They raise inflation because imports are more expensive, and lower output by depressing exports. As long as second-round effects (e.g. via wage rigidity) are not too strong, the surge in inflation will be short-lived and thus "looking through" remains appropriate.

131 Moreover, the presence of information frictions may also affect the desirability of "looking through". In this context, one source of these frictions could be incorrectly evaluating the type of shock or its underlying parameters. For instance, Bušs and Traficante (2025) demonstrate that a "looking lookthrough" approach to transitory cost-push shocks generally results in lower losses than a Taylor rule under full information, but this advantage diminishes with incomplete information. In such environments, misjudging shock persistence can lead to inflationary pressures, underscoring the importance of considering information limitations when evaluating this policy.

Chart 29

Channels that have recently been emphasised in the economic literature and are typically not considered in standard projection and policy models



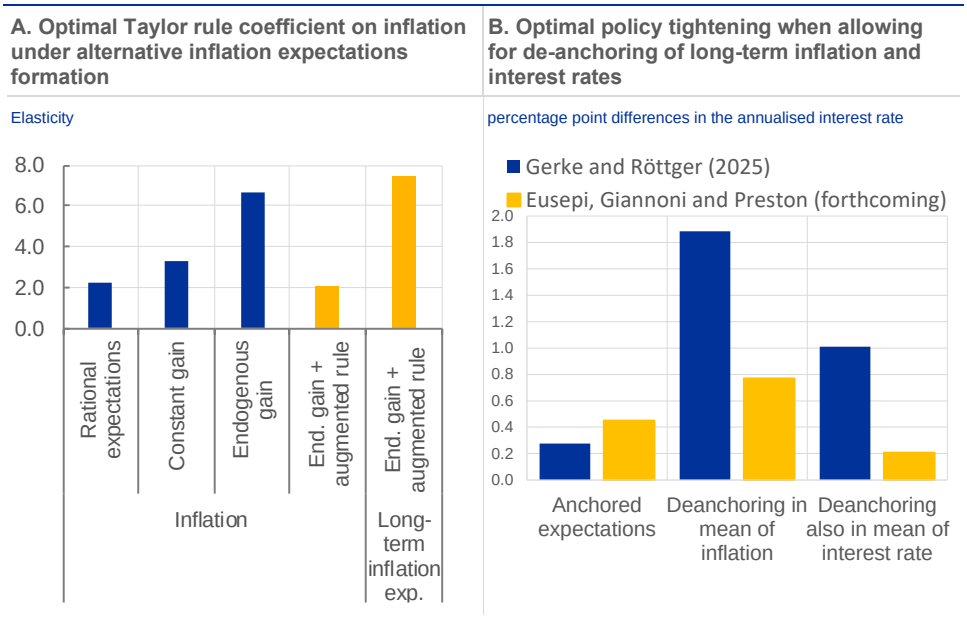
Sources: Eurosystem estimates based on models depicted in **Table 2**.
Notes: Left panel: Infographic is based on findings from contributing models to the medium-term team. right panel: The chart depicts the median of relative differences in the nominal interest rate elasticity to inflation within a channel in response to a supply shock. The elasticity is calculated as the average 2-year nominal interest rate response divided by the average 2-year inflation response following a supply shock. To improve readability the chart is truncated, excluding the upper end of the whisker for the de-anchoring channel which is 1.06.

Recently emphasised channels calling for limits to "looking through"

The inflation de-anchoring channel calls for readiness to take stronger action pre-emptively, also in the face of supply shocks. Poorly anchored expectations amplify inflationary pressures. Accordingly, the optimal monetary policy response depends on the extent to which inflation expectations are anchored, highlighting its state-dependent nature. For instance, allowing for a de-anchoring channel via modelling inflation expectations using adaptive learning, realised inflation feeds back into inflation expectations. In learning models with constant-gain mechanisms – where new information is "gained" by private sector agents at a fixed rate – the optimal response to inflation is more aggressive than under rational expectations (**Chart 30**, left panel, first versus second bar). Analysis based on Gáti (2023) shows that this effect is further amplified in models with endogenous gain, where expectations adjust more when inflation surprises are larger, calling for even more forceful policy reactions (**Chart 30**, left panel, third bar). Optimal policy tries to prevent de-anchoring through strong pre-emptive actions, because it would be even more costly to counteract inflation once it has occurred.

Chart 30

Optimal policy reaction under different inflation expectation formation mechanisms



Sources: Left panel: Gáti (2023), right panel: Gerke and Röttger (2025) & ECB staff computations following Eusepi et al. (forthcoming).
Notes: Left panel: The Taylor rule specification follows $i_t = \psi_\pi \cdot \pi_t + \psi_x \cdot x_t + \delta \cdot \bar{\pi}_t$ in which the response to the output gap is $\psi_x = 0.3$. Constant gain stands for a version of the model where the gain, the model's metric for de-anchoring, is constant and set to 0.05 and δ=0. Endogenous gain stands for the baseline version of the model where the gain evolves according to the anchoring function estimated in Gáti (2023) and δ=0. End. Gain + expectations stands for the endogenous gain specification in which the Taylor rule is augmented with a response δ to long-term inflation expectations $\bar{\pi}_t$. The inflation coefficient in the augmented rule under endogenous gain has not been optimised and is to be considered jointly with the optimised coefficient on long-term inflation expectations δ. Notes Right panel: The chart shows the peak response of the nominal interest rate in percentage points as absolute deviations from steady state in response to a cost-push shock that leads to a peak inflation impact of on average about 15 bps. The central bank follows optimal monetary policy. The underlying models are a small-scale New-Keynesian model as in Eusepi et al. (forthcoming) and a multi-sector New-Keynesian model (Gerke and Röttger, 2025).

Augmenting a policy feedback rule with a response to deviations of long-term inflation expectations from target can operationalise optimal policy predictions. A Taylor rule with a response to inflation similar in size to what is appropriate under rational expectations can deliver satisfactory stabilisation properties if augmented with a response to long-term inflation expectations (**Chart 30**, left panel, fourth and fifth bars in yellow). However, models that permit inflation de-anchoring typically omit other relevant factors in expectation formation, such as the possibility that long run expectations of nominal interest rates may also adjust in response to shocks. When this possibility is included, there is a limit to how aggressive monetary policy can be (**Chart 30**, right panel). This is because overly aggressive responses would lead to sub-optimal volatility in long-term interest rates and aggregate demand.

Counterfactual simulations show that the inflation surge would have been much more persistent and costly to counteract if inflation expectations in the euro area had not been well anchored.[132] Analysis based on Dupraz and Marx (2023)[133] shows that well anchored expectations mitigated inflation and output volatility during the recent inflation surge (**Chart 31**). This contrasts with the situation if inflation expectations had been poorly anchored as they were in the 1970s – a time

[132] See also Villeroy de Galhau (2024).

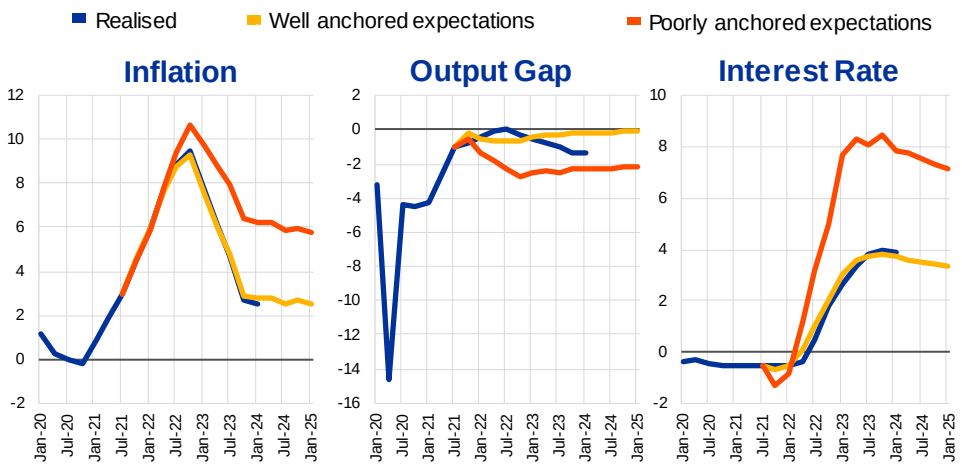
[133] For early literature, see for instance Gaspar et al. (2010), Molnar and Santoro (2014), Eusepi and Preston (2018), and Dupraz and Marx (2023).

when central bank credibility was less well established, and the initial conditions were different. In such circumstances this would have resulted in a sharper inflation surge and a more severe output contraction. The policy rate would have peaked at 8% instead of 4% and it would not have been possible to sufficiently stabilise inflation thereafter.[134] Model-based analysis in **Section 3.2** suggests that the ECB's policy tightening was crucial in preventing the upward de-anchoring of inflation expectations, whereas "looking through" would have resulted in large de-anchoring risks, necessitating an even stronger tightening.

Chart 31

Counterfactual of the recent episode if inflation expectations had been poorly anchored

(left panel: year-on-year percentage changes; centre panel: percentages of potential output; right panel: percentages per annum)



Sources: Dupraz and Marx (2023)
Notes: The two counterfactual exercises start in 2021 Q3. Results based on a model with finite planning horizon à la Woodford (2019) and long-term learning with a constant gain. The model is estimated on 1999 Q1 – 2007 Q4 euro area data. The figure shows the realised path of inflation, the output gap and the policy rate (blue), the model's optimal policy recommendation when the learning gain g is at its estimated value of g = 0.01 (well anchored expectations, yellow) and the model's optimal policy recommendation when the learning gain is at the much higher value of g = 0.145 as the case in the 1970s in the United States, following Carvalho et al. (2023) (poorly anchored expectations, red).

Channels that lead to non-linearities in the Phillips curve imply that at higher inflation levels the trade-off between inflation and output improves, weakening a key rationale for "looking through". Recent analyses of non-linearities in the Phillips curve highlight the role of state-dependent pricing, whereby firms adjust prices more frequently during periods of high inflation, creating a non-linear relationship between inflation and economic slack. Data on price changes during the inflation surge indeed display an increase in the frequency of price adjustments (see Workstream 1, Section 2.2.2). Analysis based on Karadi et al. (2024a) finds that, in response to a large cost-push shock, monetary policy under a Taylor rule reacts more strongly when this channel is present – and optimal policy further increases this response. The reason is that at very high inflation levels the trade-off between inflation and output becomes less pronounced, suggesting that policymakers should

[134] Beaudry et al. (2022) argue that looking through supply shocks initially is warranted. However, they find that under optimal policy a series of supply shocks may require a discontinuous shift to a more aggressive policy reaction to control (non-rational) inflation expectations. However, the jump behaviour arises only when the weight of employment in the loss function of the central bank is very high. With a smaller weight, monetary policy still becomes increasingly aggressive as the overheating in the previous period intensifies, but it is then optimal to only gradually increase policy aggressiveness.

act decisively in a pre-emptive manner when inflation can be reduced at a lower output cost (lower sacrifice ratio), limiting the case for "looking through". This non-linearity also enhances the potency of monetary impulses, as larger policy actions are relatively more effective and less costly. This results in a reduced trade-off between output and inflation adjustments when addressing large shocks compared to smaller ones, a result that is also supported by Ascari et al. (2025). In these models, augmenting a Taylor rule with a measure of the frequency of repricing can provide a pragmatic way of achieving macroeconomic outcomes close to the optimal ones.

The financial imbalances build-up channel that may result from protractedly loose monetary policy implies that persistent "looking through" may generate vulnerabilities later on. While loose monetary policy can temporarily bolster bank profitability and reduce short-term vulnerabilities, it may also incentivise higher leverage and increased risk-taking over the medium term. That creates a trade-off between short-term stabilisation gains and long-term financial stability risks, as shown in Darracq Paries et al. (2023).[135] Explicitly incorporating these risks suggests a more cautious approach to looking through negative supply shocks is warranted, because the resulting rise in financial imbalances may amplify systemic vulnerabilities and heighten risks to financial stability later on (Van der Ghote, 2021).[136] Conversely, it may also be appropriate to look through temporary positive supply shocks, in order to limit the build-up of financial imbalances that could arise from accommodative policies.

Recently emphasised channels calling for stronger "looking-through"

Channels related to household heterogeneity, such as the negative demand channel that may be triggered by adverse supply shocks, imply that the case for "looking through" is even stronger than advocated in standard models. Gnocato (2025) illustrates this feature in a tractable Heterogenous Agent New Keynesian model (HANK), showing that energy price shocks disproportionately affect unemployed workers compared to employed ones. This effect is due to a combination of imperfect unemployment insurance and the existence of a minimum subsistence level of energy needs that each household has – implying that there is more limited margin for substituting away from energy goods when they become more costly after an energy shock.[137] In these models, household heterogeneity gives rise to a negative demand channel, resulting in a lower inflation peak and a larger output gap decline compared with a representative agent model. Under a standard Taylor rule, this negative demand channel dampens the required increase in the interest rate. Optimal policy calls for even stronger "looking through" by

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135 See also Adrian and Liang (2018) for a review of the literature about monetary policy and financial stability and see ECB (2021d) for the discussion in the context of the strategy review 2021.

136 As indicated already in **Chapter 2**, strong regulation and effective supervision – as well as the complementary role of macroprudential policies – played a crucial role in mitigating adverse effects on banks during the inflation surge episode, see also ECB Governing Council statement on macroprudential policies (2024) and Hempell et al. (2024).

137 For an exposition of a tractable HANK model, see Ravn and Sterk (2021); see Auclert (2025) for an overview of the potential of HANK models in macroeconomics more generally.

accommodating increases not only in the energy component of the HICP, but also increases in core inflation to cushion the output decline. Households become more vulnerable to energy shocks if they lose their jobs, thus justifying partial accommodation of core inflation to curb unemployment in the face of rising energy prices. These optimal policy considerations can be operationalised in these models by a modified Taylor rule in which headline inflation is replaced by core inflation.[138] That said, fiscal policy measures could more effectively address this negative demand channel by providing targeted support to the most affected households.[139]

Turning to the endogenous growth channel, hysteresis effects exacerbate trade-offs, thus strengthening the case for "looking through". While standard models assume that total factor productivity is not affected by business cycle forces and monetary policy, there is evidence that total factor productivity should be treated as an endogenous variable.[140] Analysis based on Abbritti et al. (2021), Elfsbacka-Schmöller and Spitzer (2022), and González et al. (2023) explores various mechanisms through which total factor productivity is influenced by business cycle fluctuations. These include capital misallocation driven by financial frictions, changes in R&D investment, and technology adoption.[141] Endogenous growth alters the response to supply shocks compared with standard models, with mixed effects on inflation but consistent amplification of the negative output gap via hysteresis effects. This worsens the trade-off between output and inflation, particularly for larger shocks, as restrictive policies lead to a lasting negative impact on productivity. In these models, optimised Taylor rules assign a stronger response to economic slack, thereby mitigating the effects of hysteresis.

Non-linearities related to financial frictions give rise to stronger recessionary effects of cost-push shocks, strengthening the case for "looking through". These non-linearities arise from occasionally binding leverage constraints on banks and the interconnected solvency risks of corporates, banks and sovereigns, altering the response to cost-push shocks relative to standard models.[142] Analysis based on Karadi and Nakov (2021), Van der Ghote (2021), and Darracq Paries et al. (2023) shows that under a Taylor rule the inflation impact remains ambiguous, but the financial accelerator effect amplifies the recessionary impact of adverse cost-push

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138 Alternatively, as demonstrated by Kase and Rigato (2025a), heterogeneity can be accounted for in the Taylor rule by including the consumption patterns of a low-wealth percentile.

139 See Kharroubi and Smets (2023), who study the optimal fiscal response to an energy shock and advocate subsidising poorer, constrained households while taxing richer, unconstrained ones. Similarly, Auclert et al. (2023) examine the effects of energy price shocks in a HANK model of a small open economy, showing that fiscal policy can reduce consumption inequality in response to the shock, although it may give rise to negative externalities for other countries. McKay and Reis (2016) discuss the role of automatic stabilisers in reducing consumption volatility and stabilisingstabilizing the economy in heterogeneous agent models, while Mitman and Rabinovich (2015) caution that optimal unemployment benefits (in a model that does not explicitly incorporate energy shocks) are procyclical, which contrasts with the view of providing unemployed households with targeted fiscal support in response to rising energy prices that trigger a recession. Additionally, Auclert et al. (2023) explore the response to energy shocks and emphasise the crucial role fiscal policy can play in stabilisation.

140 For instance, using German firm-level data it is found that firms cut innovation investment in response to the rate hike episode, with an average firm-level cut of 20% (Elfsbacka-Schmöller et al., 2024). Moreover, Jordà et al. (2025) demonstrate that monetary policy has real effects lasting for over a decade, with responses that are asymmetric and more pronounced for a tightening shock.

141 See also for instance Anzoategui et al. (2019) and Bianchi et al. (2019), who study the interaction betweenbeween endogenous growth and business cycles, or Garga and Singh (2021), and Moran and Queralto (2018) for interactions between endogenous growth and the ELB.

142 See also Dou et al. (2023) for a recent review of macro-finance models featuring non-linear dynamics.

shocks. Abstracting from other stabilisation policies, optimal monetary policy recommends a greater degree of "looking through" by maintaining lower policy rates to cushion recessionary effects. Non-linear financial frictions are also evident in contractionary monetary policy shocks, which amplify output costs disproportionately for larger shocks, resulting in a higher trade-off with inflation.[143]

Channels associated with production networks do not seem to unequivocally alter the predictions of standard models as regards the appropriate degree of "looking through". In the context of the harmonised exercise, predictions from the multisectoral models based on Aguilar et al. (2024), Gerke and Röttger (2025), and Kase and Rigato (2025b), which incorporate sectoral heterogeneity and input-output linkages, are mixed and do not unequivocally deviate from those of standard models.[144] Under a Taylor rule, two of the three models predict elevated inflation, lower output and a stronger interest rate response. However, optimal policy in Gerke and Röttger (2025), and Kase and Rigato (2025b), recommends a policy response similar to that in the models without this channel. A notable insight from this framework is the importance of the shock's sectoral origin. Shocks in upstream sectors, such as basic metals, can significantly amplify both inflation and output, while shocks in downstream sectors, such as health services, may produce less amplification.

Overall, efforts to monitor economic channels not fully captured by standard projections and incorporate them into policy models should continue and be strengthened. Augmenting or complementing standard models with these channels may provide a more nuanced and responsive policy infrastructure, which would take the dynamics from these channels into account when formulating projections and policy advice (see also Workstream 1, Chapter 4). This requires monitoring these different channels in a systematic manner, identifying new ones that may become relevant, and assessing how they may interact in a non-linear manner. Finally, it seems that many of the insights coming from optimal policy in those enriched models can be achieved through augmented feedback rules, which can help to pragmatically assess the policy implications of a specific channel.[145]

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143 While monetary policy tightening might increase short-term financial stability risks by increasing the pressures on borrowers and banks, borrower-based measures (BBMs) and capital-based measures can mitigate these side effects. Through the lens of a DSGE model (Herrera et al., 2025), when BBMs and capital-based measures have been activated, the aggregate effect of monetary policy on GDP and prices does not change, but banks' and households' probability of default is reduced by two-thirds compared with non-activation. Also, in an adverse scenario where financial distress materialises, BBMs and capital-based measures can enhance the resilience of the financial sector in a high interest rate environment. With BBMs and capital-based measures, the GDP contraction under a distress scenario is reduced by 0.1 percentage points and 0.4 percentage points respectively, consistent with reductions in default probabilities.

144 See also Box 8 in the Workstream 1 report for an overview of multi-sector models with production networks developed by the ChaMP Research Network.

145 However, as shown in **Section 4.4** in reality there is uncertainty ex ante about which contingencies and channels may be relevant at each point in time. It is shown that in the face of uncertainty there is no general prescription for mechanically adjusting policy rules.

3.1.3 Some evidence on the ECB's response to supply shocks

Empirical evidence based on the last two decades suggests that the ECB has generally reacted more strongly to demand than supply shocks, adapting its response according to the specific situation. Assuming linearity, analysis based on the approach of Bobeica and Jarocinski (2019) shows that the interest rate response to demand shocks has been stronger than for supply shocks (left panel, **Chart 32**). These findings are supported by Taylor-rule type regressions that distinguish between demand-driven and supply-driven inflation (Hofmann et al., 2024). At the same time, recent evidence indicates that inflation behaves non-linearly, reacting disproportionately more strongly to large shocks while showing little response to small shocks (Bobeica et al., 2025). Such dynamics are also reflected in the policy response. Allowing for non-linearities shows that the ECB responded to supply shocks more forcefully when inflation was high (De Santis and Tornese, 2025).[146] Focusing on the period since the last strategy review, no sub-sample analysis is available. However, the analysis in **Section 2.1.3**– based on historical decompositions and optimal policy using linear models – suggests that as of the second quarter of 2023 monetary policy has responded more forcefully than historical regularities would have suggested. This is consistent with the nature of the ECB's medium-term orientation, according to which the appropriate policy response depends on the origin, magnitude and persistence of deviations of inflation from target.

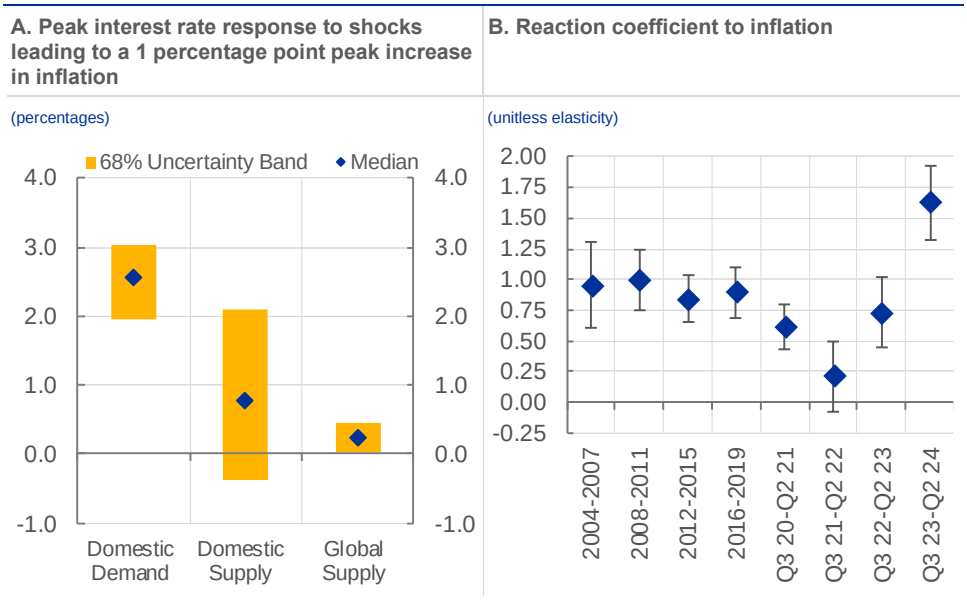
Through the lens of financial markets' perception of the ECB reaction function, the ECB reaction to the 2021-23 inflation surge was initially less pronounced than it had been historically but turned more aggressive later on. The market perception of the ECB's responsiveness to inflation has passed through distinct phases (see the right panel in **Chart 32**). In the first phase (from the third quarter of 2021 to the second quarter of 2022), the ECB was perceived as less responsive to rising inflation compared with historical patterns. In the second phase (from the third quarter of 2022 to the second quarter of 2023), the ECB's responses were perceived as aligning more closely with historical regularities, as inflation pressures intensified and risks of upward de-anchoring increased. By the third phase (from the third quarter of 2023 to the second quarter of 2024), the ECB was perceived as responding more aggressively to inflation than at any time in the last two decades.[147]

[146] In this regard, the relevance of a heightened risk of upside de-anchoring through the response is important and still needs to be addressed.

[147] An alternative approach based on similar financial market data, which takes the strong revisions to expected inflation into account, results in a more stable and less uncertain estimate for the inflation reaction coefficient than if those revisions were ignored. The stronger rise in nominal rates than in inflation compensation might not have represented a change in the reaction coefficient to expected inflation as perceived by markets, but rather a catching-up of the policy stance with past revisions to the inflation outlook. This approach estimates the reaction coefficient to have remained mostly above 1 for most of the time since 2022, amid high uncertainty, and to have stabilised at 1.4 in early 2025.

Chart 32

Evidence on the ECB reaction function



Sources: Eurosystem staff calculations (left panel) and Eurosystem calculations based on Bobeica and Jarocinski (2019).
Notes: Left panel: Peak effects from Bayesian VAR that follows Bobeica and Jarocinski (2019) and includes the Global Supply Chain Pressure Index calculated by Benigno et al. (2022). Estimation sample: 1997Q1-2024Q3. Shocks are scaled to a 0.1 peak inflation effect. right panel: Regression of euro area data (10-year OIS and ILS rates) as in Bocola et al. (2024).

3.2 Forceful or persistent monetary policy action in the face of serious threats to the inflation anchor in either direction

3.2.1 Costs of the ELB: an update

The frequency of reaching the ELB and its costs are estimated to be elevated and broadly similar in magnitude to the 2021 estimates. One key reason is that although the estimates of r* have increased slightly, they remain close to the low levels estimated in 2021 (see Workstream 1: Section 2.3). The 2021 strategy review acknowledged that, in the presence of the ELB, an inflation targeting central bank that responds symmetrically to deviations of inflation from its 2% target may encounter significant costs. These are due to an inflation rate falling short of 2% on average over the longer run and real activity persistently remaining below potential (so-called deflationary bias). The 2021 background studies indicated that the severity of these outcomes increases more than proportionally for values of real r* below 1% because of increasingly tight limits on the available policy rate space. Assuming a value of r* of 0.5%, which is at the conservative end of current estimates,[148] updated model simulations suggest that the frequency of hitting the ELB, the duration of ELB

[148] By comparison, in the context of the strategy review 2003 the level of r* employed to compute the ELB costs was 2%.

episodes and the bias in inflation are similar to the quantification made in the 2021 background studies (**Chart 33**).[149]

Changes in the estimated variance of shocks and structural parameters in recent periods result in offsetting effects on the costs of reaching the ELB.[150] According to results based on a structural model re-estimated with an updated sample (the Deutsche Bundesbank-TANK, BBk-TANK model, as also used in the 2021 strategy review), the variance of shocks has increased.[151] This increase implies that more shocks that push the policy rate to the ELB might occur, exacerbating the downward bias in inflation (**Chart 33**, blue diamonds). However, this effect is counterbalanced by the impact of updated parameter estimates that suggest that the Phillips curve may have steepened during the inflation surge period, increasing the impact on prices of a given change in monetary policy (**Chart 33**, green diamonds). Overall, the ELB costs (yellow diamond) remain similar to the estimates based on the data sample used in the 2021 strategy review (red diamonds). Looking ahead, it is uncertain whether the changes estimated over the extended sample will persist or be reabsorbed as the impact of extraordinary events, such as the COVID-19 pandemic and the war-related surge in energy prices, fades.[152] [153]

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149 Empirical estimates suggest that the euro area r* increased from somewhat negative levels before 2021 to slightly positive levels in 2024. Current estimates are consistent with r* assumptions in the model-based exercises to gauge lower bound risks conducted as part of the previous strategy review, as the value used was in the upper range of the estimates available in 2021.

150 It is a counterfactual stochastic simulation assuming that monetary policy only resorts to conventional interest rate policy and that the policy rate is adjusted symmetrically.

151 For more details on the BBk-TANK model, see Gerke et a. (2022).

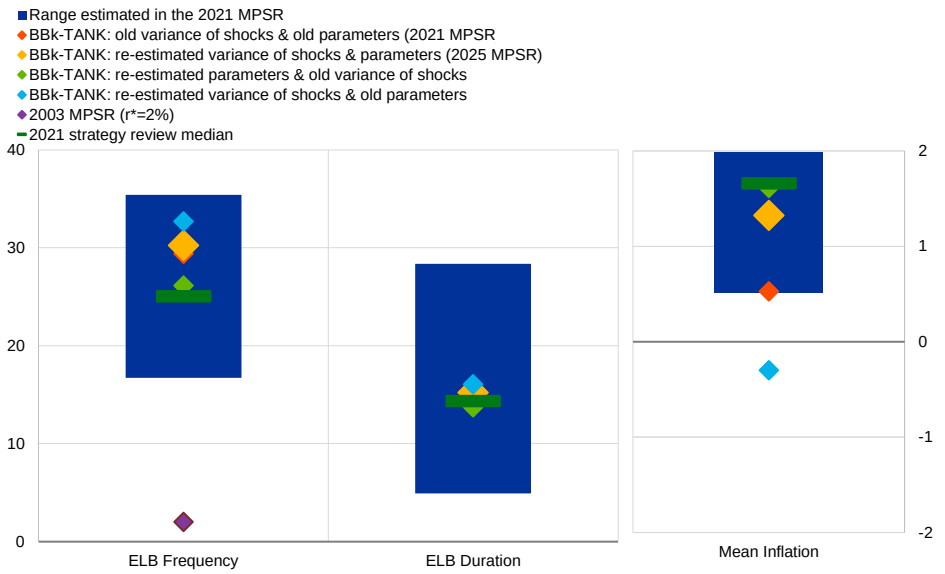
152 A competing hypothesis would suggest that the Phillips curve did not steepen, but expectations shifted higher and then lower again. Beaudry et al. (2025) find evidence for this hypothesis. See also Beschin et al. (2025). Furthermore "The slope of the euro area price Phillips curve. Evidence from regional data", mimeo, findsfind no evidence of non-linearities in the Phillips curve even after 2020 at regional level. Workstream 1 report, Section 2.2.2, finds evidence of both a steepening and a shifting of the curve, both of which are expected to have normalised.

153 In addition to the analysis on ELB risks, the effectiveness of asset purchases is found to be comparable to the 2021 estimates (see **Section 2.2**).

Chart 33

Implications of the ELB

(percentages; quarters; year-on-year percentage changes)



Sources: BBk TANK model Gerke, R. et al (2022); strategy review 2021: Cecioni, M, et al.. (2021).
Notes: The BBk-TANK model is re-estimated using data pre-Covid (old variance and old shocks) and up to 2023Q4 (re-estimated variance of shocks and parameters) and with two combinations, keeping either parameters or shock processes at levels estimated over the old sample. The 2021 estimate is the median across models reported for the strategy review 2021. The 2021 range and median are an average of the results with 0 and 1% r*, and the value of r* used in the simulations with the re-estimated models is 0.5%. The 2003 estimates refer to the strategy review 2003 based on an estimate of r*=2%.

3.2.2 Is the insight that monetary policy needs to be forceful or persistent close to the ELB still valid?

The strategy review 2021 concluded that, when close to the ELB, forceful or persistent monetary policy can help mitigate the costs of reaching the ELB. The ELB constrains downward movements of the policy rate but not upward movements, thus creating an asymmetry. This non-linearity can be counteracted by adjusting the monetary policy reaction function such that the central bank remains able to deliver a symmetric 2% inflation target. Extensive economic literature indicates that additional policy space can be created by employing measures beyond mere adjustments to policy rates, such as any one of – or a combination of – asset purchases, negative interest rates and guidance on future policy.[154] The 2021 strategy statement encapsulated this insight: "when the economy is close to the lower bound, this [i.e. maintaining symmetry] requires especially forceful or persistent monetary policy measures […]. This may also imply a transitory period in which inflation is moderately above target."

This insight that forceful or persistent policy action may help to address the ELB constraint appears to remain valid. Macroeconomic model simulations continue to support the effectiveness of this approach. This can be illustrated with a hypothetical scenario where the euro area experiences a large negative demand

[154] See Cecioni et al. (2021).

shock that pushes interest rates close to the ELB (**Chart 34**, solid blue line). For illustrative purposes, taking the baseline of the September 2024 ECB staff projections (**Chart 34**, dashed grey lines) as a starting point, in the presence of the ELB (yellow line) optimal policy calls for policy rates to be lowered more swiftly to the ELB than in a situation where the policy rate is not constrained by the ELB (red line). This underscores the merits of being forceful. This decisive action helps counter low inflation promptly, thereby also reducing the risk that shocks drive the policy rate to the ELB for a longer period. Instead, preserving policy space for future use – akin to "keeping the powder dry" – would heighten the risks associated with the ELB.[155] In addition, optimal policy calls for persistence to be communicated also ex ante because, if expectations internalise this future policy, the real rate decreases and inflation returns to target more rapidly.[156] Importantly, as shown below, optimal policy under such a commitment prescribes that the extent of persistence is state-contingent. Thus, it is not a commitment to maintain loose policy for a predetermined period regardless of changes to the inflation environment. Forcefulness and persistence are to some extent substitutes. However (i) early policy action via forcefulness can provide more stimulus per unit of interest rate change around the ELB because stimulus via persistence may require communicating about policy far into the future – beyond the exit from the ELB – and may not be as credible as decisive direct action. Also (ii) there is also a temporal dimension in that, as regards interest rates, forcefulness and persistence are to some extent substitutes in the face of ELB risks, while only persistence applies once the ELB is reached. At the same time, it is important to clearly communicate that persistence is a means to overcome the ELB rather than a promise to keep rates permanently low.[157] Finally, asset purchases and negative rates can, within limits, enhance the forcefulness or persistence of the policy response, mitigating the costs of reaching the ELB and enabling an earlier rate lift-off.[158]

[155] See Cecioni et al. (2021).

[156] Note that the model is not negatively affected by the forward guidance puzzle. The effects of forward guidance are dampened. The further into the future the policy announcements apply, the smaller their impact. The parameter that governs this dampening is estimated along with the other structural parameters in the model.

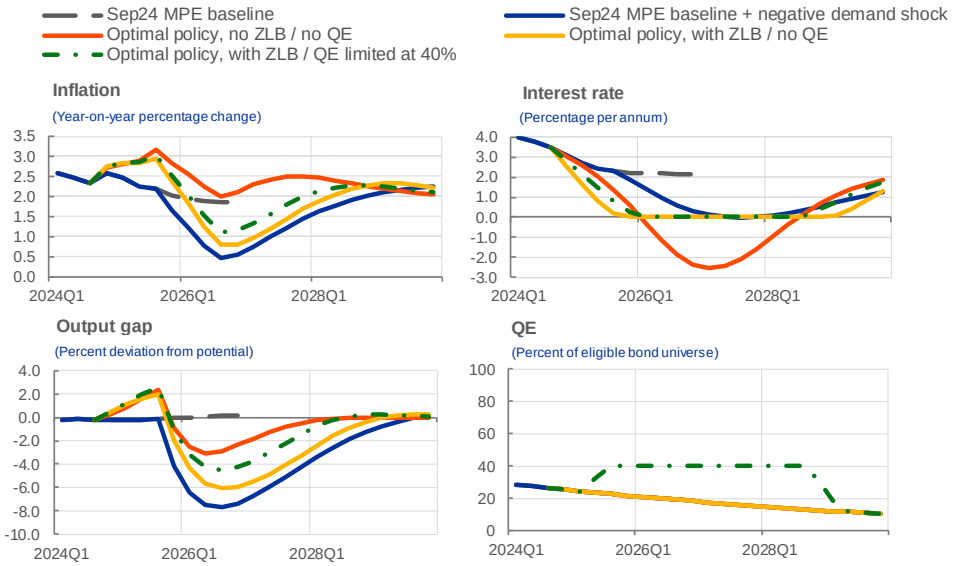
[157] A long duration at the ELB can lead to lower inflation expectations. See Box 3 in Cecioni et al. (2021), as well as Carvalho et al. (2025), Uribe (2022) and Valle e Azevedo et al. (2022).

[158] The modelling of quantitative easing in the MMR model follows Harrison, R. (2017).

Chart 34

Implications of the ELB and alternative policy approaches

Benefits of pursuing a more forceful and persistent response to the ELB risks



Source: MMR model (Mazelis et al. 2023).
Notes: Starting from the September 2024 staff broad macroeconomic projections for interest rate, inflation, and output gap, a hypothetical scenario is assumed in which the economy is hit by a large negative demand shock. Three sets of optimal policy simulations are constructed around this scenario: (i) without an ELB constraint (red line), (ii) with an ELB constraint at 0% (yellow line), and (iii) with an ELB constraint at 0% and QE with an upper bound constraint at 40% of the eligible bond universe (green dashed-dotted line).

3.2.3 Was the operationalisation via data-dependent state-based rate guidance announced in July 2021 sufficiently robust?

The strategic principle of "forceful or persistent" policy actions close to the ELB was operationalised pro tempore in July 2021 via state-based rate forward guidance. On 22 July 2021 the Governing Council operationalised this new strategy principle pro tempore, i.e. at that specific juncture and given the prevailing initial conditions and specific factors prevailing at the time. As discussed below in **Chart 40** (yellow versus red bars), these initial conditions are key in any assessment of monetary policy during this period. The state-based rate guidance included three criteria. Two of them related to the outlook, while the third established an outcome condition: "*reaching 2% well ahead of the end of its projection horizon"*; and "*durably for the rest of the projection horizon"*; while "*realised progress in underlying inflation is sufficiently advanced to be consistent with inflation stabilising at 2% over the medium term".* And it concluded that "*this may also imply a transitory period in which inflation is moderately above target"*. The three criteria had to be met jointly to limit false-positive signals witnessed in previous episodes in which temporary increases in inflation in the short term were accompanied by persistently weak underlying inflation. Asset purchases were a way to implement forcefulness at the lower bound. The link to time-based asset purchase guidance provided additional insurance against the risk of a premature lift-off, injecting stronger policy persistence in the face

of a medium-term inflation outlook going below target according to the baseline projections.[159]

The July 2021 rate guidance was intended to be data-dependent, avoiding any precommitment to a specific policy rate path or predetermined date for lift-off. The July 2021 monetary policy account emphasised that the guidance was intentionally designed to include both "outlook-based" and "outcome-based" conditions. The inclusion of the latter aimed to enhance robustness against a premature rate lift-off by also maintaining a focus on current developments through a reference to underlying inflation.[160] Additionally, the preamble restricted the validity and scope of the new guidance to a situation in which robust convergence was not yet assured. An analysis of speeches by Governing Council members, employing machine learning techniques, confirms this intention: following the adoption of the rate guidance in July 2021, all speeches that mentioned forward guidance conveyed a data-dependent connotation, i.e. the timing of rate lift-off was intended to adjust to the potentially changing inflation environment.[161]

Market and survey data indicate that the July 2021 rate guidance was indeed perceived as data dependent. If it had not been understood this way, policy rate expectations would have remained unaffected by macroeconomic and inflation news. However, high-frequency analysis shows that the response to news became significantly larger between July 2021 and June 2022 (**Chart 35**, left and middle panels). In addition, an increased share of SMA participants simultaneously revised both their inflation expectations and their expectations for the lift-off date. While in the September 2021 SMA the median respondent expected rate lift-off to occur in December 2024, in the February and March 2022 surveys the lift-off was expected to occur in December 2022. This suggests that analysts did not view the lift-off date as predetermined (right panel). At the same time, the link to the APP guidance may have played a role in preventing an even stronger adjustment in rate lift-off expectations. SMA respondents brought forward their rate lift-off expectations even further after the Governing Council announced a revision to the net purchase schedule at its March 2022 meeting, which paved the way for the eventual discontinuation of net purchases at the end of June 2022 and the subsequent rate lift-off in July 2022.

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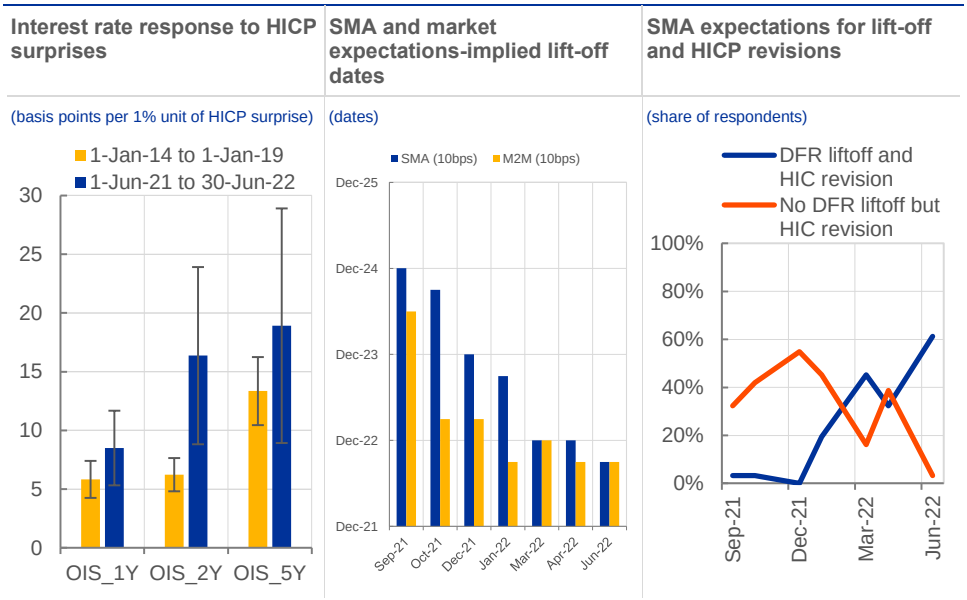
159 In December 2021 the Governing Council decided to extend the horizon of net asset purchases under the APP. At that meeting it specified the pace of purchases until October 2022 and announced that net asset purchases would be maintained beyond that horizon for as long as necessary to reinforce the accommodative impact of its policy rates. Net purchases were expected to end shortly before it started raising the key ECB interest rates.

160 The July 2021 monetary policy account clarified this intention: "First, the forward guidance remained state-contingent and would continue to provide a powerful automatic stabilisation mechanism. In one direction, if the inflation outlook were to improve by more than anticipated as the recovery proceeded, the time horizon to the first increase in interest rates would automatically shorten and financing conditions tighten. In the other direction, if there were setbacks to the inflation outlook, the time to lift-off would automatically lengthen, leading to easier financing conditions that would help support the economy and the inflation outlook."

161 An analysis using a large language model shows that all speeches discussing forward guidance made by Governing Council members after the implementation of forward guidance in July 2021 have a data-dependent connotation. In contrast, before July 2021 some speeches that discuss forward guidance are not classified as having a data-dependent connotation. See Arencibia et al. (forthcoming).

Chart 35

Was the rate forward guidance understood as data dependent? Market and survey-based evidence suggest it was



Sources: Odendahl, F. (2024) "(Non)Contingent Forward Guidance" mimeo; Bloomberg and ECB calculations; Survey of Monetary Analysts (SMA).
Notes: Left panel: High-frequency response of OIS rates to HICP surprises in the four largest euro area countries; Sample from August 2005 to June 2022. Middle panel: The analysis estimates the impact of 2Y OIS on macro news; Middle: Lift-off dates are defined as the dates in which the respective DFR expectation rises at least 10 bps above the ELB. M2M refers to the meeting-by-meeting €STR forward rates for which the cut-off dates are three days before each GovC in line with the cut-off date for final GovC presentations. right panel: The blue lines show the share of respondents that expected the DFR lift-off date to be revised and also revised their inflation expectations. The red line shows the share of respondents revising their inflation expectations but not the lift-off date.

The outlook-based conditions embedded in the July 2021 rate guidance were tightly linked to the ECB/Eurosystem staff baseline projections, which created challenges ex post in the light of large inflation projection errors. A model-based analysis was performed that operationalised the outlook conditions "well ahead" and "durably" in terms of average expected inflation according to the staff projections five to eight quarters ahead. This analysis indicates that the contribution of the rate guidance to inflation was relatively small (

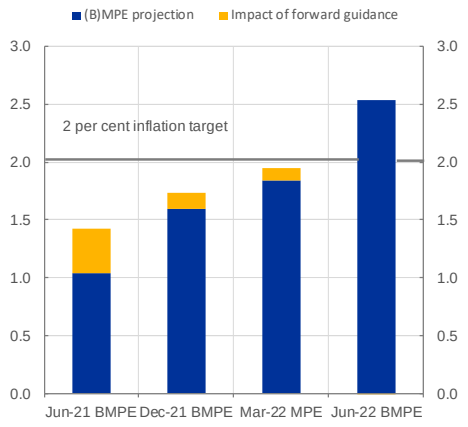
Chart 36, yellow bar) and was gradually becoming smaller as market-based rate expectations adjusted, bringing forward the expected date of rate lift-off. Importantly, from the vantage points of June 2021, December 2021, and March 2022, respectively, the forward guidance did not raise the average expected inflation five to eight quarters ahead above the 2% threshold. Consequently, the outlook conditions were not met at those times and so an earlier lift-off was not seen as warranted by the forward guidance conditions. In June 2022 the staff projections baseline indicated inflation exceeding 2% in the medium term, prompting the rate guidance to initiate a lift-off, which was indeed announced with an expected rate increase in July 2022.

Chart 36

Outlook-based conditions on the staff projections baseline

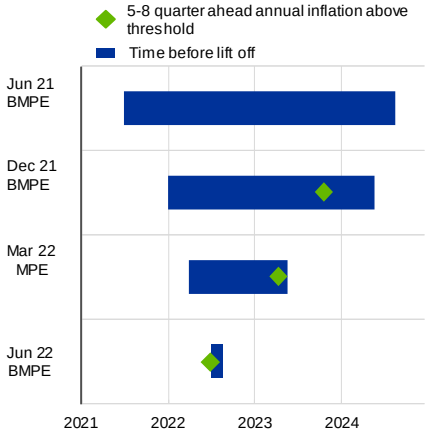
Inflation projections covering the segment of the horizon "well ahead of the end of the projection horizon" and the impact of forward guidance

(year-on-year percentage change)



Dates when the outlook-based conditions were satisfied and lift-off date – evolution over time

(time period)



Source: Simulations based on the New Area-Wide Model (Christoffel et al., 2008).
Note: The "well ahead of the end of the projection horizon" criterion is operationalised in the simulations in terms of average annual inflation 5-8 quarters ahead in the BMPE baseline for each respective projection vintage. In the left panel, the yellow bars show the extra inflation generated in simulations whereby the policy rate stays at the ELB until average annual inflation 5-8 quarters ahead reaches the inflation target of 2%. The inflation contribution for June 2022 BMPE is zero due to the fact that the lift-off conditions are met. In the right panel, the green diamonds show the dates when the lift-off conditions are met. These dates do not perfectly align with the lift-off date because the interest rate rises only slowly in some of the simulations and is assumed to only prescribe a lift-off when the interest rate is at least 10bps above the ELB.

A deeper question is whether the formulation of the July 2021 rate guidance was appropriate both initially and later on. Model-based analysis suggests that had the baseline of the staff projections been realised, the outlook-based conditions would have worked well. However, they turned out not to offer sufficient flexibility in the light of large forecast errors, introducing an element of fragility. Optimal policy at the ELB calls for persistent policy to influence expectations for interest rates and inflation in the medium term. Ex post, however, once the economy recovers and inflation starts rising it might be preferable to have full flexibility to respond to a changing inflation environment. The central bank therefore faces an intertemporal trade-off. Starting from the rate guidance issued in July 2021, an optimal policy exercise based on the June 2021 Eurosystem staff projections implied that lift-off should not occur before the end of 2023 (**Chart 37**, red dotted line in the right panel).[162] The timing of lift-off is in line with the model-based operationalisation of the state-based guidance issued by the ECB in July 2021 (

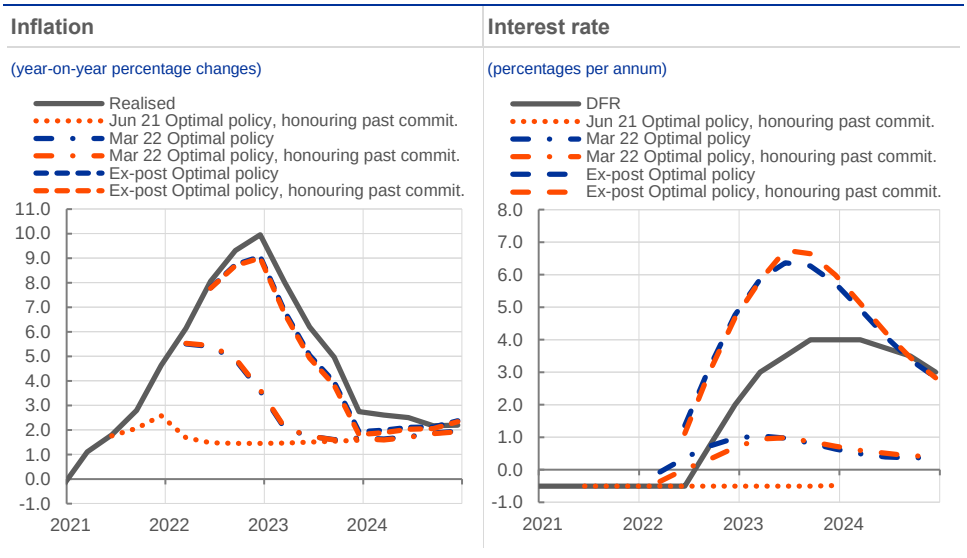
Chart 36, right panel), suggesting that the guidance was appropriate at the time. As the inflationary environment evolved in subsequent quarters, so did the prescriptions for optimal policy. For instance, from the vantage point of March 2022, optimal policy

[162] Standard optimal control simulations under commitment are typically redone at each policy meeting taking into account new information about the outlook for inflation and the real economy, while ignoring past commitments. Instead, the exercise in **Chart 37** is based on honouring past promises, thereby injecting stronger persistence. Those promises are weighed against the revised outlook. This implies that large deviations of inflation from target will lead to a change in the optimal policy path even if past promises are honoured, i.e. past promises simply make the response partly less forceful than it would be otherwise.

takes into consideration two effects: on the one hand, the original optimal guidance to implement a persistent policy to steer expectations at the ELB; and, on the other hand, the changing inflationary environment suggesting an earlier policy tightening. Ignoring the former calls for a lift-off in March 2022 (**Chart 37**, blue dashed-dotted line), in line with the analysis shown in **Section 2.3.3**. Instead, when also taking into account the former, the optimal policy prescription calls for slightly more persistence. Thus, although neglecting the persistence injected by the July 2021 rate guidance would have suggested a lift-off in March 2022, internalising such persistence advised waiting. The differential impact on inflation is small (**Chart 37**, left panel), so it would not have made a significant difference in this specific episode. In general, a fully fledged counterfactual analysis is needed to assess the costs to be borne ex post by honouring previous guidance that policy will be persistent versus the benefits brought about by promising, ex ante, some persistence in the future (i.e. in July 2021 when the euro area was at the ELB).[163] In any case, optimal policy is state-dependent and therefore adapts to incoming information, preventing it from falling unduly behind the curve. For instance, if the inflation shock is very large, as it was in reality, and had been foreseen in the staff projections, optimal policy would have suggested immediate rate increases despite attaching some weight to past guidance (red versus blue dashed lines): the change in the inflation environment is large and prevails over other considerations.

Chart 37

Optimal policy honouring past promises



Source: ECB calculations based on the MMR model – see Mazelis et al.. (2023).
Notes: Optimal policy counterfactuals computed in real time for the June 2021 BMPE and March 2022 MPE, as well as "Ex-post", which refers to optimal policy counterfactuals from the perspective of June 22 assuming that the policymaker knows the realised data until June-24 and the projections associated with the June-24 BMPE. The blue "Optimal Policy" lines are the counterfactuals without honouring past commitments, the red "Optimal Policy, honouring past commit." lines are the time-consistent counterfactual, in which past commitments are taken into account.

Turning to the outcome-based condition, it pointed to an earlier lift-off when taken in isolation, but the guidance was structured with an "and" clause

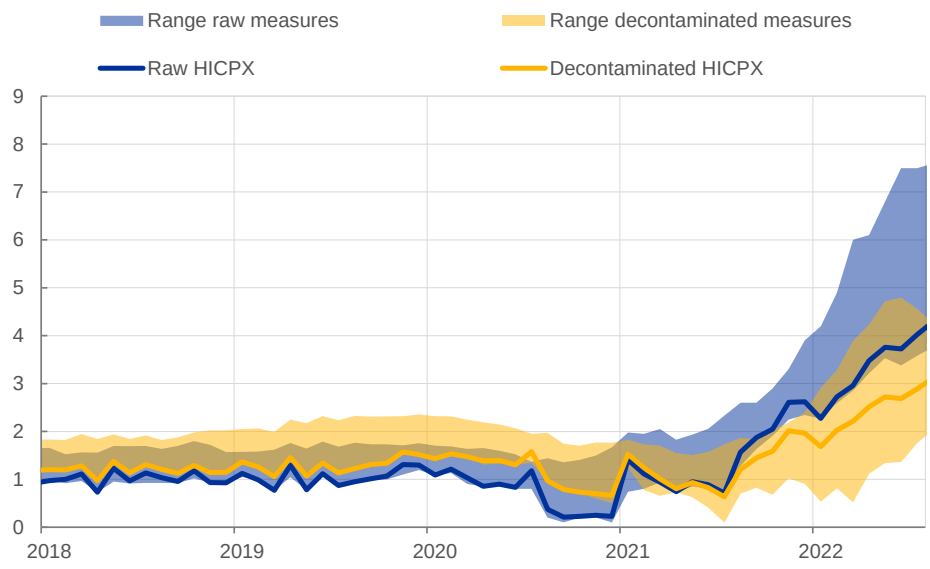
[163] This analysis could be carried out using stochastic simulations from the perspective of July 2021 when the rate guidance was issued. This would allow the analysis to span the occurrence of many potential realisations of shocks, relative to which the one experienced in 2022-23 may appear extreme. Optimal policy considerations under uncertainty are discussed in **Chapter 4**.

linking the three criteria: they were jointly verified only in June 2022.[164] Underlying inflation provides insights into the persistent component of inflation. By the end of 2021, the range of underlying inflation measures began to increase rapidly, while the decontaminated measures moved up above 2% more slowly (**Chart 38**, see also Box 7 in the Workstream 1 report).[165] With the benefit of hindsight, it could be useful to analyse whether the robustness of the rate guidance formulation increases if it were to be required to "cross check" the two outlook conditions and the outcome condition, rather than relying on an "and" clause. An alternative could be to use "or" in place of "and" to link the three criteria of the guidance. However, this might not be sufficiently robust to limit false positives in the face of adverse temporary supply shocks. At the same time "cross checking" the outlook and outcome conditions in place of using an "and" clause may be seen as allowing for excessive discretion, thus weakening the ex-ante effectiveness of the guidance. Additionally, robustness could be further enhanced by complementing the guidance with a reference to the risk assessment to avoid the outlook conditions overfocusing on the baseline projections in the face of skewed risks (see **Chapter 4**). Nevertheless, the trade-off between adopting a persistent policy to steer inflation expectations at the ELB and remaining agile in the face of unexpected large inflationary shocks remains difficult to navigate, due to the challenge of assessing the state of the economy in real time.

Chart 38

Underlying inflation measures and their adjusted counterparts

(year-on-year percentage changes)



Source: Eurostat and ECB staff.
Note: The "adjusted" measures abstract from energy and supply bottlenecks shocks using a large SVAR, see Bańbura et al. (2023a). See also Bańbura et al. (2023b).

164 "[…] we undertook a careful review of the conditions which, according to our forward guidance, should be satisfied before we start raising the key ECB interest rates. As a result of this assessment, the Governing Council concluded that those conditions have been satisfied. Accordingly, and in line with our policy sequencing, we intend to raise the key ECB interest rates by 25 basis points at our July monetary policy meeting" ECB June 2022 monetary policy statement.

165 In real time these measures were not yet available and the analysis was less refined.

Stringent lift-off criteria, coupled with commitments on the sequencing of rate policies and time-based asset purchase guidance, reduced the data dependency of rate forward guidance and meant that the guidance on the end date for purchases had to be brought forward in March 2022 to pave the way for lift-off in July 2022. The policy statements from December 2021 and February 2022 indicated that net asset purchases were expected to continue at least until October 2022. The statement was fully compatible with rate forward guidance in December 2021 given that baseline projections expected inflation to be below target in the medium term (**Chart 36**, left panel). Specifically, according to the December 2021 Eurosystem staff projections, the lift-off criteria were expected to be met significantly later than October 2022, so that time-based guidance on net purchases was compatible with the state-dependent rate guidance and the statement that purchases were expected to end shortly before lift-off (**Chart 36**, right panel). However, as inflationary pressures intensified, the net asset purchase guidance had to be revised in the March 2022 policy statement, which indicated that purchases were expected to continue at least until June 2022. This revision in asset purchase guidance paved the way for rate lift-off in July 2022.[166]

3.2.4 Would it have been useful to communicate escape clauses?

"Escape" or "knock-out" clauses offer an alternative or complementary way of ensuring that policy can react in a flexible and agile manner to abrupt changes in the inflation environment. Escape clauses are particularly relevant when the conditions for triggering rate lift-off are not based on inflation. For instance (and unlike the ECB), the Federal Reserve System and Bank of England have at times formulated thresholds in terms of unemployment only. This could cause undue delays in raising rates if inflation surges. For this reason, both central banks have incorporated escape clauses that focus on medium-term inflation. The ECB's July 2021 rate guidance was formulated in terms of inflation thresholds, making such kind of escape clauses prima facie redundant. Therefore, applying the kind of escape clauses formulated by the Federal Reserve System and the Bank of England to the euro area would not have resulted in an earlier lift-off. At the same time, an escape clause may be useful if state-based rate forward guidance is linked to stringent lift-off criteria focusing on, for example, baseline projections and time-based commitments for asset purchases, as was the case for the ECB's forward guidance. It should be noted that ex ante there is a trade-off between, on the one hand, adding highly restrictive escape clauses to limit any potential overshooting of inflation and, on the other hand, facing the risk of triggering a premature lift-off. Nonetheless, incorporating escape clauses could be beneficial to underscore the commitment to inflation target symmetry, i.e. the central bank being concerned about both too low and too high inflation. Such an escape clause could be tied, for example, to risks of inflation de-unanchoring.[167]

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166 At the March 2022 Press Conference, the ECB President explained that the "some time after" when the rates can be lifted could be very short – "weeks or months" – and was completely data dependent.

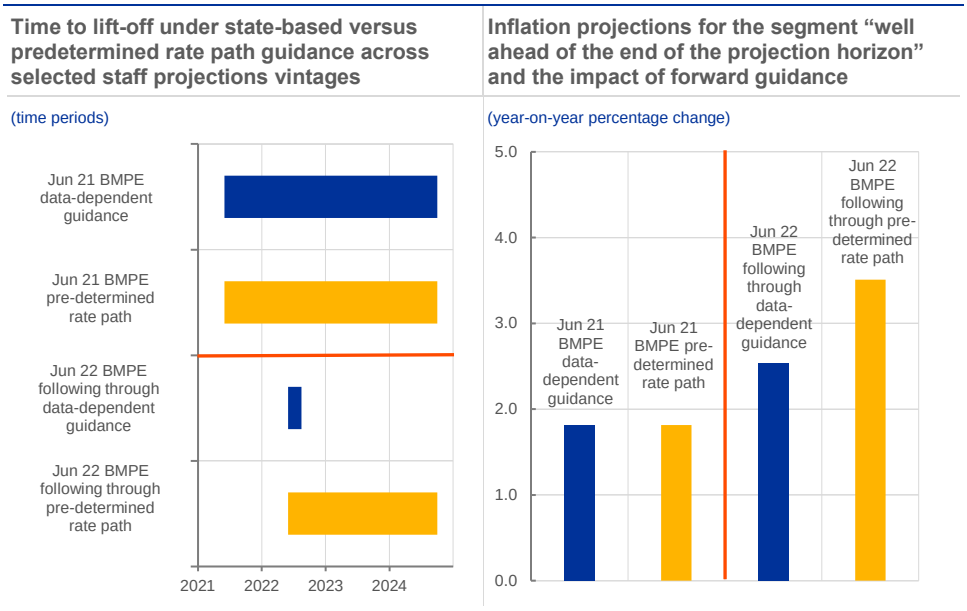
167 However, if applied to the euro area neither of them would have triggered an earlier lift-off in 2021 or early 2022 because inflation expectations did not show evidence of de-anchoring.

Similarly, escape clauses may be necessary if the guidance is time based, as opposed to being state dependent. While state-based forward guidance is preferable in principle, in exceptional situations time-based forward guidance could be considered. In general, it might be prudent to supplement time-based guidance with escape clauses to cater for sudden changes in the environment. The risks of time-based guidance without escape clauses can be shown by comparing its effects with the July 2021 ECB state-based data-dependent guidance (**Chart 39**). Specifically, a model simulation was carried out applying the July 2021 rate guidance from the vantage point of June 2021: the closest projection vintage to the announcement of the guidance. This analysis suggested that the outlook conditions would be satisfied in the third quarter of 2024 (**Chart 39**, left panel). Subsequent staff projection vintages showed an upward revision of the inflation outlook. The data-dependent nature of the July 2021 guidance automatically internalised the new inflation environment and successively brought forward the lift-off date. For instance, in June 2022 the guidance called for an immediate lift-off. This conclusion can be contrasted with a hypothetical situation in which the ECB issues time-based guidance in July 2021, pre-determining the lift-off date to be the very same date in the third quarter of 2024. In that case, the lift-off date would not subsequently have adjusted in line with the upward revisions to inflation (**Chart 39**, right panel). Consequently, the delayed lift-off would have resulted in significantly higher inflation (right panel).[168] This comparison underscores the importance of incorporating escape clauses into time-based guidance to allow flexibility in response to sudden changes in the inflation environment.

[168] The model simulations abstract from the risk of de-anchoring that a policy delay could have triggered. These considerations are taken up in the remainder of this section. For additional analysis on time-based and state-based forward guidance, see, for instance, Box 5 in the workstream on the price stability objective in "The ECB's price stability framework: past experience, and current and future challenges", Occasional Paper Series, No 269, ECB, September 2021.

Chart 39

A lack of escape clauses in time-based guidance can be costly



Source: Simulations based on the New Area-Wide Model (Christoffel et al..2008).
Note: Bars in the left panel represent the horizon of forward guidance, starting in the month of the respective projection exercise and ending in the quarter when the interest rate is lifted. The bars in the right panel show average annual inflation 5-8 quarters ahead. Four cases are illustrated, going from top to bottom in the left panel, and from left to right in the right panel: 1) the first case takes the June 21 BMPE baseline and assumes that rate forward guidance takes the form of the "outlook" conditions announced on 22 July 2021; the second case takes the Jun-21 BMPE baseline and assumes that the ECB had issued a rate guidance in the form of a predetermined time-based rate path calibrated such that it delivers the same impact as the state-based guidance in case 1 (simulations are under perfect foresight); 3) moving forward in time, the third case takes the June 22 BMPE baseline and assumes that the guidance issued in case 1 (i.e. state-based guidance) is followed through, which implies that the threshold is met, forward guidance ceases to bind, and lift-off can take place; 4) the fourth case takes the June 22 BMPE baseline and assumes that the guidance provided in case 2 is followed through, which implies that the lift-off date is maintained unchanged irrespective of the change in the inflation outlook.

3.2.5 Forcefulness or persistence in response to large, sustained upside deviations of inflation from target

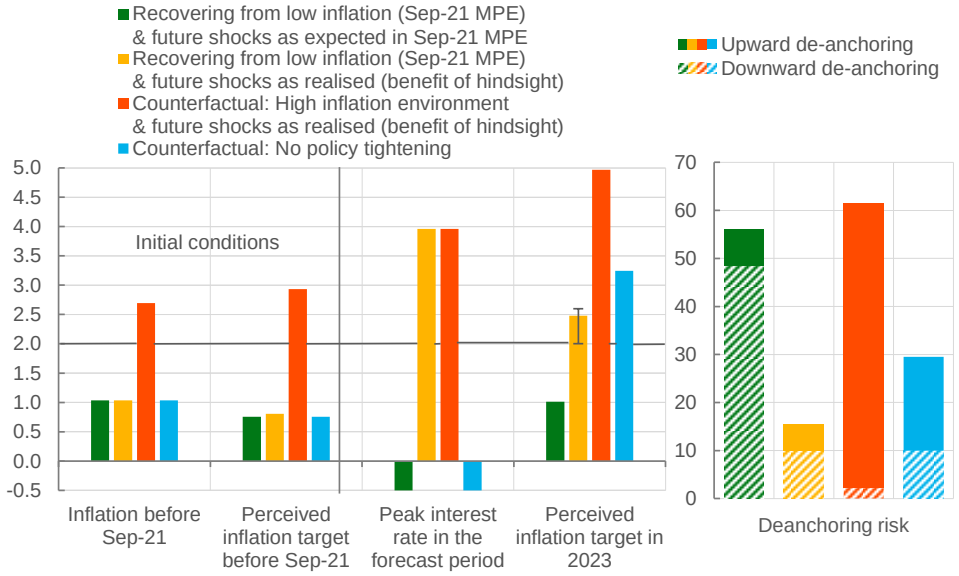
Model-based analysis suggests that the ECB's policy tightening has been essential in countering risks of upward de-anchoring of inflation expectations; tightening would have needed to be even stronger if the inflationary shocks during the inflation surge period had not followed a prolonged period of low inflation. From the vantage point of September 2021, inflation had averaged around 1% over the previous eight years, with a model-based perceived inflation target estimated to be around the same level (**Chart 40**, green bars). Given this history of low inflation and the September 2021 staff projections baseline projecting below-target inflation in the medium term, the de-anchoring risks on the downside were estimated to be large. Assuming the same starting point but introducing the extraordinarily large inflationary shocks experienced in 2022-23, model-based analysis shows that, in the absence of the monetary policy reaction that took place, de-anchoring risks on the upside would have become very large (see blue bars). In contrast, the policy reaction that took place led to only a moderate increase in the perceived inflation target and in upside risks of de-anchoring (see yellow bars). This is also evidenced by market and survey-based long-term inflation expectations. According to the model, the initial conditions characterised by a low inflation

environment – typical of ELB episodes – contribute to explaining these outcomes. To isolate this contribution, the model is run counterfactually with the very same inflationary shocks and interest rate increases but starting from a situation where inflation has been high for some time. The perceived inflation target quickly becomes very high (red bars), and upside de-anchoring risks become an order of magnitude larger than when exiting a low inflation environment, hence calling for a much swifter and stronger policy response (see also **Section 3.1** on the inflation de-anchoring channel and how it implies the need for a forceful reaction rather than "looking through"). In other words: initial conditions matter.

Chart 40

The role of initial conditions in determining de-anchoring risks in the face of large shocks

(year-on-year percentage changes for inflation and perceived inflation targets; percentage per annum for the peak interest rate; percentages for de-anchoring risk)



Sources: ECB calculations are based on a regime-switching DSGE model by Christoffel and Farkas (2025).
Notes: In the low inflation environment the level of inflation has been low as in the data, and therefore the perceived inflation target before Sep-21 is estimated to be low. In the case of the green bars, the economy evolves as expected in the Sep-21 MPE projections, while in the case of yellow bars, it evolves according to actually observed data, i.e. it is an ex-post analysis accounting for the large inflationary shocks as occurred in reality. The whisker is constructed with the maximum values of the median long run inflation expectations of SPF, SMA and 5y5y from Dec-21 to Dec-22. In the red case, the past is described by a hypothetical counterfactual where inflation is high, hence the model estimates a high perceived inflation target. The data after Sep-21 follows actually observed data.

Empirical evidence suggests that there is an interaction between de-anchoring on the downside and the ELB. The risk of de-anchoring appears to be stronger on the downside than on the upside, see for instance Gáti (2023). This might be rationalised in the endogenous regime-switching and threshold BVAR models of Akkaya et al (2025b) by the adverse interaction between two non-linearities: one coming from the ELB and the other from downside de-anchoring. This is due to the constraints on monetary policy imposed by the lower bound, which makes it harder to fight the non-linearity coming from risks of downside de-anchoring than the non-linearity from risks of upside de-anchoring.

The recent inflation surge period suggests that forceful or persistent monetary policy action is also warranted in response to large, sustained upside

deviations of inflation from the target. The 2021 monetary policy strategy statement called for "especially forceful or persistent" action close to the ELB to avoid negative deviations from the inflation target becoming entrenched. The accompanying 2021 note "An overview of the ECB's monetary policy strategy" also stated that "it is important for monetary policy to respond forcefully to large, sustained deviations of inflation from the target in either direction" (see also the discussion in **Section 3.1** of that note). The need to be forceful in either direction is confirmed by the analysis presented here. As regards persistence on the upside, while there is no upper bound on policy rates, the risks and side effects associated with tightening increase as rates move deeper into restrictive territory. These side effects range from a stronger decline in output and employment with potential hysteresis effects to the risk of financial instability. Thus, there can be instances when it is optimal to shift the focus from forcefulness to persistence as the tightening cycle proceeds. Accordingly, there is also a temporal dimension to the choice between forcefulness and persistence when dealing with large, sustained upside deviations of inflation from target.

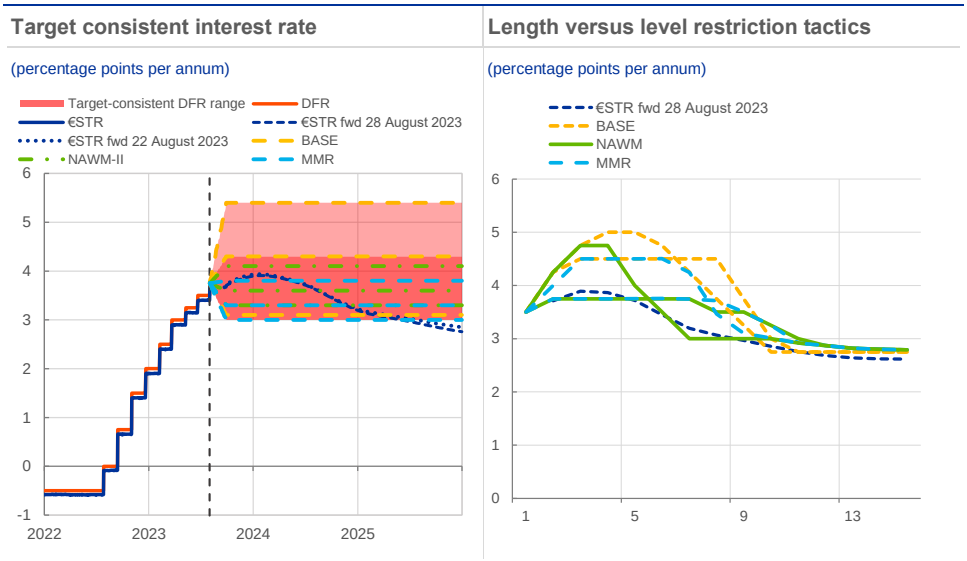
The ECB's latest tightening cycle is consistent with sequencing first forceful and then persistent policy action in the different phases of the cycle. During the early phase of the inflation surge, the ECB policy tightening was forceful. The cumulative policy rate hikes over the six meetings between July 2022 and March 2023 added up to 350 basis points – including two 75 basis point hikes in the second half of 2022. In the following phase, between April and September 2023, the rate increases became smaller (25 basis points per meeting), while the pace of balance sheet shrinkage increased and ECB policies and communication increasingly turned to the length of the period over which rates needed to be kept at sufficiently restrictive levels. This shifted the emphasis to the persistence dimension. A quantification of the substitutability/complementarity of forceful versus persistent policy can be illustrated via model simulations. Taking as an example the September 2023 MPE, the baseline market rate curve embedded in the staff projections envisaged an increase in the policy rate followed by a series of cuts (**Chart 41**). An alternative policy rate path can be constructed in terms of the level of the interest rate that, if maintained for a given number of quarters and conditional on the baseline staff projections, would bring inflation to the 2% target at a desired horizon (due to this requirement in the construction of this path, it could be labelled model-based target-consistent terminal rate (TCTR)). According to the TCTR, the same level of inflation over the medium term could be achieved by a lower peak in the interest rate compared to the September 2023 MPE but maintained for longer.[169] An alternative illustration of forceful or persistent policy options can also be carried out using customised policy scenarios comparing "level" and "length" restriction tactics, both of which would close the inflation gap over a given horizon. Unlike the TCTR, these policy scenarios do not require the same level of the interest rate to be

[169] The balancing of the level versus the length of restrictive rates is illustrated in President Lagarde's speech at the Sintra Forum on Central Banking on 27 June 2023: "In the ECB's Governing Council, we have been clear that two elements of our policy stance will be key: we will have to bring rates to "sufficiently restrictive" levels and keep them there "for as long as necessary". Both elements are affected by uncertainty about the persistence of inflation and about the strength of the transmission of monetary policy to inflation. Setting the right "level" and "length" will be critical for our monetary policy as we continue our tightening cycle."

maintained over the whole projection horizon. When applied to the September 2023 staff projections vintage, the level tactic would aim for a higher peak, implying a faster reversal of rates, and the length tactic would aim for a longer duration but a lower peak (**Chart 41**, right panel).[170] After the September 2023 policy meeting, the ECB hiked interest rates communicating that the decision was based on taking insurance against possible bad outcomes (see **Chapter 4**), and rates were kept on hold for an extended period until June 2024. By that point the inflation outlook had improved significantly, justifying a dialling back of the degree of restriction. Taken together, the ECB's initially forceful and then persistent policy responses helped to contain risks of upside de-anchoring. In this sense, the recommendation for "forceful or persistent" action applies also to large, sustained upside target deviations to avert the risk of an upside de-anchoring of inflation expectations.

Chart 41

Real-time model-based analysis of forceful versus persistent policy



Source: ECB staff calculations using the New Area-Wide Model (Coenen, G. et al., 2018), the MMR model (Mazelis et al., 2023), and the BASE model (Angelini, E. et al.., 2019).
Notes: Left panel: For each model, three lines are shown. The lowest line corresponds to the TCTR (defined as the level of the interest rate that, if maintained for a given number of quarters and conditional to the (B)MPE baseline, would bring inflation to the 2% target at the desired horizon) needed to return inflation to target by 2025Q4, the middle line by average-2025 and the highest line by 2015Q1. The whole red interval comprises TCTR values to be reached by 2023Q3 that have the property of returning inflation to target at alternative horizons (2025Q1, average-2025, 2025Q4), but excludes TCTR values that would deliver in all models significant inflation undershooting of the inflation target at the end 2025. The dark red interval comprises TCTR values that stabilise average-2025 or 2025Q4 inflation in all models, as well as 2025Q1 inflation in some models. The lighter red range includes only one TCTR value that stabilises inflation in 2025Q1 in BASE (backward-looking model) but leads in the other two models to a significant inflation undershooting of the inflation target by the end of 2025. right panel: The chart displays illustrative paths that close the average-2025 inflation gap in three different models, either following a level or length tactic. €STR forward rates are not adjusted for premia.

Box 2

The ECB's loss function under the pre-2021 and 2021 strategies

When the ECB adopted its new monetary policy strategy in July 2021, the most notable change was the introduction of a symmetric 2% inflation target. Under the previous "below, but close to, 2% target, the ECB's loss function was asymmetric: the ECB was more averse to inflation above the de facto target than to inflation below the target, creating a risk of 2% being perceived as a ceiling.[171]

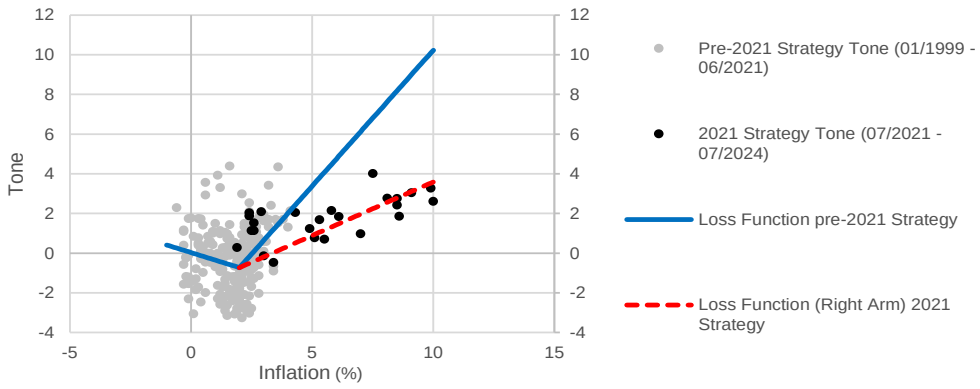
[171] Haavio et al. (2024) and Haavio et al. (2025).

The loss function asymmetry is measured by comparing current inflation to the tone of the ECB's introductory statements between January 1999 and June 2021 using a lexicon-based approach and a language model to extract the sentiment. The tone is then combined with real-time information on inflation, the real economy and financial markets, to estimate the loss function. More positive values indicate higher dissatisfaction with the inflation process.

The results show that, first, the observations (inflation-sentiment pairs) corresponding to the 2021 strategy lie predominantly below the right arm of the loss function estimated under the pre-2021 strategy (**Chart 42**). Second, when the right arm of the loss function is re-estimated under the 2021 strategy the slope becomes considerably less steep and – in fact, not much steeper than the left arm of the loss function under the pre-2021 strategy. These findings suggest markedly more symmetric policy preferences after July 2021, in accordance with the ECB's current definition of price stability.[172]

Chart 42

Comparing the relationship between the tone and inflation under the ECB's old and new strategies



Source: Haavio.,et al. (2025).
Notes The tone is computed with the lexicon-based method, applied to whole introductory statement texts. The tone measures the net negativity of the ECB's communication. Hence positive (negative) values of the tone indicate that the ECB is dissatisfied (satisfied) with the state of the economy. The de facto target under the pre-2021 is estimated to be 1.9%.

[172] As a caveat, it is still rather early to comprehensively evaluate the possible impacts of the ECB's current strategy on its preferences. The sample period is relatively short and there are practically only observations of inflation exceeding the 2% target. Nevertheless, the approach employed by Haavio et al. (2025) can be applied to provide some suggestive and preliminary evidence.

4 Policy-setting implications of risk and uncertainty

4.1 Policy implications of risk and uncertainty according to the strategy announced in 2021

The 2021 strategy statement and overview note made some reference to the implications of risk and uncertainty for monetary policy-setting.[173] The statement mentioned the implications of ELB risk for monetary policy action as well as "uncertainty in the transmission of monetary policy" and "risks to medium-term price stability from financial imbalances and monetary factors" in discussing the integrated assessment of factors relevant for monetary policy decisions (**Table 3**). Likewise, the overview note included references to "risks to economic growth and price stability" and to "financial stability risks", as well as to uncertainty about the transmission of monetary policy and long-run estimates.

Table 3

A possible taxonomy of the role of risk and uncertainty in monetary policy, and the strategy review 2021

	Strategy statement	Overview note
Uncertainty about the nature, size and persistence of shocks and their transmission (i.e. parameter and model uncertainty) and about the state of the economy	• Paragraph 9 (integrated assessment): "possible risks to medium-term price stability from financial imbalances and monetary factors"	• Economic analysis: "broad-ranging evaluation of the risks to economic growth and price stability" • Discusses monetary implications of "financial stability risks"
Uncertainty about long-run values (e.g. r*, pi*, U*, potential growth)		• Estimates "remain subject to uncertainty"
Uncertainty about the transmission of the effects of policy instruments	• Paragraph 7: medium-term orientation allows for "lags and uncertainty in the transmission of monetary policy to the economy and to inflation"	• "Identification of possible changes in transmission" • In discussing the proportionality assessment: "uncertainty about the effectiveness and side effects of policy instruments […]"
Implications for policy-setting	• In relation to the inflation buffer above zero ("safety margin against the risk of deflation") and ELB risk: "especially forceful or persistent monetary policy measures"	• In relation to the target of 2%: "guard against the risk of deflation" • Highlights "the risk of prolonged phases of below-target inflation outcomes" at the ELB

Source: ECB staff.

Risk and uncertainty do feature prominently in the ECB's regular external communications – even more so since the strategy review 2021 (Chart 43) –

[173] Risk and uncertainty are two different, yet closely related concepts. For a discussion in relation to monetary policy, see the remarks by Alan Greenspan on "Risk and Uncertainty in Monetary Policy" at the American Economic Association, January 2004. The term "uncertainty" is generally meant to encompass both Knightian uncertainty, in which the probability distribution of outcomes is unknown, and risk as such, in which the uncertainty of outcomes is delimited by a known probability distribution. In practice, however, the two are difficult to disentangle (in Greenspan's words: "one is never quite sure what type of uncertainty one is dealing with in real time, and it may be best to think of a continuum ranging from well-defined risks to the truly unknown").

and in internal policy preparations.[174] The assessment of risks to growth and price stability has been an integral part of ECB policy communication since at least 2003, albeit to a varying degree.[175] Since the introduction of the combined monetary policy decisions and statement in July 2021, the risk assessment section in the policy statement has expanded and covers risks to both economic activity and inflation. In addition, the announcement of a three-element reaction function in March 2023 represents a concrete example of how risk and uncertainty play a role in policy decisions via the combination of the signals from the inflation outlook (comprising both the baseline and risks around it), underlying inflation and the strength of monetary policy transmission (see **Section 4.5**).[176] As regards other communication, **Chart 43** shows that the terms "risk" and "uncertainty" appeared in around 90% of Governing Council members' speeches in 2022 during the high inflation period.[177] In addition, risk and uncertainty are important ingredients in ECB monetary policy discussions, as shown by the Accounts: for example, in the January 2025 Accounts the terms "risk" and "uncertainty" appear 51 times and 22 times, respectively. More generally, **Chart 43** shows that the number of references to uncertainty in the ECB's monetary policy accounts has increased after 2021, especially in relation to the topic of inflation. As a counterpart to policy discussions, the role of risk and uncertainty has also expanded in the internal policy preparation process, as discussed in the following sections (see also Workstream 1 Report).[178]

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174 For external communication providing an overview of how uncertainty is incorporated in the monetary policy process at the ECB, see Lane, P. (2024d), "Monetary policy under uncertainty", keynote speech at the Bank of England Watchers' Conference 2024, King's College London, 25 November.

175 From 2003 to 2014 the President's introductory statement featured an explicit assessment of risks to the economic outlook and price stability. After September 2014 the introductory statement of the monetary policy decision did not include a regular assessment of risks to inflation, except for in the period between September 2015 and March 2016. For an evaluation of the information provided by ECB policy communication on risks, see Istrefi, K., and Sestieri, G. (2019).

176 In terms of external communication, an earlier notable example of how policy decisions take into account risks and uncertainty is provided by Mario Draghi's April 2014 speech in Amsterdam, which outlined three contingencies and how monetary policy would react to each of them.

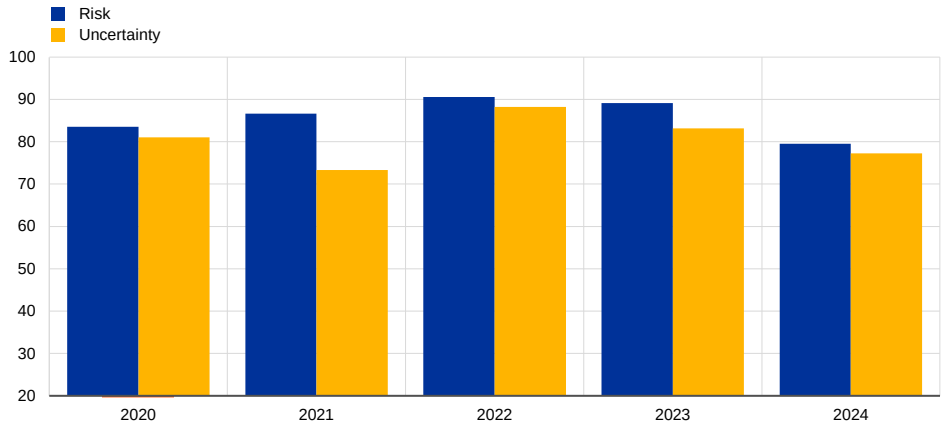
177 See Arencibia et al.(forthcoming).

178 The model-based risk assessment has a long tradition at the ECB, see for example the use of model-based monetary and financial scenarios at the time of the global financial crisis and sovereign crisis documented in Box B.8 in Rostagno et al. (2019).

Chart 43

Appearance of the terms “risk” and “uncertainty” in Governing Council members’ speeches

(share of speeches)

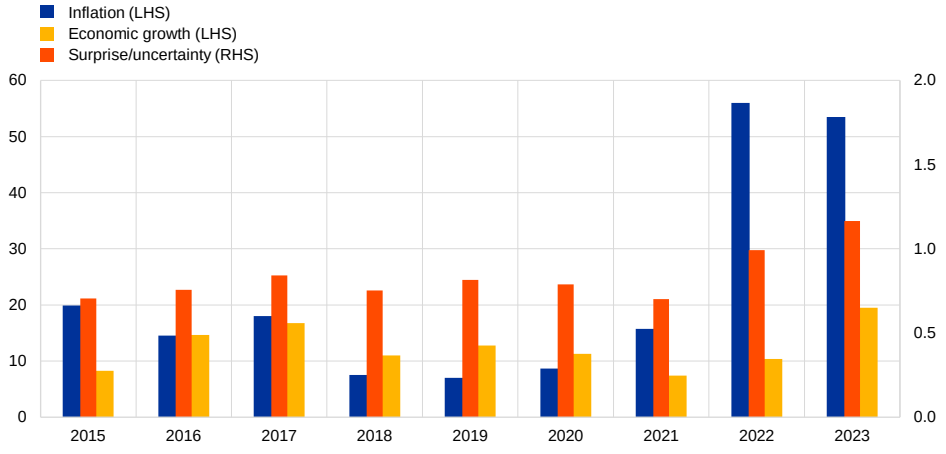


Source: Arencibia et al. (forthcoming).
Note: Speeches with the main topics on climate change and digital euro are excluded. The speech dataset ends on 30 September 2024.

Chart 44

Appearance of words related to inflation and economic growth in text related to surprise and uncertainty in ECB monetary policy meeting accounts (total and by topic)

(left-hand scale: average number of words related to the inflation and economic growth topics; right-hand scale: average count of words over total number of words)



Source: Fadda, et al. (2022).
Note: For each year, the blue and yellow bars show the average number of words related to the Inflation and Economic Growth topics, in quotes that are categorised as relating to surprise and uncertainty in the section "Governing Council's discussion and monetary policy decisions" of the ECB Accounts. The red bars show the average count of keywords related to surprise and uncertainty over the total number of words. The ECB started publishing its Accounts in 2015.

Other major central banks provide limited information about the policy implications of risk and uncertainty in their published strategic principles, with some exceptions (see Box 3). Most central banks refer to risk and uncertainty in relation to the flexibility of the framework, and/or the ELB risk. Few refer explicitly to

the implications of risk and uncertainty for monetary policy-setting, as shown in **Box 3**.

The widespread lack of explicit strategic principles on risk and uncertainty may reflect the long-time challenge of incorporating them into monetary policy decisions. As discussed in **Chapter 3**, there are circumstances in which there may be especially low confidence in baseline projections. In these cases, supplementing the baseline with an assessment of the balance of risks promises to increase robustness. At the same time, it is difficult to incorporate risk and uncertainty, owing to the absence of a unifying conceptual framework that could inform a systematic approach to risk and uncertainty in policy conduct, as well as owing to the operational challenges that arise in real time. Nevertheless, as described in the remainder of this section, the ECB has significantly expanded its analytical framework to study the implications of risk and uncertainty for policy decisions.

Box 3

Implications of risk and uncertainty for policy-setting: strategic principles published by other central banks

This box reviews the references to risk and uncertainty in other major central banks' strategic principles. The selection is limited to central banks that have published strategic statements, therefore excluding central banks such as the Bank of England or Sveriges Riksbank. It also excludes central banks that have published strategic statements but do not refer to risk and uncertainty in their statements.

Table 4

Implications of risk and uncertainty for policy-setting: strategic principles by other central banks

	Strategy principles regarding risk and uncertainty
Federal Reserve System	In relation to the flexibility of policy conduct: "…the Committee's policy decisions reflect its longer-run goals, its medium-term outlook, and its assessments of the balance of risks, including risks to the financial system that could impede the attainment of the Committee's goals." In relation to ELB risk: "Owing in part to the proximity of interest rates to the effective lower bound, the Committee judges that downward risks to employment and inflation have increased. The Committee is prepared to use its full range of tools to achieve its maximum employment and price stability goals."
Bank of Japan	In relation to the flexibility of policy conduct: "The conduct of monetary policy has to be flexible by examining various risk factors, including those related to financial imbalances, in addition to the assessment of current developments and outlook for economic activity and prices, from the perspective of achieving sustainable growth with price stability."
Bank of Canada	In discussing the flexibility given by the inflation range: "Given that there is uncertainty about the maximum level of employment that is consistent with price stability, the Bank will continue to use the flexibility of the 1 to 3 percent control range to actively seek the maximum sustainable level of employment when conditions warrant."
Reserve Bank of New Zealand	In discussing the role of risk in policy conduct: "The MPC considers the balance of risks to its objectives that arise from uncertainty about the economic outlook and the transmission of its policy decisions. In general, the MPC will incorporate likely future developments into its central economic projections and set monetary policy in response. However, the MPC will also take into account risks to its central projections when setting policy, especially when risks are significant, one-sided, or costly to correct for should they emerge. When uncertainty is elevated, the MPC may find it appropriate to use scenarios to illustrate the range of economic outcomes that could occur."
Norges Bank	"In situations where the risk of particularly adverse outcomes is pronounced, it may be appropriate to react more forcefully than normal in interest rate setting. Examples of particularly unfavourable outcomes may be that inflation expectations become de-anchored, which may make it costly to bring inflation back to target, or that there is a sharp fall in employment that may persist through hysteresis effects." "In assessing the level and path of the policy rate, the Committee gives weight to the forecasts of inflation and the real economy for the next few years. However, because it is demanding to capture all forms of forecast uncertainty, there is no mechanical relationship between the forecasts and the policy rate. The Committee seeks to set a policy rate that also provides acceptable goal attainment if realised outcomes differ from the forecasts or the forecasts are based on incorrect assumptions."

Sources: Federal Reserve Board: 2020 Statement on Longer-Run Goals and Monetary Policy Strategy; Bank of Japan: "The 'Price Stability Target' under the Framework for the Conduct of Monetary Policy", 22 January 2013; Joint Statement of the Government of Canada and the Bank of Canada on the Renewal of

the Monetary Policy Framework, 13 December 2021; Reserve Bank of New Zealand: Statement of the MPC's monetary policy strategy, 19 May 2022; Norges Bank's monetary policy strategy statement, 16 Dec 2021 with an update in May 2024.

Central banks' strategic statements mostly refer to risk and uncertainty in relation to the flexibility of their framework and/or the ELB risk (**Table 4**). In relation to the flexibility of policy conduct, the Federal Reserve statement emphasises the "assessments of the balance of risks" by the Federal Open Market Committee (FOMC) as a key complementary element of the policy decisions. The Bank of Japan statement highlights the need for flexibility that calls for "examining various risk factors, including those related to financial imbalances", while the Bank of Canada explains the flexibility of its inflation control range with reference to "uncertainty about the maximum level of employment" consistent with price stability. In relation to the ELB risk, the Federal Reserve's 2020 statement explicitly refers to increased downward risks to employment and inflation, which call for aiming at inflation "moderately above 2 percent for some time" following periods of persistently low inflation.

Only Norges Bank and the Reserve Bank of New Zealand explicitly refer to the policy implications of risk and uncertainty for monetary policy-setting. The Reserve Bank of New Zealand's strategic statement refers to scenario analysis as an appropriate tool to guide policy decisions in a context of elevated uncertainty. Norges Bank foresees that the policy rate should be set not only with respect to the baseline forecasts, but also with a view to providing "acceptable goal attainment if realised outcomes differ from the forecasts or the forecasts are based on incorrect assumptions." Norges Bank also stresses that "there is no mechanical relationship between the forecasts and the policy rate". In addition, its strategy statement opens the possibility of a "more forceful" policy reaction than normal in situations where the risk of particularly adverse outcomes is pronounced, for example if inflation expectations become de-anchored or there is a sharp fall in employment that may trigger hysteresis effects on demand.

4.2 Addressing the policy implications of risk and uncertainty via scenario analysis

Several experts have recently suggested de-emphasising the central forecast and giving more prominence to scenario analysis in policy conduct. A recent influential example is the 2024 Bernanke review at the Bank of England, which called for more prominence to be given to scenario analysis in internal discussions and external communication.[179,180] The Bernanke report recommended de-emphasising the central forecast and adding alternative scenarios assessing the effects of risks to the outlook arising from unexpected changes to the state or structure of the economy.

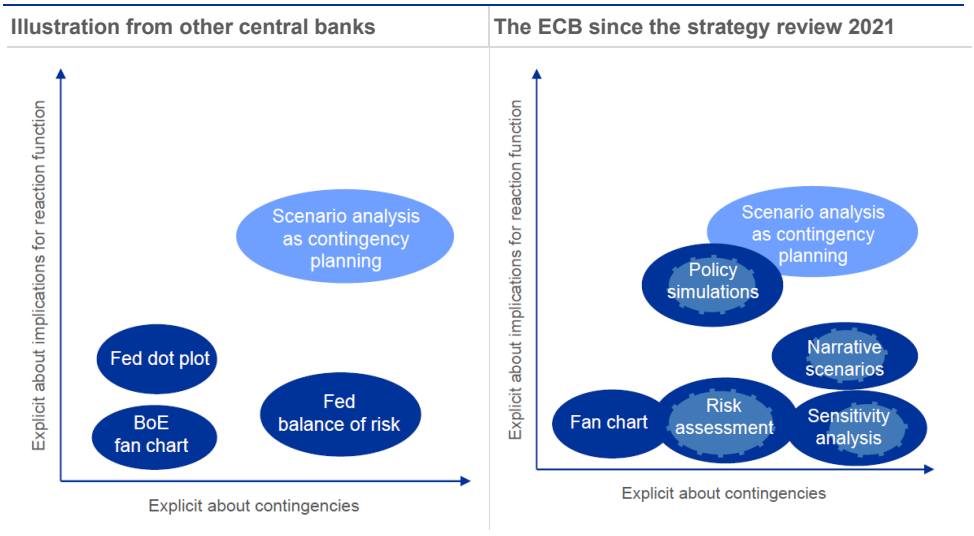
[179] The importance of going beyond the baseline has long been recognised in literature. See for instance the idea of "distribution forecast targeting" put forward in Svensson and Williams (2005).

[180] See Bernanke, B. (2024). In the words of Ben Bernanke, the aim of scenario analysis would be to "allow for direct comparison of the likely effects of alternative policy paths on the outlook" (in particular policies close to, but different from the preferred strategy), to foster "robustness of the MPC's policy plans" in the presence of elevated uncertainty on the state and structure of the economy, and to improve the public's ability "to anticipate how policymakers will respond to various contingencies".

The aim is not simply to identify relevant contingencies but also to assess the appropriate policy reaction under each contingency. An illustrative taxonomy in **Chart 45** represents common central bank risk assessment practices along two metrics: whether they are explicit about the exact contingencies that might materialise in the future, and whether they provide a mapping to the policy reaction under each contingency. The inflation fan chart – pioneered by the Bank of England in the 1990s – is common central bank practice and typically shows the likelihood of a future inflation outcome falling within a specified range. However, it does not give information on the underlying contingencies and policy reactions. Another example includes the Federal Reserve's dot plots, which report the median, central tendency and range of expectations across (anonymised) individual FOMC members. Yet the uncertainty range is largely a measure of disagreement across individual members, and there is no mapping between the individual FOMC members' views on inflation, the economy and the interest rate, thus preventing inference about the implicit reaction function. Another approach is exemplified by the Federal Reserve's "balance of risks" assessment in its monetary policy decision. This assessment is largely qualitative, and typically does not give policy implications in terms of possible deviations from the preferred policy course.[181,182]

Chart 45

Risk/uncertainty and policy implications



Source: ECB staff.
Notes: In the right panel, the bubbles with shaded colour stand for elements that have been expanded since the 2021 strategy review.

[181] For example, at the January 2025 FOMC meeting, Chair Jerome H. Powell said: "We see the risks to achieving our employment and inflation goals as being roughly in balance, and we are attentive to the risks on both sides of our mandate". The Summary of Economic Projections published by the Federal Reserve includes various measures of uncertainty based on each FOMC member's assessment of risk and uncertainty around their own projections. Participants are asked to assess whether uncertainty on real GDP, inflation and unemployment is "lower", "broadly similar" or "higher" than the historical average, and whether risks are "weighted to the downside", "broadly balanced", or "weighted to the upside".

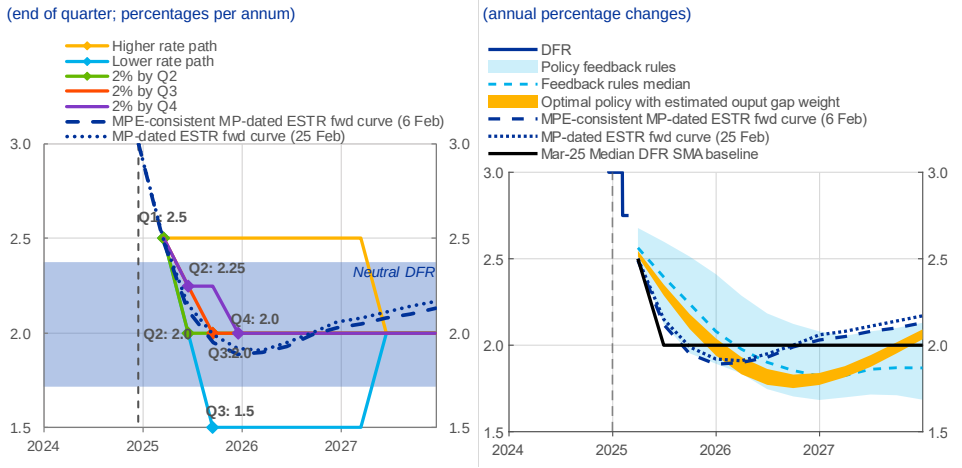
[182] The FOMC Tealbook includes a section on monetary policy alternatives and a section on policy strategies that includes a quantitative exercise based on alternative scenarios with endogenous rate paths, simple policy rules, optimal policy and robust control. These are published with a five-year lag when the transcript material is released.

Since the strategy review 2021, the ECB has significantly expanded its regular risk assessment and scenario analysis (Chart 45, right panel). As discussed in the Workstream 1 Report, the ECB has expanded its risk assessment in internal policy preparation and external communication. This has consisted in increasing the use of "narrative" scenarios (e.g. on Russia's war against Ukraine and the Red Sea Trade disruptions), expanding the assessment of alternative conditioning assumptions (the so-called sensitivity analysis)[183] and strengthening the regular quantitative model-based risk assessment, including financial stability risks.

The risk assessments and scenarios have been complemented with analysis of the implications for monetary policy setting (Chart 45, right panel).[184] The assessment of the policy implications has been expanded along several dimensions. One dimension is the likely effects of families of policy paths that differ in their sequencing of policy actions that are regularly assessed across a range of models.[185] An example would be alternative policy paths around the market interest rate curve on which the staff macroeconomic projections are conditioned (as an illustration, see **Chart 46**, left panel). Another dimension is the assessment of optimal policy and feedback rules (as an illustration, see **Chart 46**, right panel), which can be carried out around the baseline projections but also around various scenarios. An additional dimension is risk management considerations across a set of scenarios (as an illustration, see **Table 5** in **Section 4.3**).

Chart 46

Sensitivity analysis around the baseline market forward curve (left panel) and optimal policy and feedback rules simulations (right panel)



Sources: Optimal policy and policy feedback rule paths are calculated using the MMR model (Mazelis et al., 2023)
Notes: The interest rate paths are in DFR space after 8bp adjustment.
Latest observation: March 2025 MPE and 25 February for the latest DFR expectations.

[183] For example, the ECB internal analysis prepared for the March 2024 Governing Council included nine sensitivity analyses, against two in the March 2021 Governing Council material. The ECB was an early adopter of regular scenario analysis, which it has used since at least 2007 – see Box 8 in Rostagno et al. (2019).

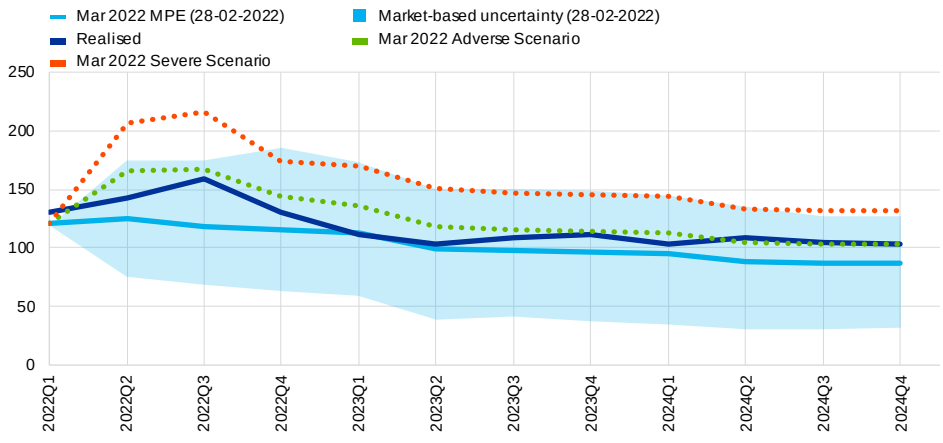
[184] See P. Lane (2024d), "Monetary policy under uncertainty", keynote speech at the Bank of England Watchers' Conference 2024, King's College London.

[185] The range of models include semi-structural and structural models. Importantly, it includes the ECB-BASE model, which is regularly used in the euro area projection process and reproduces the euro area projections well.

Scenario analysis remains challenging to operationalise. For instance, in March 2022 two scenarios, an adverse and a severe downside scenario, were prepared to quantify the impact of Russia's invasion of Ukraine that had started less than two weeks before the March Governing Council meeting. Despite featuring assumptions that were seen as extreme at the time, the scenarios under-predicted the ensuing inflation surge, with the adverse scenario predicting around 2% and the severe scenario around 3% inflation in 2023; when the realised value was more than 5%. This is despite the two scenarios predicting higher energy prices than those that were eventually realised (**Chart 47**). In fact, even counterfactually assuming that the correct path of the technical assumptions had been available in real time, it is found that about half of the forecast error in projecting inflation would have remained. The reason is that the projection models did not fully capture the transmission of the technical assumptions owing to the presence of non-linearities such as higher wage indexation and higher pass-through compared with historical regularities. In addition, assessing the overall impact of channels potentially missing from the main projection models is not straightforward, because the impact of individual channels may not be linearly additive when they are considered jointly (see Workstream 1 Report). This highlights the difficulties of identifying in real time the most relevant drivers of future inflation and the real economy, and the scale of their impact. Hence, scenario analysis, while useful, remains challenging (see Workstream 1 Report for a detailed discussion).[186]

Chart 47

Energy price index, assumptions in the March 2022 projections and uncertainty (based on option-implied pricing)



Source: ECB calculation, Morningstar data, ECB-BASE (Angelini et al. (2019)) conditional forecasts, March 2022 MPE.
Note: Option implied PDFs: the Synthetic energy index median is recentred around the December 2022 BMPE and computed using option-implied PDFs for oil and gas prices with all shocks included. The option-implied PDFs for oil and gas are calculated using market quotes of options on Dutch TTF Natural gas and ICE Brent Crude Oil futures with fixed quarterly expiry dates. The light blue area shows the distribution between 5th and 95th percentiles of option-implied PDFs projections on February 28, 2022.

[186] An additional challenge is to agree on the set of relevant scenarios, their quantification and possible likelihood.

4.3 How can risk and uncertainty be best factored in ex ante in policy-setting?

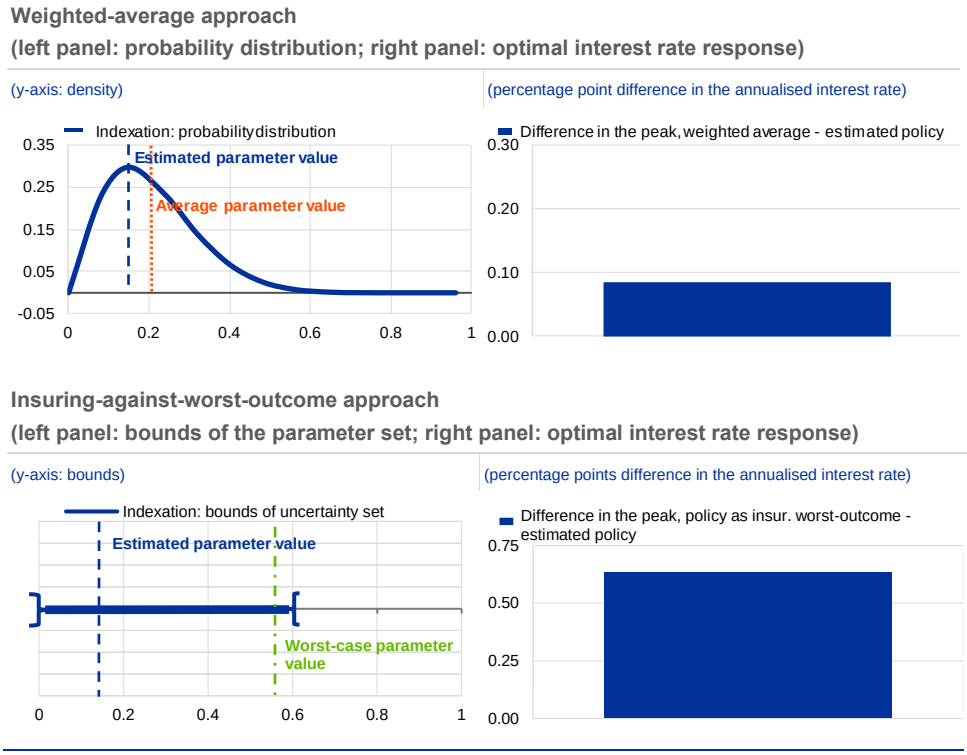
A policy that is optimal under some contingencies is unlikely to be optimal under other contingencis. A preference for robustness may lead to a policy that may not be optimal under the central projections but may display an acceptable level of performance across contingencies when uncertainty is factored in. There are several ways to operationalise a preference for robustness in model-based analysis. The first main approach is the weighted-average (Bayesian) approach, where probabilities are assigned to each of the contingencies that are considered relevant, and the appropriate policy is chosen according to a criterion defined in terms of weighted average performance across all those contingencies. An advantage of this approach is that policy is not dominated by contingencies that are very unlikely. A disadvantage is that it is hard to assign probabilities. The second main approach is to choose a policy that insures against the worst outcome within the set of plausible contingencies considered. It has the advantage of not requiring probabilities to be set and is thereby able to deal with Knightian uncertainty. This is especially useful in the face of unprecedented contingencies whose impact is hard to assess, or in the presence of ELB risks. A disadvantage is that the policy chosen by this approach may perform worse than alternative policies under most remaining contingencies. However, since this approach rests on unwillingness to assign probabilities (or the impossibility of doing so), it cannot truly be said that a given contingency is unlikely. A third approach would be an average of the above two approaches, in which the weighted-average approach is extended by assigning extra weight to the worst-case scenario. Yet another approach would be to lean against asymmetric inflation risks. While this rests on a probabilistic description, it does not necessarily require probabilities to be assigned to each individual contingency that may materialise. In any case, all approaches are subject to the difficulty of constructing relevant scenarios (or the bounds of the uncertainty set) in real time, especially in an environment of high uncertainty.

The insights of robust policy can be illustrated by considering the implications of uncertainty about the degree of indexation of prices and wages (**Chart 48**). The degree of indexation of prices and wages was closely monitored during the inflation surge episode because these factors govern the persistence of the impact of shocks. Standard optimal policy simulations take the model(s) at the estimated parameter values over a long sample and consider these parameter values as “known” when computing optimal policy. The weighted-average approach would instead assign probabilities to alternative values of indexation, while the insuring-against-worst-outcome approach would define the bounds of the set of values that are deemed relevant for the indexation parameter. As higher indexation causes inflationary shocks to be more persistent, it is costly to let inflation increase in the first place. Given that the estimated baseline value of indexation is low, both approaches to policy robustness call for a stronger policy response than standard optimal policy using baseline parameter values (**Chart 48**). The insuring-against-

worst-outcome approach leads to larger increase in interest rates than the weighted-average approach because it focuses on a more extreme value of indexation.[187]

Chart 48

Risk management in the presence of uncertainty about wage and price indexation: a weighted-average approach vs an insuring-against-worst-outcome approach



Source: MMR model (Mazelis et al., 2023)
Notes: The left panels show values of the price indexation parameter. The vertical blue dashed lines show the baseline (i.e. estimated) parameter. The vertical dotted red line (top-left panel) is the value of the average indexation parameter, while the vertical green dash dotted line (bottom-left panel) is the value of the worst-case parameter. The right panels show the difference between the robust policy rate and the policy rate computed under the case in which the indexation parameter is considered as known at the estimated value (results are in percentage points, both counterfactual policy rates are in deviation from their respective baseline). The policy rate as a weighted-average-approach is computed assigning probabilities to each value of the price indexation parameter on a pre-defined grid and finding the interest rate path that performs best in term of weighted average performance across all contingencies. The policy rate as insuring-against-worst-outcome is the policy rate path that performs best under the worst contingency.

The communication associated with the September 2023 interest rate hike emphasised an insurance motive in the face of high uncertainty.[188] The insurance motive in September 2023 can be illustrated with a policy simulation. It is assumed that there are two possible strategies: the first one brings the interest rate to around 4.5-5% followed by a fast reversal (level tactic), while the second one foresees a lower but more persistent rate path (length tactic). The rationale behind the first tactic is the risk that inflation may be more persistent, while behind the second one is the risk of stronger than expected monetary policy transmission, i.e. rate hikes having a larger disinflationary impact than assessed in the baseline

[187] In reality, it is often the case that several contingencies and sources of uncertainty will be present at the same time, and they will need to be analysed jointly because they are typically not additive.

[188] "[…] the choice between holding the deposit facility rate at 3.75% and moving to 4.00% was finely balanced. However, at the margin, it was safer to decide on an additional hike, given the highly uncertain environment […] In consequence, a more secure pace of disinflation and greater insurance against upside risks would also reinforce the anchoring of inflation expectations, which remained a precondition for the disinflation process to keep up its pace." See account of the September 2023 monetary policy meeting.

projections. Focusing exclusively on inflation developments, the insuring-against-worst-outcome approach (**Table 5**, top two rows) would favour bringing the interest rate to high levels as in the level tactic. However, when some weight is given to the output gap, the length tactic becomes the robust policy as it results in smaller losses across models (bottom two rows). In September 2023 the Governing Council decided to insure against the persistent inflation scenario with a 25 basis point hike bringing the DFR to 4% and, subsequently, to keep the rate at this level for the following nine months. The three-element reaction function introduced in ECB communication in March 2023 can be seen as a way to capture in simpler, non-technical terms the implications of the risk-management exercise shown in **Table 5** (see **Chapter 5** for a discussion of the reaction function), with the "underlying inflation" element relating to the "persistent inflation" scenario and the "monetary policy transmission" element relating to the "strong transmission" scenario. It served the Governing Council well when there was high uncertainty about the inflation dynamics and outlook as well as the transmission of monetary policy. In different circumstances, the three elements may be weighted differently, or other elements may become relevant.

Table 5

Range of losses of alternative paths under different scenarios

		Outcome		
[MMR | NAWM | BASE]		Baseline	Persistent inflation	Strong transmission
Weights: Inflation gap=1, Output gap=0				
Path	***Level* tactic**	[13.4 |13.9 |15.7]	[14 |14.5 |16.5]	[9.1| 9.5 |10.4]
	***Length* tactic**	[15.3 |17.4 |16]	[16 |18.2 |16.8]	[10.2 |11.4 |10.6]
Weights: Inflation gap=1, Output gap=0.25				
Path	***Level* tactic**	[20.9 |21.3 |21.5]	[20.3 |20.7 |21.2]	[27| 27.2 |25.1]
	***Length* tactic**	[20.2 |21.2 |21.4]	[20 |21.3 |21.1]	[23.7 |22.6 |24.5]

Source: ECB staff calculations based on the September 2023 MPE. The numbers reported in the cells correspond to the loss (based on quadratic loss function) in the models listed in the following order [MMR | NAWM | BASE]: the MMR model (Mazelis et al., 2023), the New Area-Wide Model (Coenen et al., 2018), and the BASE model (Angelini et al. 2019). Red numbers indicate the path and contingency with the highest loss. A weight of 0.25 on the output gap follows the literature (Kiley and Roberts, 2017) and practice in other policy institutions (Yellen, 2012).

Assigning probabilities to contingencies is often difficult, but there are costs of not doing so. Rationalising the insuring-against-worst-outcome approach from the perspective of the weighted-average approach may reveal that the former amounts to attaching a possibly implausibly large weight to the worst case. The insuring-against-worst-outcome approach does not, furthermore, adjust to the inflow of information that may provide stronger (or weaker) support to the contingency representing the worst case.[189] There is thus a risk that, if applied systematically, this approach may introduce a bias into policy, as it selects policy assuming that the

[189] One way to overcome this shortcoming is to incorporate learning. For instance, Bušs and Traficante (2025) describe a situation of incomplete information about the persistence of cost-push shocks, recursively using Bayesian updating to solve the signal extraction problem, given current and past information. They find that monetary policy tailored to a transitory shock is suboptimal as it may create additional demand-driven inflationary pressures, while a standard Taylor rule performs well.

worst contingency materialises – which however may never happen, it can thus be thought of as a cost of insurance. Overall, additional analytical work is needed to better understand the features of robust policy under uncertainty and how best to incorporate learning in the face of the information inflow.

Despite the challenge of deriving definitive conclusions on how best to tackle uncertainty, carrying out the analysis of alternative contingencies and the preferable policy course can in itself strengthen flexibility to react to changing circumstances. Ex ante discussion of contingencies that may materialise beyond the baseline projections can improve the robustness of policy decisions. At the same time, the broader the set of contingencies, the greater becomes the complexity of policy preparation and discussion.

4.4 Does factoring in risk and uncertainty in policy-setting call for a mechanical adjustment of the reaction function?

Whether risk management considerations call for a more aggressive policy response or a more cautious response depends on specific contingency, i.e. there are no general results. Brainard's classic attenuation result arises from a bias-variance trade-off[190]: uncertainty about the policy multiplier means that a strong response can reduce bias but at the cost of amplifying variance, so a more cautious (attenuated) approach is optimal in a static setting. However, when uncertainty concerns the persistence of inflation, the cost of a prolonged bias accumulates over time, outweighing short-term increases in variance. Hence, as shown by Sargent (1999), Söderström (2002) and Coenen (2007), a more aggressive policy response becomes optimal, to prevent enduring deviations from target. Giannoni (2002) extends this logic to a multi-target setting: when policymakers face uncertainty about how shocks affect different objectives (for example, inflation and output) and hence about the optimal trade-off between them, the risk of adverse spillovers from under-reacting becomes significant. Consequently, the optimal reaction in Giannoni's framework is also more aggressive. Dupraz et al. (2023) show that attenuation can be counterproductive in a model set-up that allows for de-anchoring of inflation expectations. In practice, effective risk management has to account for the economic context case by case, assessing the impact of relevant uncertainties and evaluating how different policy choices perform in addressing these risks.

The lack of general policy prescriptions can be illustrated with an example focusing on uncertainty about the frequency of price adjustments, which was relevant during the inflation surge period. Optimal policy under uncertainty about the frequency of price adjustments calls for a stronger reaction to cost-push shocks and less gradualism compared with optimal policy under known model parameters

190 See Brainard (1967).

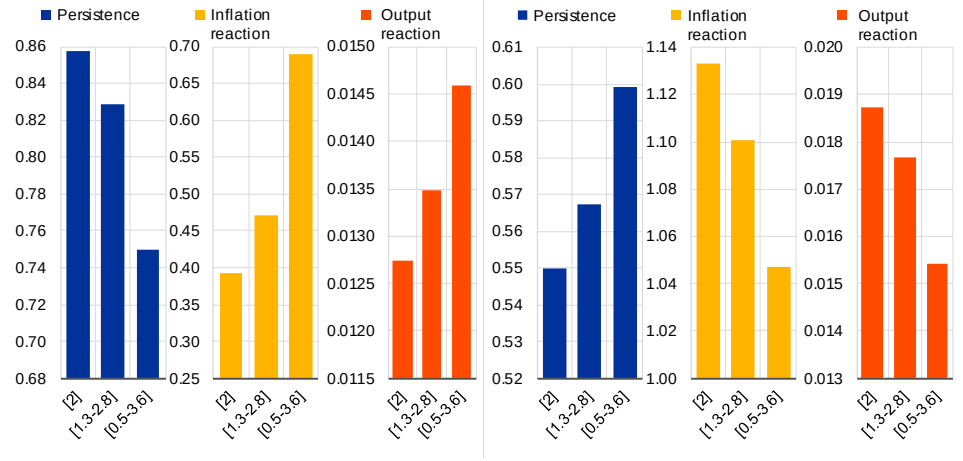
(**Chart 49, left panel**).[191] But the recommendation is opposite if the persistence of cost-push shocks is low and thus demand shocks become relatively more important (**Chart 49, right panel**). Given that during the inflation surge period the persistence of supply shocks was high, the prescription of a stronger policy reaction would apply. The impact of higher uncertainty about the frequency of price adjustments on optimal monetary policy can be decomposed into two steps. The following illustration focuses for simplicity on an economic environment with less persistent supply shocks. In a first step, higher uncertainty will increase the volatility of inflation, but even more so the volatility of interest rates, as the optimal monetary policy reaction to inflation deviations is more aggressive and less persistent in the lower cost-push shock persistence environment. In a second step, a re-optimised Taylor rule assuming the higher uncertainty implies a more persistent and less aggressive response to both inflation and output. The higher persistence counteracts the higher interest rate volatility, which enters the central bank loss function with a relatively low weight. At the same time a more persistent response does not aggravate the volatility of inflation, owing to the relatively less important supply shocks.[192]

[191] The analysis is carried out using the Smets and Wouters (2007) model estimated using a non-linear solution (pruned second order) on euro area data between the first quarter of 1990 and the first quarter of 2020, on all parameters except for the Taylor rule parameter on the change of output, which is set to 0. The estimated Taylor rule coefficients are then assumed to be optimal, and the corresponding central bank loss function weights are calculated for a loss function containing the variance of inflation, and the output gap and changes in interest rates. The respective weights are estimated as 1, 0.12, and 0.3. Subsequent re-optimisation of the Taylor rule coefficients to compute policy under uncertainty is based on these loss function weights. The exercise is carried out using optimal policy under uncertainty using the weighted-average approach. For analytical results regarding the optimal response to uncertainty about the slope of the Phillips curve and the role of persistence of shocks, as well as about uncertainty about other parameters, see Ferrero et al. (2019).

[192] This result is in line with the Brainard (1967) attenuation result, though the framework and mechanisms leading to this result differ. In the original work the problem was posed in a discretionary policy context and the attenuation related to precautionary behaviour by the policymaker.

Chart 49

Relative importance of supply and demand shocks can change the optimal policy implications

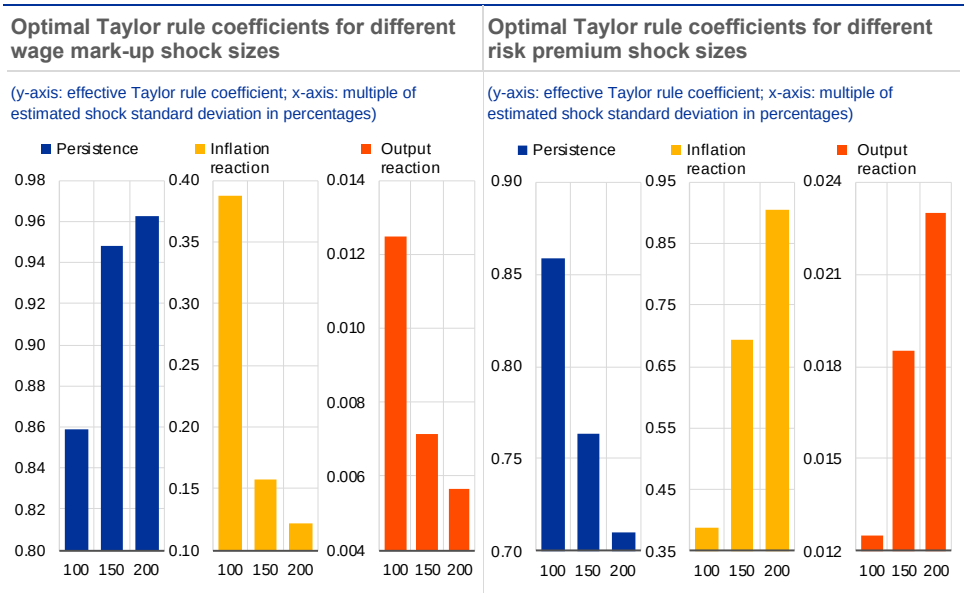


Source: ECB staff calculations based on Smets and Wouters (2007).
Notes: Optimal simple rule coefficients for loss function containing inflation, output, and change in policy rates, for different levels of Calvo price parameter uncertainty. Effective Taylor rule coefficient means that the inflation and output reaction coefficients are the corresponding Taylor rule parameters adjusted for persistence. For example, the effective inflation coefficient equals the inflation coefficient multiplied by (1 – persistence). Right: Wage mark-up shock persistence set to 0.5 (otherwise estimated to be 0.967).

Uncertainty regarding supply and demand shocks requires distinct responses: supply shocks – entailing trade-offs between output and inflation – call for a less aggressive but more persistent response, and vice versa for demand shocks. Since the start of the pandemic, the euro area has experienced elevated uncertainty about the size and persistence of supply and demand shocks. Capturing this uncertainty in the estimates of the size of the shocks reveals an increase in both wage mark-up (supply) and demand shocks. The effects of the increase in the relevance of the respective shocks on optimal policy are similar in size but go in opposite directions. For supply shocks that are twice as large compared to normal, the optimal response of a flexible inflation-targeting central bank is to look through the shock by reacting substantially less to inflation (1/3 of the standard reaction coefficient) and output deviations but be much more persistent overall (**Chart 50, left panel**), as the central bank faces a trade-off between output and inflation. As a caveat, the model does not consider risks of inflation de-anchoring. For demand shocks, which the central bank can undo, it is optimal to be more aggressive and less persistent in the face of twice as large as normal shocks. Twice as large demand shocks require more than twice as strong a reaction to inflation and just about twice as strong a reaction to output (**Chart 50, right panel**).

Chart 50

Estimated increase in supply and demand shock sizes has opposite implications for optimal policy

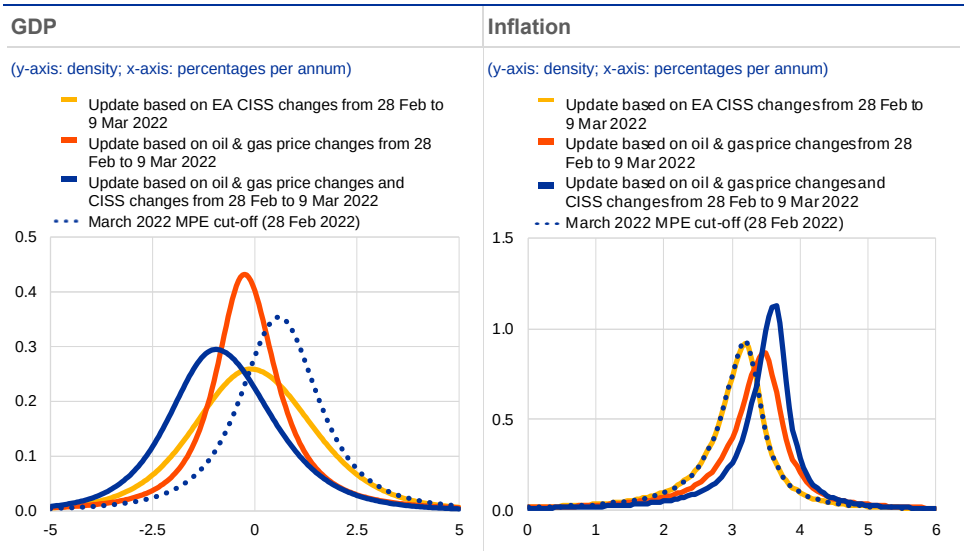


Source: ECB staff calculations.
Notes: Smets and Wouters (2007) optimal simple rule (OSR) coefficients for loss function containing inflation, output, and change in policy rates, for different levels of wage mark-up shock standard deviation (left panel) and risk-premium shock standard deviation (right panel). Effective Taylor rule coefficient means that the inflation and output reaction coefficients are the corresponding Taylor rule parameters adjusted for persistence. For example, the effective inflation coefficient equals the inflation coefficient multiplied by (1 – persistence).

Incorporating risk considerations can provide valuable information for policymaking beyond the implications of the baseline projections. The shift in risks preceding the March 2022 Governing Council meeting provides a natural experiment to illustrate the challenges faced in real time. The cut-off date of the March 2022 staff projections was 28 February, just a few days after Russia's invasion of Ukraine. From the cut-off date to the Governing Council meeting (9-10 March) oil and gas prices increased significantly. A macro-at-risk model estimated using data up to the beginning of 2022 is used to map this increase into macroeconomic effects: there is an upward shift in the model-based risk distribution of inflation and a downward shift in the risk distribution for GDP growth (**Chart 51** red lines). The second notable development between the cut-off date of the projections and the Governing Council meeting, was the increase in financial stress. Using the same macro-at-risk model, this leads to a shift of the GDP risk distribution to the downside while not significantly affecting inflation (yellow lines). If the two developments are considered jointly, there is a large downward shift in the GDP risk distribution and an upward shift in the risk distribution for inflation (solid blue). These macroeconomic effects may appear mild from an ex-post perspective, in that the March 2022 ECB staff projections baseline saw inflation in the first quarter of 2023 at 2.5%, and all contingencies considered here assign zero likelihood to inflation being above 6% in early 2023, whereas in February 2023 inflation turned out to be 8.8%.

Chart 51

Distribution of one-year ahead year-on-year GDP growth and inflation



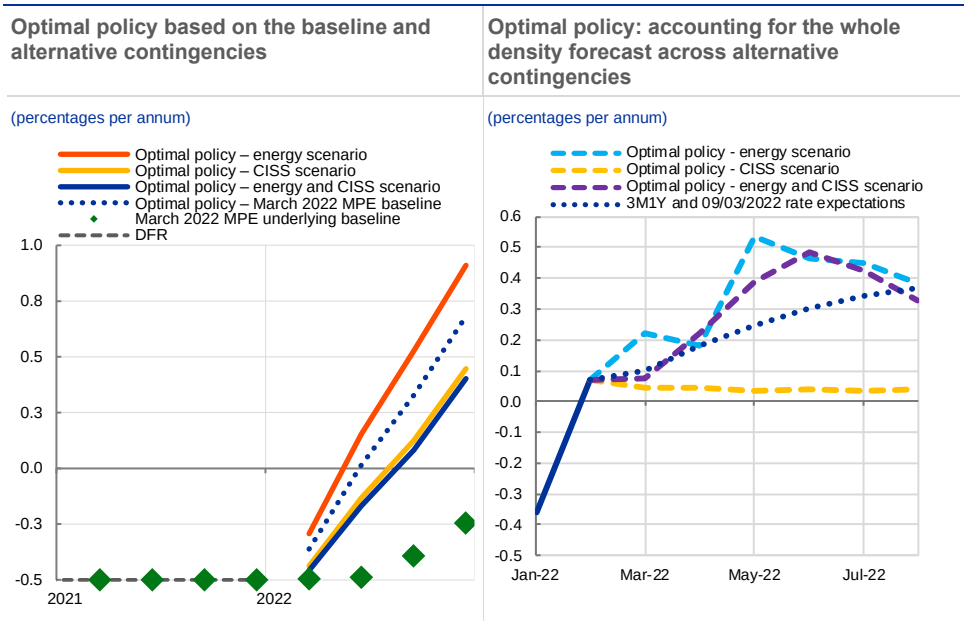
Source: ECB calculations based on Fonseca, L. et al. (2023) and Carboni, G. et al. (2025).
Note: The results are based on fitting a skewed-t distribution on the estimated values for different quantiles based on quantile regressions of 1-year-ahead year-on-year GDP growth and inflation on CISS, the 10y-2y nominal slope of the yield curve, and the first principal component of linearly-detrended natural gas and oil prices.

The optimal policy prescription of immediate rate lift-off on the basis of the March 2022 baseline projections would be further reinforced by taking into account risks coming from higher energy prices, but tempered when considering financial stress, while all contingencies call for forceful actions subsequently. Optimal policy based on the March 2022 baseline would call for rates to be raised at that meeting (**Chart 52**, left panel, dotted line) – this reproduces the result shown in **Section 3.2**. Considering higher energy prices in isolation would advocate for a more forceful response in March 2022 (red line). Considering higher financial stress in isolation would call for keeping policy unchanged (yellow line). If the two sources of risks are combined, optimal policy would also call for keeping rates unchanged. The message is similar if optimal policy is computed accounting for the whole density forecast (**Chart 52**, right panel). This appears in line with the two-sided risks highlighted in the March 2022 monetary policy account: “More than ever there was a need to maintain optionality in the conduct of monetary policy. In the current conditions, it was especially important for monetary policy to remain data-dependent and for optionality to be two-sided.”[193]

[193] See the March 2022 account of the monetary policy meeting.

Chart 52

Optimal policy based on alternative contingencies



Sources: MMR model (Mazelis et al., 2023) (left panel), Schröder 2025, and Ascari, et al. 2025 (right panel).
Notes: Left panel: The optimal policy path based on the March 2022 MPE baseline projections (blue dotted) is the same as the one shown in Section 3.2 of WS2 Report. The remaining lines show optimal policy counterfactuals constructed around the March MPE projection, which is adjusted for the changes in inflation and GDP depicted in **Chart 51**. Right panel: The loss function penalises future expected quadratic deviations of inflation from 2%, output gap from zero and interest rate volatility (weight 0.1).

A complementary approach to factoring risk considerations into policy-setting is to respond to a risk-adjusted baseline outlook, which provides a way to increase robustness in the face of asymmetric risks. A possible measure of risks around the Eurosystem/ECB staff baseline projections is the difference between the mean (the expected value) and the mode (the most likely outcome) of the distribution of risks. The mean is different from the mode when the predictive distribution is asymmetric and has more mass on one side. Interpreting the baseline projections as mode forecast, mean projections can be computed with risk analysis tools such as Bayesian Quantile Regression-based models using real-time information.[194] Computing optimal policy using a risk-adjusted inflation baseline, where the mean is used to illustrate asymmetric risks (for the theoretical underpinning of using a model approximated to first order, see De Polis et al. (2024)), would call in 2022 and the first half of 2023 for slightly higher policy rates than on the basis of the baseline itself, while when both inflation and GDP risks are considered their effects tend to offset because GDP risks were consistently on the downside over that period.

An agnostic way of computing measures of risk and uncertainty that could flank the model-based measures is to rely on the distribution of risks from surveys or markets. For instance, in the SMA respondents can be grouped according to their baseline views on inflation and the economy.[195] It turns out that

[194] A suite of internal risk models that exploit the leading properties of monetary and financial indicators, independently of the Eurosystem/ECBstaff projections, sees inflation risks to be initially contained and then increasingly large using real-time data up to January and July 2022.

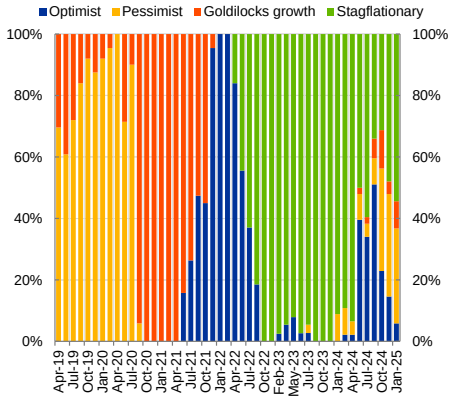
[195] This recording of disagreement about the baseline can convey sensitivity analysis around the median response. Each respondent also provides an expected interest rate path.

the respondents' views fluctuate over time between pessimistic, optimistic, stagflationary and "goldilocks" (**Chart 53**, left panel).[196] An illustration based on the January 2025 SMA shows that most respondents at that time either expected stagflation or held pessimistic views about the economy. In addition to optimal monetary policy at the level of individual respondents, two possible rate paths, a higher and a lower path, are assessed together with the baseline interest rate path against three contingencies: first, inflation and output developing as predicted by the baseline projections; second, as predicted by the pessimistic SMA respondents; and third, as predicted by the SMA respondents expecting stagflation. Robustness considerations based on the insuring-against-worst-case approach suggest avoiding the higher path, resulting in a pronounced undershooting of inflation further down the road and depressing economic activity, about which both groups of respondents were already pessimistic (**Chart 53**, right panel). The distribution of SMA respondents' views is available at each monetary policy meeting, allowing the change in views over time to be captured. This can provide information to supplement model-based measures of evolving risks.

Chart 53

Distribution of SMA respondents views (left panel) and risk control simulations across scenarios (right panel)

(shares of respondents)



(absolute losses)

	Baseline	Pessimist	Stagflation
No output gap weight			
Higher path	[0.2|1|0.3]	[0.4|3.1|1.6]	[0.1|0.5|0.1]
Baseline path	[0.2|0.2|0.2]	[0.2|0.9|0.8]	[0.1|0.2|0.1]
Lower path	[0.2|0.6|0.3]	[0.1|0.2|0.3]	[0.1|0.6|0.3]
0.25 output gap weight			
Higher path	[0.7|3.5|1.3]	[4.6|16.9|9.1]	[2.5|6.3|3.4]
Baseline path	[0.4|0.4|0.4]	[3|6.8|5.9]	[1.5|1.4|1.8]
Lower path	[0.5|1.6|0.7]	[2.2|2.4|3]	[1.1|0.8|0.9]

Sources: SMA, ECB calculations using the New Area-Wide Model (Coenen et al. 2019), the MMR model (Mazelis et al. ,2023), and the ECB-BASE model (Angelini et al. 2019).
Notes: The left panel chart shows the evolutions of SMA respondents views about the economy. Losses on the right panel are displayed for [BASE | NAWM | MMR]. The rows contain losses across the three models for the policy paths that are chosen ex-ante. The columns display the contingency that materialises ex-post. Losses are calculated within the time horizon between Q1 2025 – Q4 2027. A weight of 0.25 on the output gap follows the literature (Kiley and Roberts, 2017) and practice in other policy institutions (Yellen, 2012). The risk control approach identifies the policy paths that would deliver the largest losses per model (marked in red).
Latest observation: January 2025 SMA, December 2024 projections.

196 The pessimistic (optimistic) respondents are those that see inflation below (above) target and growth below (above) the individually assessed long-run growth rates in the next four quarters on average. Stagflationary views see instead inflation above target but growth below long-run growth rates and Goldilocks growth views have the opposite assessment: i.e. inflation below target and growth above long-run growth rates.

4.5 Do risk and uncertainty change the cost-benefit balance of policy guidance?

In the presence of uncertainty, pre-commitment to a policy rate path can be costly, while soft signalling may help in some circumstances to provide a sense of direction without sacrificing the agility to respond to new shocks.[197] Forward guidance about the rate path may be useful under some circumstances. First, when the economy is faced with one-sided, persistent shocks pushing it towards the ELB, forward guidance can provide confidence that policy will be sufficiently persistent to counteract those shocks, while also helping to provide insulation from spillovers from abroad. This was the situation in the euro area when forward guidance was first introduced in July 2013. Second, when the economy has been at the ELB for a long time, forward guidance can help reduce uncertainty about the future rate path in the face of two-sided shocks, hedging against the risk of false positives. However, such guidance can become less helpful when uncertainty about the persistence of inflationary shocks is high, as under such conditions the risk of a delayed lift-off (i.e. a type 2 error) may rapidly increase.[198] Therefore forward guidance should explicitly take account of the risks and uncertainty surrounding the baseline. If commitment to a rate path is at the one end of the spectrum, at the other end there is complete discretion, which would generally lead to poor stabilisation of inflation and the real economy as it forgoes the opportunity to steer public expectations in the desired direction. Soft signalling may represent an intermediate approach in some circumstances (see **Box 4**).

Box 4
Signalling of monetary policy intentions

A well-understood state-contingent central bank reaction function, supported by clear communication that explains how a policy decision issare related to the economic assessment and projections, ensures that the whole yield curve moves endogenously in response to shocks and helps stabilise macroeconomic variables. In the academic literature, communicating about future

197 See, President Lagarde, C. (2025), "A robust strategy for a new era", speech at the 25Th 25th "ECB and Its Watchers" conference, 12 March 2025.

198 The ECB's communication on its data-dependent approach highlights that there is no pre-commitment to a specific rate path, for instance in the following excerpts: "We are not pre-committing to a particular rate path" (April 2025 monetary policy statement); "In the current circumstances with exceptionally high uncertainty, specific forward guidance on the future interest rate path was seen as excessively constraining the Governing Council's optionality, flexibility and data-dependence, with the risk that the Governing Council would tie itself to decisions that it needed to reverse later when circumstances changed" (July 2022 account of the monetary policy meeting); "we are not pre-committing to any particular rate path" (President Lagarde, Q&A at the March 2025 press conference). The data-dependent approach has been explained in terms of high uncertainty leading to quick changes in the outlook, thus calling for a meeting-by-meeting reassessment, for instance: "[…] our assessment of the inflation outlook in light of the incoming economic and financial data. This will be informed primarily by our staff inflation projections. […] As the cut-off date for the projection round was in early March, the forecasts do not incorporate the effects of the recent financial market tensions. Those tensions have added new downside risks and have made the risk assessment blurrier. More generally, many of the assumptions in the projections, such as those on fiscal policies and energy and food prices, are volatile. This implies additional uncertainty around the baseline for both growth and inflation" (Lagarde, C. (2023), "The path ahead", speech at "The ECB and Its Watchers XXIII" conference, Frankfurt, 22 March).) "[…] on the basis of the cut-off date […] it was legitimate […]. If you look at energy prices today, whether it's oil or gas, the impact would be seriously different. So that gives us the dimension of uncertainty that we have and the many risks that we have to look at" (President Lagarde, Q&A at the March 2025 press conference).

policy is considered futile under pure discretion, as the central bank cannot “tie its hands” because its freedom to make any decision at any time is considered to be absolute and unconstrained. In this case, the only way a central bank can influence private expectations of future policy is by making its expectations of its own future actions as clear as possible through forecasts for policy-relevant macroeconomic variables. This moves markets if it conveys information that the market does not have. Moreover, conveying a precise, unconditional intention for future policy is risky if events do not turn out as expected. However, there may be circumstances in which there are advantages in sending a “soft” signal.

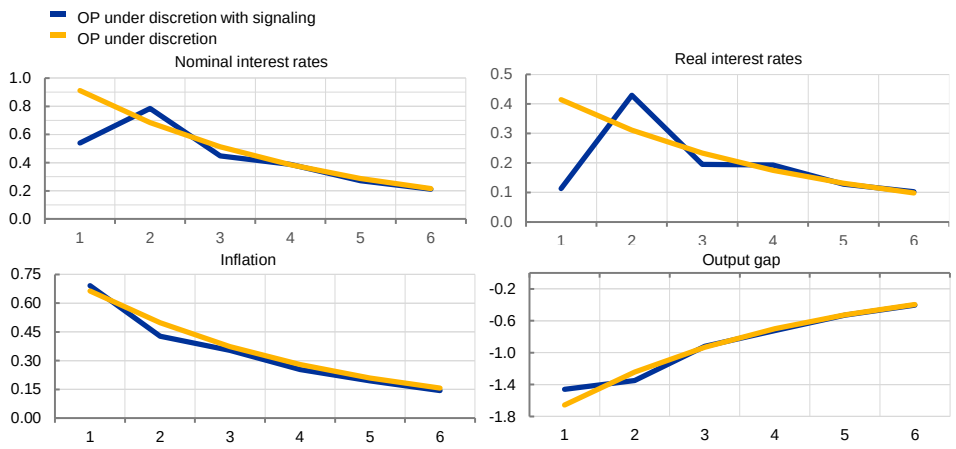
As well as setting the current policy rate, the central bank might decide to send a non-binding signal about the policy rate in the future. However, deviating from this signal when setting the rate in future becomes increasingly costly (a quadratic loss).

Penalver (2025a) applies this idea in a one-off setting in which “opinionated markets” are projecting future interest rates differently from the central bank’s expected path. This difference arises not because of a misperception of the policy objectives of the central bank (the state-contingent reaction function is fully understood) but because of a different assessment of the likely future path of the underlying state. For example, in late 2023/early 2024 markets were anticipating faster disinflation than the Governing Council and therefore pricing in earlier cuts in interest rates. The central bank could resolve this either by being more restrictive now, all else being equal, or by credibly signalling a tighter future stance to counteract the looser than desired monetary conditions. Penalver (2025a) shows that signalling is the superior option, in part because the risk of regret is smaller if the central bank assessment of the disinflationary process is right.

Penalver (2025b) explores the role of signalling in a systematic monetary policy response to mark-up shocks. While the reputational cost of deviating from a previously sent signal always makes it harder for the policy rate set in the current period to deal with the current shock, this is offset by the power to send a signal about future policy. The paper shows that the gains from influencing future interest rates always exceed the reputational loss. One implication of this is that, provided public expectations internalise it, signalling of future rate increases can mitigate the effect of a delayed response to an inflationary shock because of a previous forward guidance commitment at the effective lower bound. In this respect, the model supports the Governing Council’s monetary policy statement in June 2022. In addition, signalling with a reputational cost can improve the time-consistency of a length tactic, as opposed to a level tactic. As illustrated in **Chart 54**, the optimal monetary policy response to a cost-push shock with signalling entails a lower peak level of the nominal interest rate, but a more persistent response.

Chart 54

Monetary policy response to a cost-push shock: optimal policy under discretion vs optimal policy under discretion with signalling



Source: Penalver (2025b).
Note: Illustrative comparison of impulse responses to a cost-push shock with and without signalling of one-period ahead policy rate intentions. There is a net welfare gain under optimal policy with signalingl compared to optimal policy under discretion.

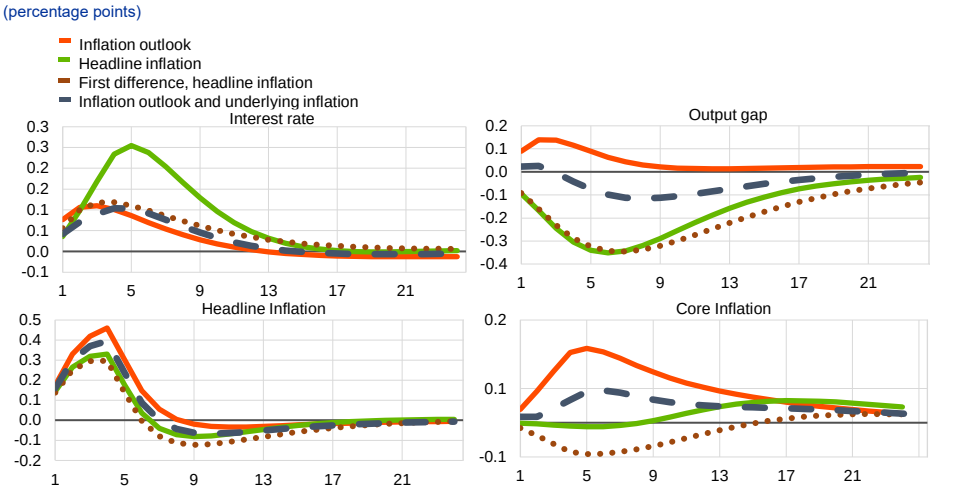
Policy guidance exhibiting robustness in the presence of uncertainty may take the form of providing clarity about a data-dependent appropriately chosen reaction function.[199] While the implicit reaction function used by a central bank may be extremely complex and probably impossible to approximate in mathematical terms, simple policy feedback rules may be able to provide a flavour of the most important indicators to be considered, thus helping the public to distinguish signals from noise. An extensive body of literature has shown that simple feedback rules may turn out to be more robust to model uncertainty than more complex rules that may only be optimal under specific constellations of shocks, transmission channels and parameter values but may lack robustness when applied under different constellations. In general, alternative specifications of the policy reaction function generate different trade-offs. At one extreme, a policy response focusing on the latest print of headline inflation would, in the face of an increase in energy prices, typically lead to large interest rate fluctuations and very sizeable costs in terms of lost real activity – for an application to the NAWM model see **Chart 55**, green line. On the opposite side of the spectrum of impacts, a policy focusing on the baseline projection of medium-term inflation would typically take a "look-through" approach that supports real activity, but at the cost of a noticeable rise in headline and core inflation (red line). However, a reaction function that attaches weight to both the inflation outlook and to underlying inflation may equip policy with useful ways to increase the robustness of policy decisions. It can bring inflation down more quickly

[199] See, for instance, Lagarde. C. (2025), "A robust strategy for a new era", speech at the 25th "ECB and Its Watchers" conference, 12 March: "when the size and distribution of shocks becomes highly uncertain, we cannot provide certainty by committing to a particular rate path. Otherwise, forward guidance may constrain policy agility in the face of abrupt changes to the inflation environment. But we can provide clarity about our reaction function. We can still help the public to understand how we will navigate the new environment. […] Our reaction function has always been state-dependent. In other words, policy should react differently depending on the context and the origin, size and persistence of shocks".

than when policy is responding to the inflation outlook only, and with smaller output losses than when it is responding to the latest headline inflation figures (blue dashed lines). While these results are promising, additional analytical work is needed to systematically assess the features needed for a policy reaction function to be robust across a large range of shocks, transmission channels and sources of uncertainty. At the same time, it appears infeasible to specify ex ante the relevant set of shocks, models and sources of uncertainty to be considered, which would call for a systematic assessment of the inputs needed for a robust reaction function.

Chart 55

Impulse response functions following a 10% energy price increase: alternative monetary policy reaction functions



Source: ECB calculations an updated and re-estimated version of New Area-Wide Model II with a direct oil price channel (Coenen et al., 2024).
Notes: The policy reaction functions feature a response parameter to inflation at 2.5 and a persistence parameter at 0.9, with the exception of the first difference specification in which the persistence parameter is 1 and the response to headline inflation is 0.5, Headline inflation is measured as year-on-year change in headline HICP; the inflation outlook is measured as year-on-year change in headline HICP one year ahead. The weighted average specification features inflation as average of outlook inflation and underlying inflation with equal weights; in turn, underlying inflation is computed as weighted average of core and a filtered measure with equal weights.

A data-dependent reaction function also implies that the weight attached to different indicators might change over time – for instance, the weight of baseline inflation projections should decrease when the uncertainty surrounding the outlook becomes greater.[200] With a reaction function featuring response to both the inflation outlook and outcomes for underlying inflation (as well as output gap and interest rate smoothing), optimal policy under uncertainty in a model estimated on the euro area, including the recent inflation-surge episode, prescribes that in the face of higher uncertainty about the inflation outlook (**Chart 56**, green bars) the response to the outlook should decrease in favour of a stronger

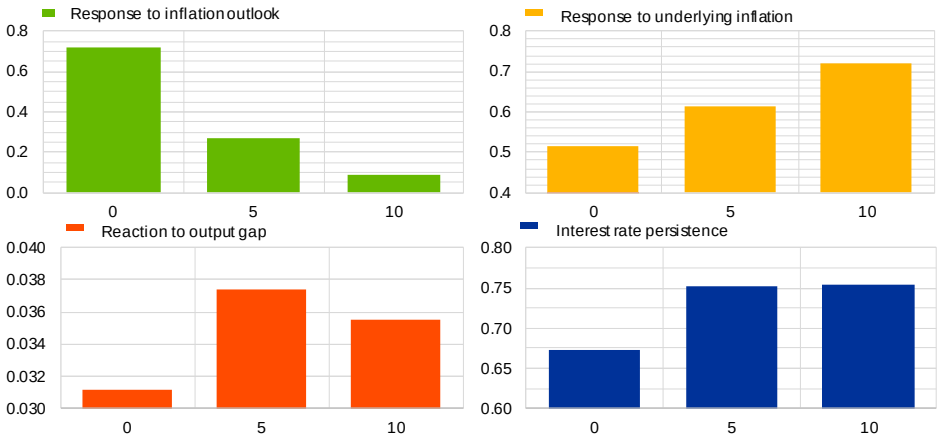
[200] As explained by President Lagarde, "Our reaction function has always been state dependent. In other words, policy should react differently depending on the context and the origin, size and persistence of shocks. See Lagarde, C. (2025), "A robust strategy for a new era", speech at the 25th "ECB and Its Watchers" conference, 12 March.

response to underlying inflation (yellow bars).[201] This provides some normative support for the three-element reaction function discussed further in **Chapter 5**.

Chart 56

Optimal policy under uncertainty: reaction function coefficients for different levels of uncertainty about the inflation outlook

(y-axis: effective Taylor rule coefficient; x-axis: additional inflation forecast standard deviation in basis points)



Source: ECB staff calculations based on Smets and Wouters (2007) model.
Notes: Optimal simple rule coefficients for loss function containing inflation, output, and change in policy rates, for different levels of inflation outlook uncertainty. The Taylor rule has coefficients for underlying inflation (last four quarter average), inflation outlook (four quarter ahead), output gap, and past interest rate levels. The uncertainty about the inflation outlook is captured by an error term multiplied with the inflation outlook in the Taylor rule. The model with augmented Taylor is estimated nonlinearly and loss weights are implied by optimality assumption of estimation results. Effective Taylor rule coefficient means that the inflation and output reaction coefficients are the corresponding Taylor rule parameters adjusted for persistence. For example, the effective inflation coefficient equals the inflation coefficient multiplied by (1 – persistence).

[201] Cuciniello et al. (2025) show that underlying inflation and the strength of transmission (proxied by financial conditions) provided useful indications for future inflation at times when baseline projections showed sizeable errors in predicting inflation. They conclude that the reaction function may feature the deviation of inflation from target in the medium term and remain invariant over time, but its ability to predict inflation through the three elements may change over time. This would also suggest that under different circumstances other elements may become relevant.

5 Monetary policy communication issues

5.1 Benefits of a simple price stability objective

The 2021 strategy review reformulated the ECB's price stability objective to provide a more solid anchor for inflation expectations, enhance communication and build trust. The 2% symmetric inflation target replaced the previous double-key formulation of "below, but close to, 2%".[202] This eliminated ambiguity around the target's symmetry, provided more precision and made the target more comprehensible. A simpler, clearer definition was expected to resonate better with expert and non-expert audiences, build credibility and thereby trust in the ECB's ability to deliver on its mandate, and ultimately improve the anchoring of inflation expectations over the medium term.[203]

Consumers, firms and professional forecasters exhibit different levels of understanding of and responses to the ECB's new inflation target. Evidence from the ECB's Consumer Expectations Survey reveals that, immediately after the results of the strategy review were announced in 2021, only 10% of consumers were aware of the new inflation target, with businesses showing similarly low awareness levels (Ehrmann et al., 2023 and Bottone et al., 2022).[204] Over time, the awareness of the inflation target has risen considerably, to 38% and 48% for consumers and firms respectively (see **Box 6**). At the same time, the clarification of the ECB's inflation target affected the medium-term inflation expectations of firms and consumers differently from those of historically better-informed market participants. Data from the Bundesbank Panel on Household Finances survey and the Banca d'Italia Survey on Inflation and Growth Expectations (SIGE) indicate that medium-term expectations of consumers and firms, respectively, rose in line with inflation trends during the 2022 surge, with widening dispersion reflected in the interquartile range (**Chart 57**, left panel).[205] In contrast, the medium-term inflation expectations of professional forecasters first rose from somewhat below 2% and then remained firmly around the target, with a narrower dispersion. This differential underscores the challenges in reaching broader audiences, while providing some evidence of an improved anchoring of inflation expectations among professional forecasters compared with in the period 2013-21.

The revised inflation target may have contributed to a stronger anchoring of inflation expectations among professionals. A machine learning algorithm trained on pre-2013 data on macroeconomic expectations from the ECB Survey of Professional Forecasters (SPF) and contemporaneous macroeconomic variables is used to construct counterfactual predictions of the SPF participants' long-term

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202 See European Central Bank (2021), "The ECB's monetary policy strategy statement", 8 July.

203 In a survey of former members of the Governing Council, 40% of respondents agreed that a "more precise" aim would help to anchor inflation expectations, see Ehrmann et al. (2024).

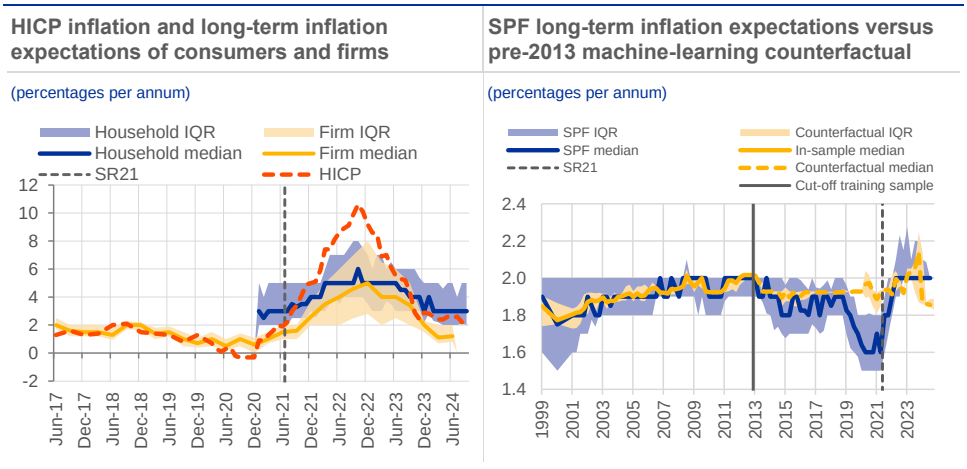
204 Similar results for the United States are presented in Coibion et al. (2023a).

205 This pattern is also documented in a representative Dutch household panel study, see Galati et al. (2022).

inflation expectations out of sample, both before and after the switch to the 2% target (**Chart 57**, right panel).[206] Until 2019 the median out-of-sample predictions remain within the interquartile range of the actual SPF. During the pandemic and the subsequent surge in inflation, the algorithm does less well at capturing inflation expectation dynamics owing to the unprecedented nature of the shocks that hit the economy over that period. In the most recent period, after the fading of the pandemic and inflation shocks, median model predictions for the counterfactual have fallen, with the interquartile ranges of the counterfactual and actual SPF expectations no longer overlapping after the second quarter of 2024. While the algorithm trained on data prior to the announcement of the change to the inflation target predicts that inflation expectations should now have fallen below 1.9%, actual SPF expectations have remained firmly anchored at 2%, indicating a structural shift in long-term expectations. The clarified inflation target may, therefore, have supported the anchoring of long-term inflation expectations at 2%. However, the overall identification of the revised inflation target's impact on long-term inflation expectations is complicated by the inflation surge period, which tends to push long-term inflation expectations in the same direction.

Chart 57

Evolution of longer-term inflation expectations of firms, consumers and professional forecasters



Sources: SIGE, Bundesbank Household Panel, SPF, and ECB calculations.
Notes: The dashed vertical lines indicate the date of the 2021 Strategy Review conclusion. In the left panel, the red line depicts the realised rate of y-o-y monthly HICP inflation at each point in time. The solid lines correspond to the median expected rates of HICP inflation over the next five years in the Bundesbank Household Panel survey (blue), and three to five years ahead in the SIGE (yellow). The shaded areas depict the interquartile ranges. In the right panel, the solid vertical line marks the end of the machine learning training sample. 2013 is chosen to exclude the lower bound period. The yellow line and area show the median and interquartile range of the actual SPF expectations for long-term HICP inflation. The blue line and area show the median and interquartile range of the inflation expectations predicted by the machine learning algorithm.

Fostering public awareness of the ECB's inflation target requires ongoing communication and targeted outreach activities. Randomised control trials demonstrate that providing households and firms with clear information about the 2% target, along with explanations of its role in economic stability, significantly improves

[206] The machine-learning approach consists of two steps. First, variable selection is performed via Bayesian model averaging. The set of explanatory variables includes SPF expectations for headline and core inflation, unemployment, GDP growth and the balance of risks, the prevailing DFR and key contemporaneous macro indicators. Second, a boosted regression tree algorithm fits a non-linear model to predict the long-term inflation expectations, relying on the variables selected in the first step.

trust and anchors expectations (see also Box 6).[207] Because the effects of information fade over time and there is still potential to increase awareness of the inflation target, it is important that the ECB reiterate its messages to the general public on an ongoing basis in a simple and relatable way by exploiting a broad range of communication channels (see **Section 5.5**).

Box 5

Consumers' and firms' attentiveness to inflation, awareness of the ECB's inflation target and inflation expectations – a CES/SAFE perspective

Since the strategy review 2021, more comprehensive and granular information on inflation expectations has become available. This box explores how much attention consumers and firms pay to inflation developments, how well they understand the ECB's 2% inflation target, and how providing information on the target may support credibility and help to anchor inflation expectations. To do so, it draws on insights from two ECB surveys: the Consumer Expectations Survey (CES) for consumers and the Survey on the Access to Finance of Enterprises (SAFE) for firms.[208]

Attention to inflation developments and knowledge of the ECB's inflation target

In December 2024 surveyed consumers and firms reported paying significant attention to current inflation, with consumers exhibiting a higher level of attention than firms. The majority of consumers (76%) and firms (69%) paid at least some attention to inflation developments, while more consumers (37%) than firms (27%) were highly attentive to inflation.[209] This difference could be because firms often focus more on sectoral prices – i.e. their competitors' prices – than on aggregate price developments. In addition, firms' higher awareness of the ECB's inflation target (**Chart 62, right panel**) and credibility as outlined below might partially explain their lower subjective level of attention.[210] Attentiveness of firms and consumers was higher than a year earlier, even though actual inflation had declined, suggesting that the inflation surge may have persistently increased consumers' and firms' focus on inflation.[211]

Inflation expectations differ between consumers and firms, influenced by their relative attentiveness to inflation (Chart 58, left panel). Firms that pay little attention to current inflation reported slightly higher median inflation expectations at the five-year horizon (3.2% compared with 3.0% for firms with at least some attention). They also had more dispersed expectations, suggesting greater uncertainty or more diverse views about future inflation among less attentive firms. By contrast, consumers' median inflation expectations and their dispersion were higher for

[207] For evidence that credibility gains are best achieved when the information about the 2% target is complemented by further clarifying statements, see Ehrmann et al. (2023) and Hoffmann et al. (2023).

[208] D'Acunto et al. (2024) review recent insights into CES household inflation expectations, while Baumann et al. (2024) present new evidence on SAFE firms' inflation expectations. Box 1 of the SAFE 2024 Q4 report provides further insights into firms' attention to inflation and their knowledge of the ECB's target.

[209] In both surveys, consumers and firms are asked about their attention to and expectations for domestic inflation or inflation in the country in which they currently live/mainly operate.

[210] D'Acunto et al. (2021) and Weber et al. (2022) find that consumers rely primarily on price changes in their grocery bundles when forming expectations about aggregate inflation, potentially making them more sensitive to price changes than firms.

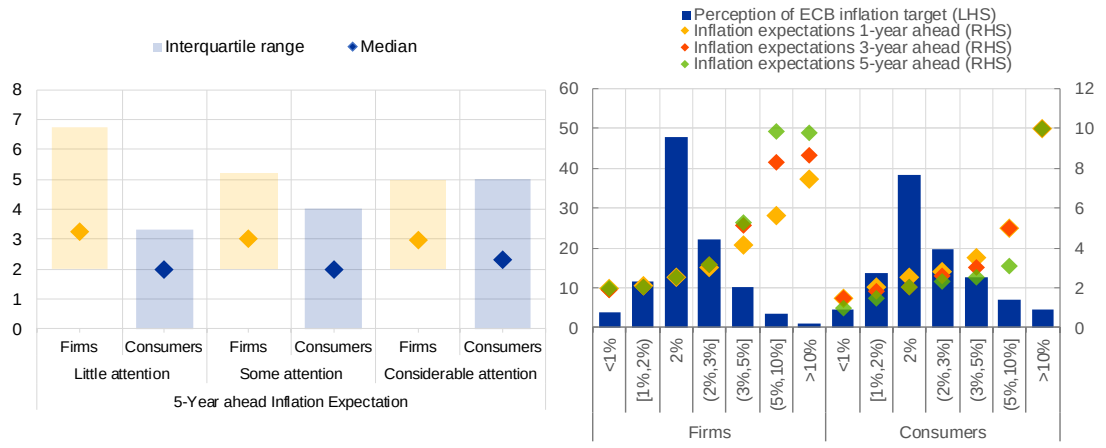
[211] This refers to a survey question asking about the change in attention over past 12 months. Binder (2017) shows that consumers are less attentive to inflation if they do not understand the central bank objective or how monetary policy affects their personal situation. Malmendier and Nagel (2016) highlight the persistent impact of lifetime experiences on consumers' and firms' sensitivity to inflation.

respondents who indicated paying considerable attention to price developments.[212] Dietrich (2024) shows that households tend to pay more attention to the volatile non-core components of their individual consumption baskets (e.g. food and energy) when forming their expectations, which could explain a higher dispersion and occasionally higher inflation expectations of attentive consumers. This comparison of survey responses from the CES for consumers and the SAFE for firms thus highlights important disparities in inflation expectations and attentiveness. The degree of attentiveness may also matter for communication strategies. For example, Weber et al. (2025) find that reaching economic agents is difficult when they are inattentive, but that communication is effective once achieved. When agents are attentive, however, they are easier to reach but less responsive, shifting the challenge to the content of communication.

Chart 58

Attention to inflation developments, perception of the ECB's inflation target and inflation expectations of consumers and firms in December 2024

(left panel: annual percentages; right panel - left-hand scale: percentages of respondents, right panel - right-hand scale: annual percentages)



Source: Survey on the access to finance of enterprises (SAFE) and Consumer Expectations Survey (CES).
Notes: (left panel) Median inflation expectation and interquartile range for firms and consumers over a five-year horizon conditional on their subjective level of current attention to price developments. For the CES question on inflation attention, the answers are grouped such that "Considerable attention" is "A great deal of attention" and "Much attention", "Some attention" remains "some attention" and "Little attention" is "A little attention" and "Almost no attention". (right panel) Histogram of perceived inflation targets, weighted survey results. Numeric answers are grouped into bins. The left panel shows the results for the SAFE (all firms); the right panel shows the results for consumers responding to the CES. The dots represent median inflation expectations (1-,3- and 5-year ahead) conditional on the provided target estimates. CES respondents are asked about their domestic (national) inflation expectation, while firms in the SAFE provide their expectation for euro-area aggregate inflation. The answers on firms' and consumers' inflation expectations are trimmed at the country-specific 1st and 99th percentile.

Consumers and firms aware of the ECB's inflation target report lower inflation expectations than those perceiving the target to be well above 2% (Chart 58, right panel). 48% of firms and 38% of consumers correctly perceived the ECB's inflation target to be 2%.[213] Both distributions were notably right skewed, with a significant number of respondents giving answers above 3%. However, the median perception of the target was not related to the level of consumers' and firms' attentiveness, with the dispersion decreasing for more attentive consumers but not for more attentive firms. The median inflation expectation for firms that knew the ECB's inflation target was consistently at 2.5% across all time horizons. Consumers who knew the 2% target reported median inflation expectations of 2.5% at the one-year horizon and 2.0% for the three and five-year horizons, indicating lower longer-term expectations than firms with a similar perception of the inflation target.

[212] Greater dispersion in expectations among attentive consumers may reflect variations in subjective consumption baskets (Cravino et al., 2020), while attentive firms may align their expectations more closely with analyst forecasts, reducing dispersion.

[213] Refers to a numerical question on the perceived target in annual percentages without fixed bins.

This difference may partly reflect differing belief formation for firms and consumers, especially for longer-term horizons.[214]

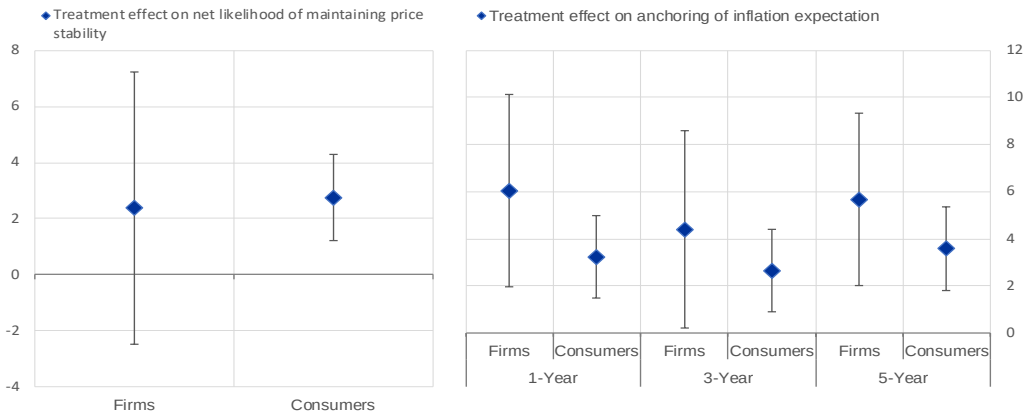
Information on the inflation target, credibility and the anchoring of expectations

Providing basic information about the ECB's symmetric 2% inflation target boosts credibility, as firms and consumers benefiting from more information assign a higher likelihood to the ECB maintaining price stability over the medium term (Chart 59, left panel). To test whether providing information about the ECB's inflation target affects the perceived credibility of the ECB maintaining price stability, we used a randomised control trial.[215] Providing such information raised the likelihood that the ECB would maintain price stability over the next three years, as perceived by consumers, in a statistically significant way – by 2.8 percentage points, from 20.3% to 23.1%. For firms, the effect was also positive (at around 2 percentage points) but marginally insignificant. Two explanations may account for the insignificant results for firms. First, more firms (46%) than consumers (20%) in the control group already perceived it as likely that the ECB would meet the inflation target within three years. The higher overall credibility of the ECB among firms to start with might have lowered the impact of providing information. Second, a smaller sample size may be behind the higher standard errors and consequentially insignificant results for firms.[216]

Chart 59

Awareness of the ECB's inflation target among consumers and firms and its impact on central bank credibility and inflation expectations

(increase in perceived likelihood in percentage points)



Source: Survey on the access to finance of enterprises (SAFE) and Consumer Expectations Survey (CES).
Notes: The plots illustrate the estimated coefficients from two regression models, with robust standard errors (95% confidence intervals indicated by the whiskers). The left panel plot illustrates the estimated coefficient for the treatment dummy D_i in the following regression model: $y_i = \propto_c + \propto_1 D_i + \beta X_i + \varepsilon_i$ where the dependent variable y_i corresponds to the perceived likelihood of firms and consumers that the price stability target will be met over the next 3 years. The numeric answers by consumers were converted into a binary variable using a likelihood threshold of 70% (results are robust to other threshold values). The right panel plot illustrates the treatment effects for $A_i^{post} = \propto_c + \propto_0 A_i^{pre} + \propto_1 D_i + \beta X_i + \varepsilon_i$ investigating the effect on anchoring of 1-year, 3-year and 5-year ahead inflation expectations around the symmetric inflation target of 2%. A_i^{Post} and A_i^{Pre} are binary indicator variables taking the value 1 if the inflation expectations, post/pre-treatment respectively, lie between 1% and 3% (see Ehrmann, Georgarakos and Kenny (2023) for more information on both specifications).

214 D'Acunto et al. (2024) for example find that consumers' longer-term expectations co-move more closely with shorter-term inflation news. The modal value for three-year and five-year ahead inflation expectations was 2% both for consumers and firms.

215 Randomised control trial treatment: "*The ECB aims for a 2% inflation rate target over the medium term as the best way to maintain price stability. This target is symmetrical: inflation may sometimes be slightly higher or lower than this target. The ECB overlooks short-term deviations. Persistent negative and positive deviations are regarded as equally undesirable*".

216 The SAFE had a sample of 5,393 firms, while the CES had responses from 18,754 consumers.

Providing information about the inflation target also significantly reduces the dispersion of inflation expectations across horizons (Chart 59, right panel). For firms, the likelihood of inflation expectations being in a range between 1% and 3% – rather than being more widely dispersed – increases by around 6, 4.5 and 5.5 percentage points for the one-year, three-year and five-year horizons respectively.[217] For consumers, the increases are also significant, though more contained (3.4, 2.7, 3.6 percentage points). Restricting the sample to respondents who already accurately perceived the ECB inflation target yields insignificant results for both consumers and firms, suggesting that the effect from providing information is driven by less informed respondents.

These findings underscore the importance of effective central bank communication in shaping inflation expectations. The disparities between firms' and consumers' expectations highlight the need for tailored communication strategies addressing their distinct perspectives and attentiveness levels. Moreover, enhancing awareness of the ECB's inflation target can foster credibility and help to contain risks of expectations becoming unanchored from the target, as those who are informed tend to have more target-aligned inflation expectations.

5.2 Communication challenges arising from the complexity of the toolkit

The comprehensive package of monetary policy measures taken by the Governing Council presented challenges for clear and simple communication. The measures put in place in response to the pandemic were designed to further ease the policy stance in the vicinity of the lower bound and counter risks to the transmission of monetary policy. In response to surging inflation, the ECB took a sequence of steps to first normalise and then significantly tighten monetary policy (see **Section 2.1.1**). This entailed the use of multiple tools and also created a complex combination of partly interlinked forward guidance on policy rates and balance sheet tools.[218] These complexities may not have been well understood by observers, as evidenced by the frequent clarifications sought during press conferences.

The complex mix of tools also presented policymakers with a trade-off between honouring past commitments and reacting flexibly and swiftly to changing circumstances. As the extent of the inflation surge became clear, a rapid shift in policy was needed. This exposed the Governing Council to some trade-offs with previously made commitments (see **Section 3.2**), creating communication challenges.[219] The central challenge was to explain clearly why the rise in inflation necessitated a change in policy, which could have been interpreted as reneging on

[217] Reducing the range around the inflation target to [1.5%,2.5%] leads to similar results (in significance and magnitude) for consumers, while firm estimates are insignificant for the three-year and five-year horizon.

[218] Specific measures included the expansion of the APP, the extension of and more favourable terms for TLTRO III and the introduction of the PEPP. The minimum duration of APP net purchases and of PEPP reinvestments were also calendar-based.

[219] **Section 2.1.1** provides an overview of monetary policy, including its communication, during the inflation surge. Bouscasse et al. (2023) review the evolution of the communication tone during this period.

previous commitments, without undermining the ECB's credibility and reducing the effectiveness of the future use of such instruments.[220] The linking of interest rate and balance sheet tools, combined with sizeable upward surprises to inflation in the second half of 2021 and the first half of 2022, also presented a challenge for communication.[221] Given the need to rapidly remove policy accommodation, previous communication pertaining to the pace and duration of asset purchases had to be revised to pave the way for rates to be raised in July 2022. Still, there was a perception among some observers that rate lift-off was delayed owing to the formulation of prior guidance that constrained policymakers.[222] In particular, the ECB was seen as being behind the curve by some observers, compared with both the inflation projections, which saw significant upward revisions in December 2021 and over the course of 2022, and with other major central banks, which had started raising rates earlier.[223] The emphasis on "optionality, gradualism and flexibility" in the conduct of monetary policy in April 2022 and addition of "data dependence" in June 2022 were attempts to navigate these tensions. The recalibration of the terms of TLTRO III announced in October 2022 is another example of this trade-off between commitment and flexibility. The need for recalibration to remain consistent with policy normalisation appears to have been well understood by the public and helped to maintain credibility. Careful communication was also needed when calibrating the complex mix of balance sheet tools, which included explaining the possible trade-off between the pace and duration of net purchases, on the one hand, and the duration of reinvestments on the other.[224]

Significant pressures on central bank profitability have been another challenge for communication. The rapidly changing inflation environment, and sharp monetary policy tightening, resulted in financial losses for the Eurosystem linked primarily to past asset purchases programmes (see **Section 2.2.4**). This presented a communication challenge, with a need to explain to the public both the reason for these losses and the rationale behind certain policy decisions which themselves had an impact on the Eurosystem's monetary income. The recalibration of the remuneration of minimum reserves, which was set at 0%, on the basis of efficiency considerations in July 2023, for example, was perceived by some observers as an adjustment of monetary policy tools for reasons of profitability. The accounts of the

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220 A narrow notion of credibility would imply leaving the set-up of instruments unchanged as economic circumstances change. However, a broader notion of credibility that focuses on the commitment to achieve the inflation target rather than time-invariant instrument design implies adjusting instrument design when the achievement of the target is at risk. At times, these two interpretations can be contradictory.

221 See discussion of the chronology of monetary policy decisions over this period in Lane (2024a).

222 See, for example, questions during the December 2021 press conference relating to the formulation of rate forward guidance, and during the June 2022 press conference about the delay in ending purchases and in raising ratesrate, as well as a view expressed by some analysts that lift-off had been delayed by the constraints of prior guidance (see Böhme, 2022).

223 See, for example, questions during the December 2021 press conference relating to the ECB's divergence from the other major central banks, Wieland and Hegemann (2025) and various reports in the media (including Böhme, 2022; Niedermayer, 2022 and Look, 2022).

224 In December 2021 the Governing Council announced multiple, directionally different, adjustments to the pace of asset purchases, including a) an increase in the monthly purchase pace under the APP (though as part of the "step-by-step reduction" of the pace of asset purchases), b) an extension of the intended minimum duration of PEPP reinvestments, c) a lower expected purchase pace under the PEPP than in the previous quarter and d) the discontinuation of net asset purchases under the PEPP at the end of March 2022. The rationale for these adjustments, and the link to the overall stance, may not have been well understood, as evidenced by the clarifications sought during the press conference.

monetary policy meetings, as well as ECB and NCB annual reports and speeches, provided useful communication tools to shed light on the considerations underlying such recalibrations of policy measures.[225] These examples underscore the importance of clear communication to the public to explain the benefits and risks, as well as the proportionality assessment applied to the use of different tools.

Careful communication was needed to explain the overlapping use of tools that seemingly pulled the monetary policy stance in opposite directions. Full reinvestments under the APP continued until end-February 2023, by which time policy rates had increased by 300 basis points and reached restrictive levels, and full PEPP reinvestments – bound by a commitment announced in December 2021 – continued well after the conclusion of the rate hiking cycle (**Chart 60**). More recently, policy rates were lowered alongside a declining Eurosystem balance sheet. To address these concerns, the Governing Council highlighted in December 2022 that interest rates were the primary tool for setting monetary policy. It also emphasised that the ongoing "normalisation" of the balance sheet would continue in a "measured and predictable" way that did not interfere with the monetary policy stance.[226] In addition, communication focused on the combined contribution of reductions in TLTROs and securities holdings to balance sheet normalisation, which, at least during the rate hiking phase, pulled the stance in the same direction, thereby helping to ease the burden on communication.[227]

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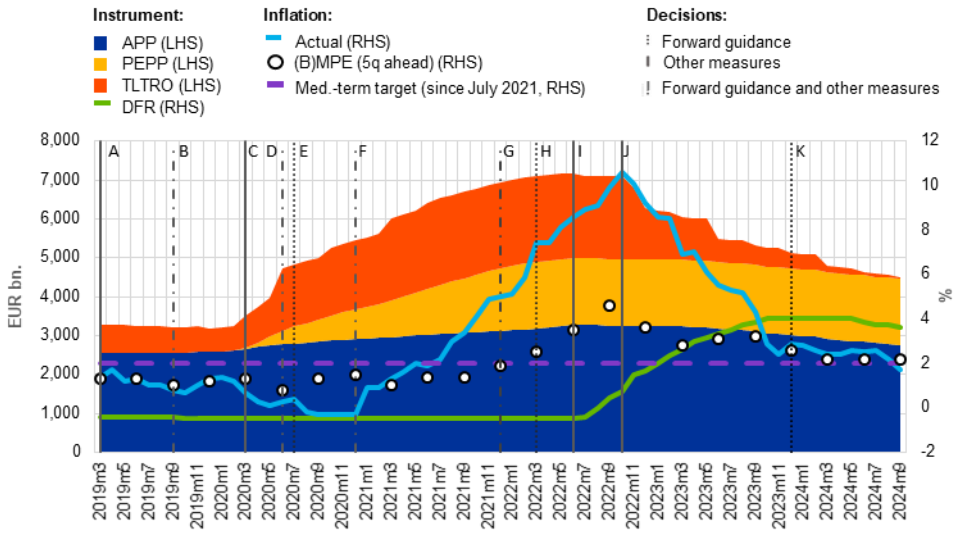
225 In addition to the discussion in the accounts of the monetary policy meetings, see e.g. Schnabel (2024c) and Villeroy de Galhau (2022).

226 Similarly, in January 2022, the Federal Reserve clarified that the federal funds rate was the "primary means of adjusting the stance of monetary policy" (see the transcript of Chair Jerome H. Powell's press conference on 26 January) and that balance sheet reduction would run "in the background". By contrast, in February 2023, Sveriges Riksbank argued that a more favourable overall effect on inflation and resource utilisation would be achieved by combining its policy rate rise with sales of government bonds and an increased offered issue volume of Riksbank Certificates, thereby effectively linking interest rate and balance sheet tools (see the Decision by the Executive Board of Sveriges Riksbank, Annex A to the minutes: Decision on policy rate, sales of government bonds and increased volume of Riksbank Certificates, 8 February). In August 2022 the Bank of England also informally linked these tools, arguing that a reduction in the monetary stimulus provided via its Asset Purchase Facility was appropriate (see the Bank of England's Provisional Market Notice on the Asset Purchase Facility: Gilt Sales, 4 August).

227 See, for instance, the 2022 ECB annual report.

Chart 60

The combination of multiple tools and related forward guidance



Source: Eurostat, Eurosystem.
Notes: Vertical lines mark key communication events. **A**: Mar 2019: Announcement of TLTRO III (maturing Mar 2021). **B**: Sep 2019: APP reinvestments in full for an extended period of time past the date when the GovC starts raising key interest rates; APP purchases expected for as long as necessary to reinforce the accommodative impact of policy rates and to end shortly before the GovC starts raising key interest rates; TLTRO III maturity extended to 3 years (maturing Mar 2022). **C**: Mar 2020: PEPP purchases will be conducted until end-2020; additional LTROs introduced; more favourable terms for TLTRO III; APP envelope increased. **D**: Jun 2020: PEPP envelope increased; PEPP purchases extended to at least end of Jun 2021. **E**: Jul 2020: PEPP reinvestments until at least end-2022. **F**: Dec 2020: PEPP purchases extended to at least end of Mar 2022; PEPP reinvestments extended to at least end-2023; TLTRO: 2 additional operations (last operation maturing Dec 2021). **G**: Dec 2021: step-by-step reduction of APP purchases; PEPP purchases discontinued end-March 2022; PEPP reinvestments extended to at least end-2024. **H**: Mar 2022: Any adjustments to key policy rates will take place some time after the end of APP net purchases and will be gradual. **I**: Jun 2022: Decision to end APP purchases Jul 1, 2022. **J**: Oct 2022: Recalibration of TLTRO III remuneration. **K**: Dec 2023: Full PEPP reinvestments intended during 2024H1 and partial reinvestment in 2024H2.

Indications for future policy also presented challenges for communicating a data-dependent approach to setting interest rates. On several occasions over the more recent period the Governing Council gave clear indications as to the direction of policy rate decisions, at times including specific intentions for policy rate adjustments at subsequent meetings, while emphasising data dependence.[228] Speeches by Governing Council members can also play an important role in communicating intentions for rate policy.[229] Using this type of guidance as a policy tool may have been perceived, to some extent, as pre-commitment, presenting challenges for data dependence as well as the meeting-by-meeting approach. The swift improvement in the inflation outlook in early 2024, for example, laid the ground

[228] In June 2022 the Governing Council signalled its intention to begin raising rates at the following meeting, stating that "in line with our policy sequencing, we intend to raise the key ECB interest rates by 25 basis points at our July monetary policy meeting", adding that "we expect to raise the key ECB interest rates again in September" and that "beyond September, based on our current assessment, we anticipate that a gradual but sustained path of further increases in interest rates will be appropriate". In February 2023, after having raisedraising the policy rates by 300 basis points, the Governing Council stated that "future policy rate decisions will continue to be data-dependent and follow a meeting-by-meeting approach", and that "we intend to raise interest rates by another 50 basis points at our next monetary policy meeting in March". In April 2024, the Governing Council signalled a likely start to rate cuts at the subsequent meeting, stating that that "If our updated assessment of the inflation outlook, the dynamics of underlying inflation and the strength of monetary policy transmission were to further increase our confidence that inflation is converging to our target in a sustained manner, it would be appropriate to reduce the current level of monetary policy restriction", adding that "we will continue to follow a data-dependent and meeting-by-meeting approach to determining the appropriate level and duration of restriction, and we are not pre-committing to a particular rate path".

[229] See Ehrmann and Fratzscher (2007).

for official communication in April of that year to signal that "it would be appropriate to reduce the current level of monetary policy restriction", conditional on gaining greater "confidence that inflation is converging to our target in a sustained manner".[230] By the time of the June meeting, this expectation had become embedded in market pricing.[231] A potential side-effect of the emphasis on data dependence, however, is that market participants may have paid too much attention to incoming data (including single data points) during periods where official communication offered little in the way of new guidance (see **Section 5.3**).[232] This created communication challenges when transitioning from one approach to another. In this regard, some (soft) guidance as to the direction of policy rate decisions was able to alleviate overreactions to macroeconomic news.

Recent experience underlines the importance of being able to swiftly adjust the monetary stance in either direction. Communication in these circumstances is complicated by the simultaneous use of multiple tools, with different objectives and different effects on the monetary policy stance, including instruments that cannot easily be adjusted or unwound in response to a worsening inflation outlook (e.g. large-scale asset purchases). Stressing state dependence and optionality in certain circumstances, in line with the meeting-by-meeting and data-dependent approach adopted during the recent period, can help to mitigate risks of unfavourable trade-offs, while pledges of "gradualism" or unconditional commitments may have the opposite effect. In addition, the recent experience with the complex toolkit has underscored the importance of explaining clearly which tools are the most important from a stance perspective, and how this evolves over the policy cycle.

5.3 Evaluation of communication approach during the inflation surge period

Evidence shows that in mid-2022 ECB policy decisions became more responsive to incoming measures of underlying inflation, a shift also reflected in analysts' perceptions of the ECB's monetary policy. With the medium-term outlook surrounded by exceptional uncertainty, incoming data, in particular indicators with high predictive power for near-term inflation developments, were elaborated on in the ECB's communication following each policy meeting. A rolling-window regression of the policy rate changes suggests that the weight placed on incoming underlying inflation readings – proxied by core inflation in this analysis – increased significantly in mid-2022 but subsided in early 2024, while still remaining above pre-inflation surge levels (**Chart 61**, left panel). The weight placed on current developments in core inflation was significantly greater during the post-pandemic period than in the 1999-2013 pre-forward guidance period. Consistent with this, Bernardini and Lin (2024) show that, after July 2022, policy expectations of analysts in the Survey of Monetary Analysts (SMA) aligned well with a simple Taylor rule but

230 See the April 2024 monetary policy statement.

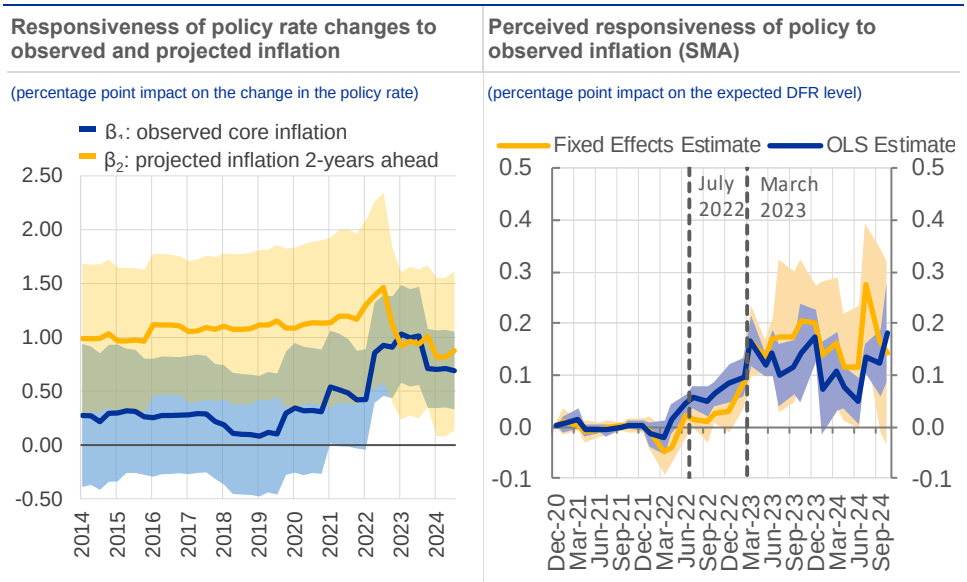
231 See the June 2024 account of the monetary policy meeting for a discussion.

232 The President emphasised repeatedly that the Governing Council was not "data point-dependent". See e.g. Lagarde (2024a) and the Q&A at the July 2024 press conference.

were better represented by a rule based on core inflation instead of headline inflation. At the same time, analysis of SMA policy expectations also highlights an increase in the ECB's perceived responsiveness to contemporaneous headline inflation, particularly after the March 2022 Governing Council meeting (**Chart 57**, right panel). Despite fluctuations, the coefficient has stayed positive and significantly different from zero since then.

Chart 61

The ECB's actual and perceived responsiveness to elements of underlying inflation



Notes:
left panel: Sources: Lünnemann and Wintr (2025). The chart shows coefficients from rolling-window regression $\Delta rate_t = \beta_1 \Delta \pi_t^{obs} + \beta_2 \Delta \pi_t^f + \varepsilon_t$ estimated by OLS based on real time dataset with observations for each monetary policy meeting with new projections. The rate is the MRO rate prior to the GFC, the shadow rate (Wu and Xia, 2020) between the GFC and mid-2022 and the DFR afterwards. Π_t^{obs} is observed core inflation and π_t^f 2-year ahead inflation projection. Horizontal axis denotes the end of each rolling window covering 60 quarters. Shaded areas represent 90% confidence band. The sample period is 1999Q1 – 2024Q4.
right panel: Sources: Survey of Monetary Analysts (SMA) and ECB calculations. The chart shows time-varying OLS and Fixed Effects estimates of the inflation coefficient of a Taylor rule regression based on expectations from the SMA. The estimation is based on the approach of Bauer et al. (2024 a, b), For the analysis, the DFR is regressed on the lagged DFR, HICP deviations from target and GDP growth and the long-term expected long-run DFR. The estimated parameters are the joint parameters and do not separately deduct the weight placed on interest rate smoothing. Standard errors are clustered at the level of respondents and forecast horizon.

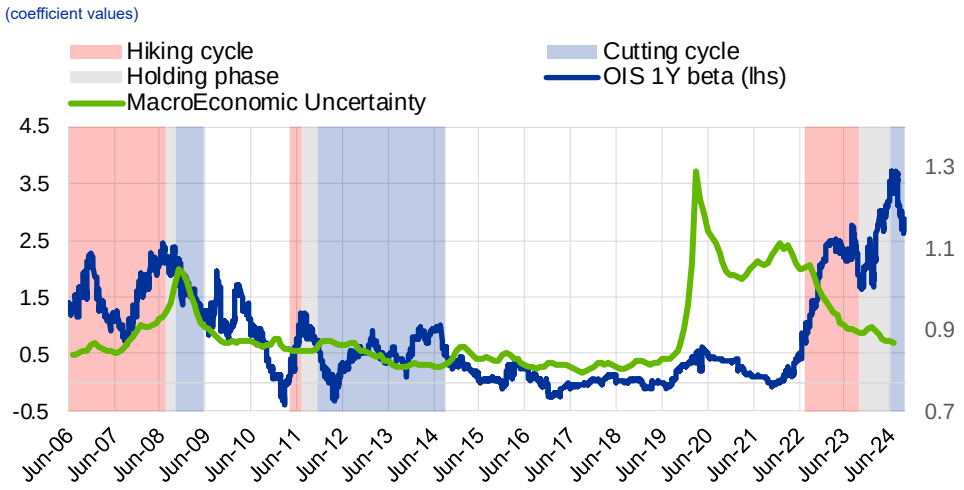
Financial market sensitivity to macroeconomic data rose following the shift away from forward guidance, aligning with the emphasis on a data-dependent approach to policy, but also increasing the risk of excess sensitivity. The Governing Council's communication on "not offering forward guidance of any kind" and the emphasis on a data-dependent approach prompted market participants to monitor incoming data more closely to form expectations for policy.[233] Regression-based evidence demonstrates that the sensitivity of one-year overnight interest swap (OIS) rates to macroeconomic news, such as inflation and economic activity indicators, increased significantly from 2022 onwards (**Chart 62**, blue line). This increase persisted even after macroeconomic uncertainty (**Chart 62**, green line) had subsided. Thus, the heightened financial market sensitivity appears to have been related more strongly to the shift in communication strategy than to underlying uncertainty. Heightened market sensitivity, which was suppressed during the forward guidance period between July 2013 and July 2022, can be seen, to an extent, as a

[233] See the July 2022 monetary policy statement (with Q&A).

return to levels comparable to, if somewhat higher than, those observed in the pre-forward guidance period. Particularly large market moves, however, likely represent excess volatility triggered by surprises in key data releases. To mitigate such dynamics, members of the Governing Council repeatedly stressed that data dependence and the meeting-by-meeting approach should not be confused with "data point dependence".[234]

Chart 62

Sensitivity of one-year OIS rates to macroeconomic news



Sources: Bloomberg, ECB and ECB calculations
Notes: The news index is constructed as a regression-based weighted average from 40 variables related to inflation, GDP, and other measures of economic activity, as well as survey-based confidence and expectation indicators. These variables are sourced from the aggregate Euro Area (6 variables), Germany (8), France (7), Italy (7), Spain (4), and the United States (8). The regression equation to infer the sensitivity to macro news from the news index is defined as: Asset_t^i=β_1 NewsIndex_t^i+β_2 Dummy_t^FG+β_3 Dummy_t^MbyM+β_4 NewsIndex_t^i×Dummy_t^FG+β_5 NewsIndex_t^i×Dummy_t^MbyM. MacroEconomic Uncertainty shows the measure of Comunale and Anh (2023).

At the beginning of the rate hiking cycle the ECB faced the challenge of aligning communication with policy moves. This initial phase was marked by historically large monetary policy shocks, driven by unanticipated rate decisions (captured by "target", **Chart 63**) and indications for future rates (captured by "path", **Chart 63**). For example, the unexpected 50 basis point hike at the July 2022 meeting, following the the announcement in June of the intention to raise rates by 25 basis points in July, led to the largest "target" shock in the whole sample. Furthermore, varying communication triggered the largest dovish (in October 2022) and the largest hawkish (in December 2022) market surprises in the policy rate "path" factor since the global financial crisis (**Chart 63** right panel).[235] A similarly large surprise was experienced in March 2023 when the Governing Council increased policy rates by 50 basis points, while market participants had expected a

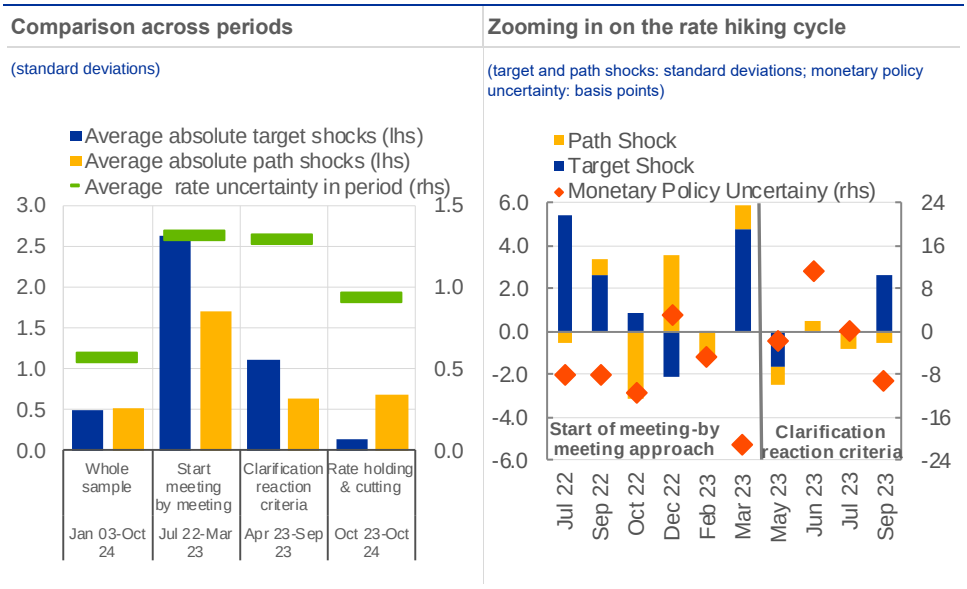
[234] See Lagarde C. (2024), the Q&A at the September 2024 press conference and the Q&A at the October 2024 press conference as prominent examples.

[235] The absence of changes inon APP guidance and the reference to "substantial progress in withdrawing monetary policy accommodation" in October 2022 (see the October 2022 monetary policy decisions press release) constituted a historically large easing surprise. In contrast, interest rate path guidance and – to some extent – the quantitative tightening communicated in the December 2022 monetary policy decisions press release induced a significant tightening, which was further reinforced during the press conference, including through communication such as: "Based on the information that we have available today, that predicates another 50 basis point rate hike at our next meeting, and possibly at the one after that, and possibly thereafter".

smaller step in light of the elevated financial stability risks following the failure of Silicon Valley Bank and distress at Credit Suisse. However, monetary policy communication at the press conference after the meeting provided clarity and reassurance that the ECB stood "ready to respond as necessary to preserve price stability and financial stability in the euro area" and successfully reduced monetary policy uncertainty (**Chart 63**, right panel).[236] The second phase of the rate hiking cycle, following the introduction of the three-element reaction function framework in March 2023, saw less pronounced market movements following policy decisions, despite similar levels of interest rate uncertainty (**Chart 63**, left panel, second vs third panel).

Chart 63

Target rate and rate path guidance policy shocks and the reduction of monetary policy uncertainty within the Governing Council policy meeting window



Sources: Bloomberg and ECB calculations.
Notes: The model decomposes the yield curve into movements along the target, path, QE, and transmission components as documented in Akkaya et al. (2024a). The target factor captures surprises to the expectations of the current short-term rate through movements in risk free yields at very short maturities up to six months. The path factor is related to surprises to the future interest rate path, reflected in changes in yields between six months and two years. Average interest rate uncertainty is based on the option-implied standard deviation of the 3-month Euribor 1-year ahead. Median change in monetary policy uncertainty is the change in interest rate uncertainty on Governing Council days.

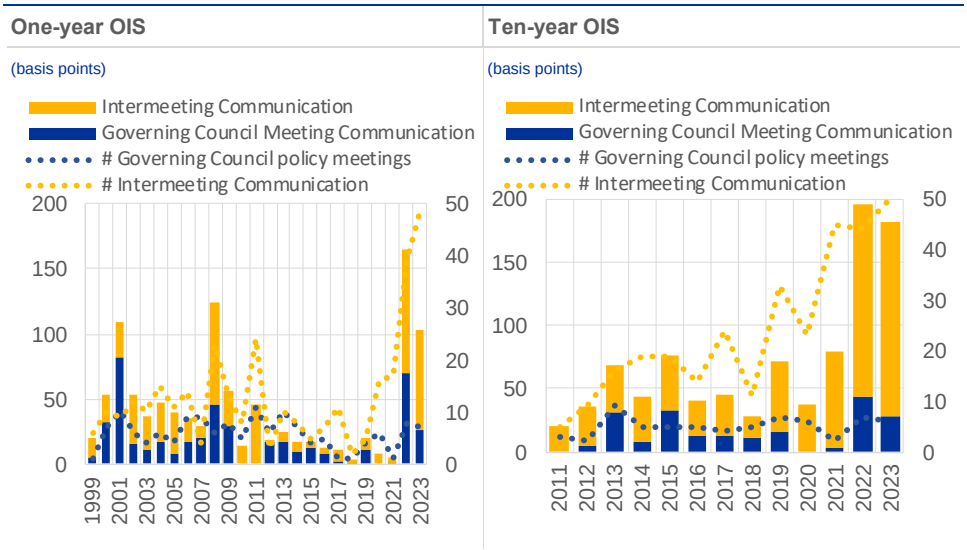
Communication between monetary policy meetings gained prominence in shaping market expectations, with both benefits and costs. Communication between policy meetings, including via speeches and interviews given by ECB Governing Council members, can convey significant policy signals (see e.g. Istrefi et al., 2024; Jurkšas and Kaminskas, 2024; and Akkaya et al., 2025a). These effects were particularly pronounced during the rate hiking phase in 2022-23, with notable effects on both short-term and long-term yields (**Chart 64**). Inter-meeting communication is useful for explaining the monetary policy decisions made by the Governing Council, its reaction function and the inputs that guide decisions, thereby supporting transparency and public accountability (see **Section 5.5**). It can also be helpful in indicating how incoming information between meetings is processed,

[236] See the March 2023 monetary policy statement (with Q&A).

especially in the face of major shocks. But inter-meeting communication also poses challenges, including risks of communication noise and potential misalignment with official policy statements. Leaks are particularly detrimental: they significantly affect markets and have been shown to undermine official policy announcements (e.g. see Ehrmann et al., 2023a). Unexpected changes in communication can also have significant and long-lasting macroeconomic effects (Gebauer et al., 2024a).

Chart 64

Cumulated excess returns on one-year and ten-year OIS yields associated with Eurosystem communication events



Sources: Istrefi, Odendahl and Sestieri (2024)
Notes: Charts show the sum of absolute above normal changes for the OIS 1- and 10-year maturity, around a tight window of ECB communication events (primary axis) and the respective number of events that lead to abnormal returns in the respective asset (secondary axis). This may lead to a varying number of Governing Council policy meetings with abnormal returns although the number of Governing Council meetings per year is constant. Intermeeting communication events include speeches and interviews of the ECB Executive Board members as well as the governors of the Banque de France, Banca d'Italia, Bank of Spain and the Bundesbank. The abnormal return from the release of Monetary Policy Accounts is also considered in the Intermeeting Communication. However, the overall impact of the Accounts release is minor, and classifying it under "Governing Council meetings" would not significantly alter the chart. An abnormal change associated to a communication event is any change that is higher than the asset price changes that were expected over the event window based on the prior-to-the-event intraday volatility.

5.4 Assessment of the three-element framework in supporting communication of the reaction function

The introduction of the three-element framework, spanning the inflation outlook, the dynamics of underlying inflation and the strength of monetary policy transmission, helped to clarify the key elements of the policy reaction function in the face of elevated uncertainty.[237] The clarification of the ECB's

[237] The concept of underlying inflation had been used during the ELB period. See, for example, Draghi (2018) and the analysis in Ehrmann et al. (2018). Interest rate decisions were also explicitly linked to developments in underlying inflation during that period. See, for example, the September 2019 introductory statement (with Q&A) and the July 2021 monetary policy statement (with Q&A) given at the press conferences following the respective Governing Council meetings.

reaction function via the three-element framework was introduced in March 2023.[238] With policy rates firmly in restrictive territory by then, monetary policy was shifting from a phase of rapid removal of accommodation to fine-tuning of rate decisions as the peak of the rate hiking cycle neared. The framework complemented the inflation outlook with the formal introduction of two additional criteria, which were seen as particularly informative in assessing the balance of risks to the near-term outlook. In particular, "the dynamics of underlying inflation" provided a useful signal regarding the persistent component of inflation, which, in the context of extraordinarily high inflation and very high uncertainty, was informative about future inflation developments at a time when the performance of the inflation projections was lower than usual. Indeed, optimal policy modelling under uncertainty suggests that it is preferable to assign comparatively more weight to underlying inflation when uncertainty about the inflation outlook increases (see **Chapter 4**). Meanwhile, the focus on "the strength of monetary policy transmission" allowed policymakers to indicate that, in the context of a steep rate hiking cycle, their decisions would take account of possible amplification or attenuation effects of interest rate changes on future inflation.[239] A novel feature of the framework was that it made the criteria for interest rate decisions explicit, and provided a natural structure for organising official communication, including in the monetary policy statement (MPS), but also in the account of the monetary policy meeting and in the President's responses to questions during the press conference. The framework offered clarity on the Governing Council's reaction function and helped to convey in simple, non-technical terms how risk and uncertainty were being factored into decision-making (see also **Chapter 4**).[240]

The flexibility afforded by the framework was reflected in the official communication of rate decisions. The language used by the Governing Council over the review period since 2021 provides some insight into the way in which the different elements helped guide the decision-making process and communication, while recognising that the Governing Council did not attach specific weights to the elements. Between the start of the inflation surge and the introduction of the three-element framework, the monetary policy statement gradually included more references to the latest data releases, reflecting the importance of incoming data in explaining policy decisions (**Chart 65**, left panel). Over the same period there was also a shift in the specific words used in official communication towards commentary on underlying inflation dynamics and, to a lesser extent, monetary policy transmission, rather than on the inflation outlook (**Chart 65**, right panel).

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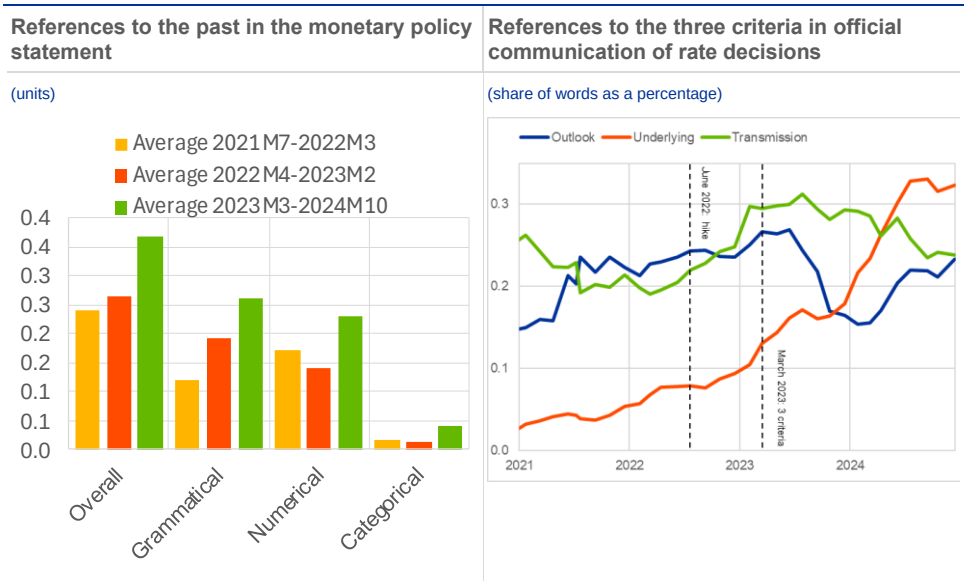
238 See the March 2023 monetary policy statement. Other central banks also clarified their reaction function over the tightening cycle. For example, the FOMC stated in its November 2022 press release that future rate increases "will take into account the cumulative tightening of monetary policy, the lags with which monetary policy affects economic activity and inflation, and economic and financial developments". This changed in the January 2024 press release to a more general statement that, in considering further rate adjustments, the Committee would "carefully assess incoming data, the evolving outlook, and the balance of risks".

239 See the discussion of underlying inflation in: Lane (2023a) and Lane (2024e); and the discussion of monetary policy transmission in: Lane (2023b); Lane (2024b); Lane (2024c); and Lane (2024). On the informativeness of these cross-check criteria, see Lane (2024d) and Schnabel (2024e).

240 See speeches by Lane (2023) and Schnabel (2024d), and the 22 May 2024 ECB blog by Christophe Kamps (2024).

Chart 65

Flexibility of the three-element framework under uncertainty



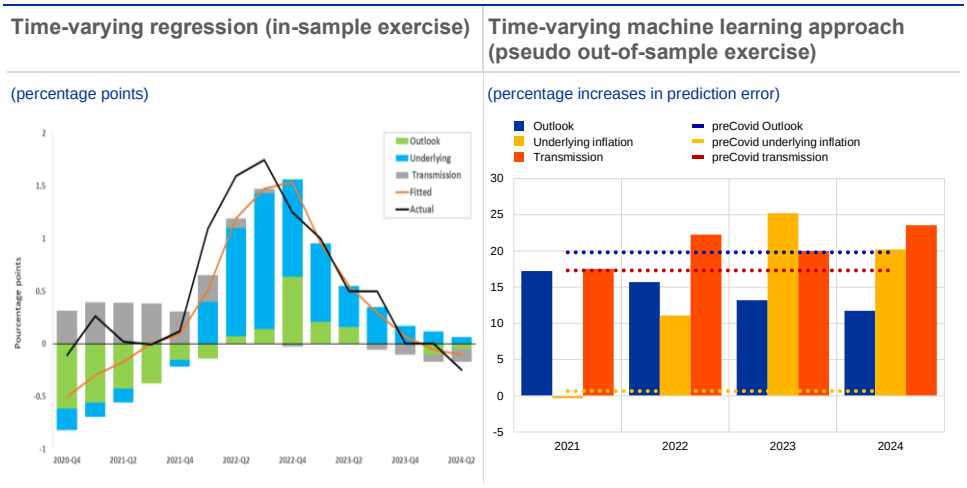
Sources: Left panel: MPS and Central Bank of Ireland staff calculations. Right panel: MPS and ECB staff calculations.
Notes: Left panel: Figure shows averages across sub-periods of the fraction of sentences with temporal tags. We tag grammatical, numerical, and categorical references to time. The overall measure is the fraction of sentences with at least one tag of any type. The textual data are ECB Monetary Policy Statements. See Byrne et al. (2025), "From Forward Guidance to Data Dependence: Temporality and Complexity in ECB Communication After the Pandemic", Central Bank of Ireland Economic Letter, forthcoming. Right panel: The lines refer to the number of words associated with each of the three elements of the criteria (inflation outlook in blue, underlying inflation in orange, and strength of transmission in green) in the MPS and press conference transcript, normalised for the total number of words. The specific words associated with each element is based on a user defined dictionary.

These implicit time-varying weights are also visible in an estimated ECB reaction function. Specifically, a time-varying parameter Taylor rule suggests that the inflation outlook was the main driver of policy decisions before 2022. But over the tightening cycle, the estimates suggest a greater weight on measures of underlying inflation (**Chart 66**, left panel). This finding is confirmed using a machine learning approach to predict changes in the ECB's interest rates on the basis of a larger set of 60 indicators related to the three criteria, and allowing their relative importance to vary over time (**Chart 66**, right panel).[241] Results of a pseudo out-of-sample exercise show that measures of underlying inflation significantly improve the model's ability to predict rate changes from 2022 onward, whereas they have limited predictive power in earlier periods. Moreover, while the role of monetary and financial indicators of monetary policy transmission in predicting rate changes is already substantial before the inflation surge, their predictive power has increased since 2022. This suggests that the three-element framework is a fair account of what was driving monetary policy decisions.

[241] The machine learning model uses 60 variables to predict quarterly changes in the shadow rate. The analysis relies on an elastic net approach to handle multicollinearity. In particular, results are robust to using Lasso or Ridge regression, including five-year forward, five-year ahead inflation compensation measures and replacing the shadow rate with the one-year OIS rate.

Chart 66

Contributions of the three criteria to policy rate changes



Sources: Lhuissier (2025), SDW, BSI, MIR, BLS, ECB and staff calculations.
Notes: Left panel: The bars display the contribution of each component (inflation outlook, underlying inflation, and transmission) in explaining changes in the DFR from 2021 Q1 to 2024 Q2. The actual series of changes in the proxy DFR is shown in the black line while the model-implied DFR is shown in the orange line. The proxy DFR is a combination of the proxy rate (developed by DEMFI) when the policy rate is at the ELB and of the DFR otherwise. The time-varying parameter Taylor rule regression model is estimated over the period 2003Q1-2024Q2 follows: $\Delta DFR_t = \beta_1 OUTLOOK_t + \beta_2 UNDERLYING_t + \beta_3 TRANSMISSION_t + \varepsilon_t$, where ΔDFR_t is the quarterly change in the generalized DFR, which is a combination of the proxy rate (developed by DEMFI) when the policy rate is at the ELB and the DFR otherwise, $OUTLOOK_t$ is the 2-year ahead inflation projections (B)MPE $UNDERLYING_t$ is the principal component of a set of underlying measures, $TRANSMISSION_t$ is a composite cost of borrowing indicator, which reflects borrowing costs for households, nonfinancial corporates and sovereigns in both bond and banking sector markets, relative to a measure of the nominal natural rate of interest (r*) developed by DEMFI, and ε_t is the error term.
Right panel: The bars display the relative gain in the prediction error of the change in the ECB shadow rate from including each set of indicators, additionally to the other two sets, replicating the availability of the indicators as close as possible to the effective conditions in each period. The prediction exercise is carried out with Ridge regression with monthly data over the period Jan. 2003 – Nov. 2024. The estimation is carried out with an extending-window approach. The dotted lines represent average relative gains up to 2019. The outlook indicators include 1-quarter, 1-year and 2-year ahead GDP and inflation projections and their lags. Underlying inflation indicators include a set of underlying measures and their lags. The indicators of the transmission of monetary policy include quarterly data from the Bank Lending Survey and monthly indicators of lending rates, lending volumes and money and their lags. The shadow rate is an average of the one by De Rezende and Ristiniemi (2023) and Lemke and Vladu (2017).

Clarifying communication was occasionally required to explain how the Governing Council was synthesising the different signals coming from the three criteria. At times, the data underpinning the different criteria offered different prescriptions as to the direction, magnitude and timing of rate adjustments. Even within each element, individual data can send conflicting signals about the appropriate policy stance. These issues often required clarifying communication to explain how the criteria were being operationalised and what messages the Governing Council was taking from specific data. These explanations were offered during press conferences, as well as in speeches by policymakers and publications produced by staff.[242] The framework linking inflation developments to the interplay between wages, profits and productivity was one example of how the ECB explained judgements during the early phase of the rate cutting cycle despite sticky domestic and services inflation.[243]

The introduction of the specific criteria embedded in the policy reaction function simplified the communication of the complexity associated with incorporating risks and uncertainty in policy-setting, fostering robustness

[242] The President clarified that the Governing Council was "not data point-dependent" (see, for example, the Q&A at the October 2024 press conference and the Q&A at the January 2025 press conference). On the informativeness of these criteria, see Lane (2024d), Schnabel (2024e) and Bańbura et al. (2023b).

[243] See Lagarde (2024b) and Gebauer et al. (2024c) for explanations of the framework.

while preserving agility. The recent inflation surge period underscores the value of a flexible and state-dependent, but still consistent, communication strategy. When the size and distribution of shocks becomes highly uncertain, committing to a particular rate path has significant drawbacks, as it may constrain policy agility in the face of abrupt changes to the inflation environment. At the same time, communicating the policy reaction function clearly can help the public understand how the Governing Council is navigating the environment it is facing. Part of this relates to explaining how different risks and uncertainties are likely to affect the inflation and growth outlook, as is systematically done in the monetary policy statement, with these judgements also informed by scenario and sensitivity analysis. Clarifying which kind of data the Governing Council is focusing on to make its decisions under uncertainty can help market participants to distinguish signals from noise. These considerations underpinned the introduction of explicit criteria in addition to the inflation outlook.[244] The framework provided several communication benefits, including as a simple, non-technical organising framework for explaining the rationale behind policy decisions under uncertainty, while also helping to increase the robustness of policy decisions (see **Chapter 4** for a technical discussion of risk-management considerations). Indeed, the market movements following policy decisions became less pronounced after the introduction of the criteria in March 2023, despite similar levels of interest rate uncertainty, suggesting that market participants better understood the reaction function (see **Chart 63**, left panel). Looking ahead, the types of additional criterion that might be needed in future contingencies may be different to those currently in place. One general lesson from the recent period is that indicators and analytical tools that help to capture risks and uncertainty are helpful for guiding both policy-setting and communication.[245]

5.5 ECB communication with the wider public

5.5.1 Why communication and outreach matters

To fulfil their mandate legitimately and effectively, central banks need to be understood and trusted – not only by experts, but also by the general public. That is why clear communication matters.[246]

Public outreach can help central banks foster understanding and support among non-expert audiences (Haldane and McMahon, 2018; Bholat et al., 2019; Haldane et al., 2021; Jung and Kühl, 2021; Ehrmann et al., 2023b; Mochhoury, 2023; Hayo and Meon, 2023). This supports monetary policy in at least two ways. First, knowledge and attitudes affect the economic expectations of consumers and firms (see also

244 See Lagarde (2025).

245 See Istrefi and Sestieri (2019) on how the Governing Council has communicated about the balance of risks to inflation and economic growth in the past and how this relates to policy decisions. See Lane (2024d) for a discussion of how the ECB has incorporated risk and uncertainty in forecasting, policy preparation and communication in recent years.

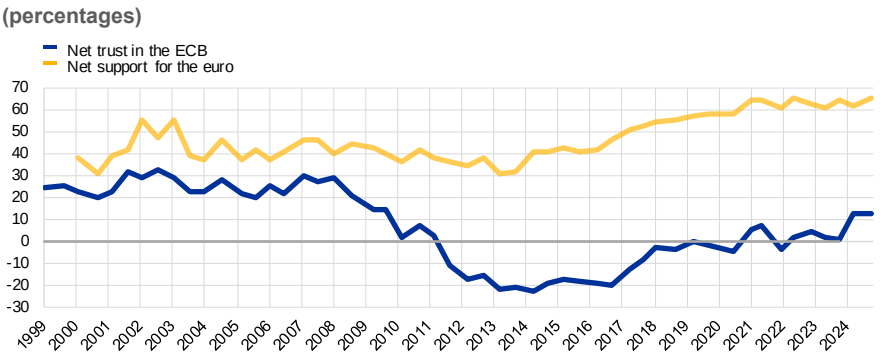
246 See Workstream on monetary policy communications (2021), "Clear, consistent and engaging: ECB monetary policy communication in a changing world", Occasional Paper *Series*, No 274, ECB, revised December.

Box 5), thereby informing their decisions, which in turn affects the transmission of monetary policy (Haldane and McMahon, 2018; Christelis et al., 2020; Haldane et al., 2021; Coibion et al., 2023; McMahon and Naylor, 2023). Second, knowledge and public trust help central bankers to remain independent and successfully pursue their mandate (Ehrmann and Fratzscher, 2011; Tucker, 2019; Hayo and Neumeier, 2020).

Trust in the ECB has been gradually rising since 2017 and support for the euro recently reached an all-time high (see Chart 67).[247] To reinforce these trends, the ECB and the NCBs have expanded and enhanced their communications. As part of the strategy review 2021, the ECB and NCBs pledged to explain their strategy and decisions "as clearly as possible to all audiences", to complement their outreach "by a layered and more visual version of policy communication" and to "make outreach events a structural feature of the Eurosystem's interaction with the public".[248,249] The following sections discuss how the Eurosystem has delivered.

Chart 67

Net trust in the ECB and net support for the euro (1999-2024)



Source: Standard Eurobarometer.
Note: Net trust is the difference between the share of respondents who tend to trust and the share of respondents who tend to not trust. Net support is the difference between the share of respondents who are "for" and the share who are "against" a European economic and monetary union with one single currency, the euro.

5.5.2 Enhancing the ECB's established policy communication

Following the strategy review 2021 the ECB modernised the communication of its monetary policy decisions and improved the clarity and readability of its key policy communication channels, which are targeted mainly at expert audiences but also beyond: 1) the monetary policy statement read out by the President at the press conference following Governing Council's monetary policy meetings, 2) the press release communicating monetary policy decisions, 3) the Economic Bulletin, and 4) the account of the monetary policy meeting.

[247] In the Eurobarometer 102 (Autumn 2024), 51% of euro area respondents said they trustedtrust the ECB, while 38% said they diddo not. 81% of respondents in the euro area were in favour of the single currency.

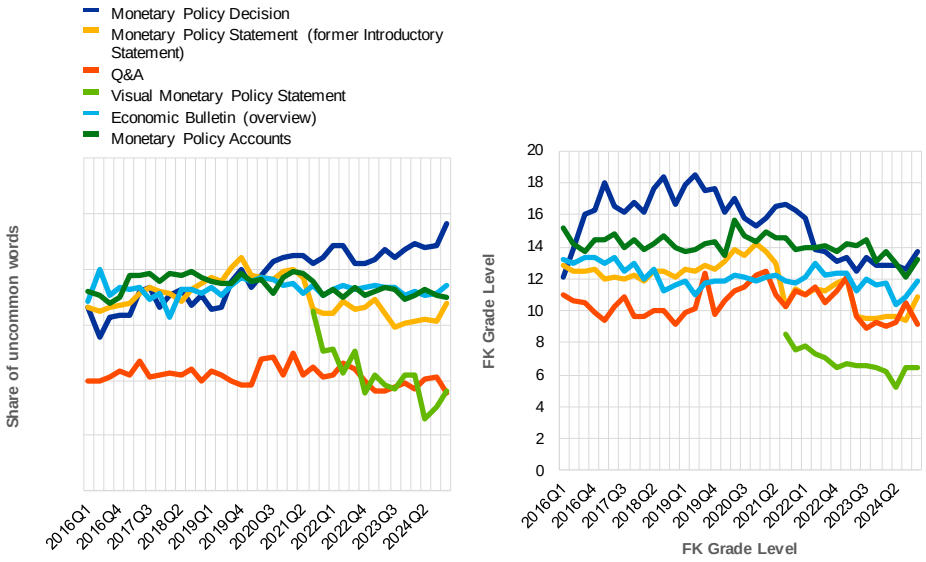
[248] See European Central Bank (2021), "An overview on the ECB's monetary policy strategy", July.

[249] Thereby, they join similar efforts on part of have been made by other major central banks (Blinder et al., 2024; de Haan &and Hoogduin, 2024).

The new monetary policy statement is shorter and more accessible than the earlier "introductory statement". It sets out a narrative drawn on information from economic, monetary and financial analysis, explaining how monetary policy decisions are based on the assessment of inflation, growth and other economic developments. To quantify readability, we use the Flesch Kincaid Grade Level (FKGL). Analysing the length of sentences and words, this standard metric indicates how many years of formal education are required to understand a text. The typical monetary policy statement has become easier to read over time and is now understandable to people with high school diploma (baccalaureate). To complement the analysis, Angino et al. (forthcoming) develop a measure of conceptual complexity which assesses the share of "uncommon words" as a proxy for jargon.[250] In this regard, too, readability of the monetary policy statement has improved (see **Chart 68**). Using a third indicator of textual complexity, Byrne et al. (2025) find contradicting evidence. They find that in light of rising inflation and more detailed debate and discussion, the MPS has become more conceptually complex.[251]

Chart 68

Readability of monetary policy communications over time



Source: ECB.
Notes: Figure shows moving average over four quarters of the readability of the Monetary Policy Decision, the Monetary Policy Statement (including Introductory Statement), the Q&A section of the monetary policy conference, and the Visual Monetary Policy Statement, the Economic Bulletin and the Monetary Policy Accounts in share of uncommon words (left panel) and Flesh Kincaid Grade Level (right panel). The first metric helps quantifying the conceptual complexity of a text, the second the semantic complexity.

The President's responses to the media question and answer session following the reading of the monetary policy statement are also highly accessible. The responses are accessible in terms of both textual and conceptual complexity, especially since the last strategy review. As snippets are often

[250] Conceptual complexity may be approached statistically by measuring the share of uncommon words used within a text, which include – among other things – economic jargon that may reduce accessibility, especially for a non-expert audience.

[251] Following the Conceptual Complexity Index (CCI) of McMahon and Naylor (2023) texts are more conceptually difficult when they use more jargon terms overall, when they include more distinct economic topics, or more distinct jargon terms are used in a given topic.

reproduced on television and radio, the accessibility of the press conference also supports outreach to the wider public (see Byrne et al. (2025)).

By contrast, the press release on the monetary policy decisions remains complex. Even though its readability has improved from an average FKGL of 18 in 2021 to 15.5 recently, the share of uncommon words has increased (**Chart 68**). However, the press release is primarily aimed at experts, which requires a high level of precision.

The Economic Bulletin continues to present the economic context and analysis relevant to Governing Council's decisions. Since the strategy review **2021** the ECB has provided more analysis of monetary and financial issues in the Bulletin and regularly provides a proportionality assessment. Readership has increased, with each issue currently accessed by 2,000 to 5,000 readers. In addition, up to 100,000 people receive its contents via social media. In comparison with the period before 2021, traditional media coverage has also increased, with up to around 100 items covering each issue. However, the Bulletin remains relatively complex (**Chart 68**).

The account of the monetary policy meeting continues to provide the full range of arguments considered during the Governing Council's deliberations. Though the account has become substantially longer since 2021, it is easier to read (**Chart 68**). At the same time, the account is geared towards an expert audience, with precision and faithfulness to the policy discussion being the most important dimensions of its content.

5.5.3 Layering communication to reach the wider public

The four established policy communication channels are complemented by communication aimed at the wider public: 1) the visual monetary policy statement, 2) the ECB Blog, 3) the ECB Podcast, and 4) the YouTube channel "Espresso Economics". With understandable language and relatable examples, they enhance awareness of what the Eurosystem does and the economic context in which it operates.

"Our monetary policy statement at a glance", the visual statement introduced following the last strategy review, offers a condensed and visualised version of the messages in the monetary policy statement. The ECB and NCBs disseminate the visual statement via their websites and social media in all 24 official EU languages, alongside the monetary policy statement. It is used on Instagram as a swipe post, which multiplies its reach, especially beyond expert audiences. While on average around 1,800 users visit the monetary policy statement on the ECB's website on press conference day, an average of 14,700 users see what the Governing Council decided via Instagram. The visual statement uses only a few uncommon words, and its average FKGL readability score is 7. It can thus be understood by secondary school pupils.

The ECB Blog is an additional instrument of layered monetary policy communication. The blog was introduced in 2020 as a channel for ECB Executive Board members. Since the strategy review 2021, it has disseminated analysis and research of both Board members and ECB staff, in a succinct, intuitive and reader-focused style. 12 NCBs also publish their own blogs.

The ECB Podcast also addresses a wider audience. Since 2021 it has featured recordings of the monetary policy statement and covered a wide range of topics, including some of particular popular interest, e.g. the impact of Taylor Swift concerts on inflation. The editors also incorporate listener questions. Publication frequency has increased from ten episodes in 2020 to 22 in 2024. Episodes have 8,650 plays on average within the first six months. Additionally, five NCBs publish their own podcasts.

As the latest addition to its layered communication, the ECB introduced its YouTube channel Espresso Economics in 2025. Here, ECB staff explain key economic concepts and developments in a relatable and accessible manner, focusing on the interests of viewers and using engaging visual content. 16 NCBs also run a YouTube channel.

5.5.4 Effective communication and engagement with the wider public

The ECB and NCBs have increased outreach via listening and explaining events, expanded their presence in traditional and social media, and increased direct communication through museums and visitor centres.[252]

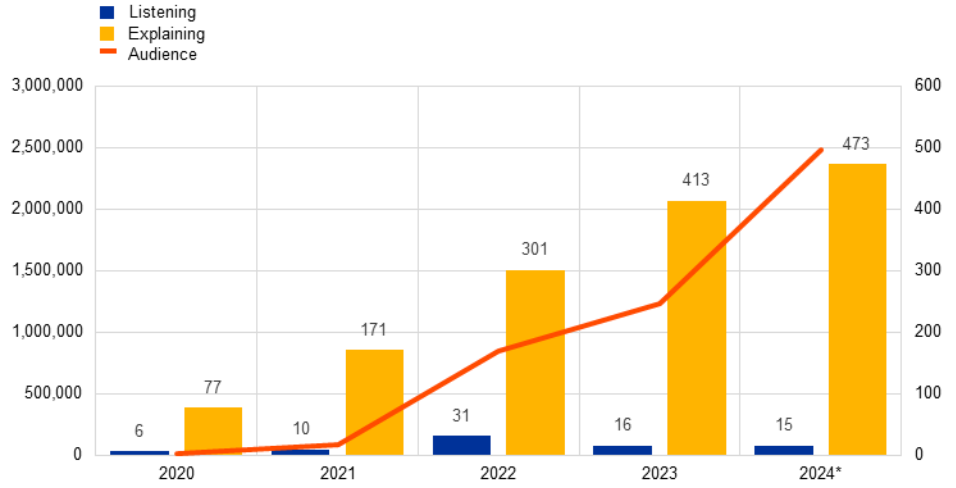
Between 2020 and 2024 the ECB and NCBs conducted 1,435 events to explain what the Eurosystem does. They also held 78 listening events aimed at gathering citizens' views and concerns. Overall, these events reached 4.7 million people over five years.[253] While the number of explaining events has been steadily increasing, even well after the end of pandemic-related restrictions (**Chart 69**), the number of listening events peaked in 2022. However, the ECB in particular shifted towards surveys, most prominently the ECB's Consumer Expectations Survey, which is based on 19,000 interviews across eleven countries (see **Box 5**).

[252] The figures given in the following section are based on a survey conducted among the NCBs of the Eurosystem. The authors of this chapter express their gratitude and appreciation for their helpful contributions.

[253] The figures for 2024 include data up to October.

Chart 69

Listening and explaining events held by ECB and NCBs



Note: To account for the events conducted, the communications department of ECB and NCBs were asked to provide a list of events aiming to enhance the overall public understanding of the Eurosystem and its economic context, e.g., public town halls, open days, webinars, laymen lectures, listening events, exhibitions, roundtable discussions, Twitter Q&As, dedicated surveys or polls. Banks were asked to distinguish between 'listening' and 'explaining' events. Events focussing on expert or professional communities, e.g., academic conferences, panel talks, or industry dialogues, were explicitly excluded. * Figure shows total number of listening and explaining events conducted among Eurosystem during the years 2020 until 2024, as well as the added total audience of those events. Note that the year 2024 (*) includes data until October 2024 only.

In addition, NCBs invited members of the public for presentations, workshops and discussion rounds. In the period from 2022 to 2024 NCBs conducted a total of 18 open days with up to 18,000 guests including remote participants. Some NCBs regularly conducted regional outreach events. For example, the Banco de Portugal conducted open classes in high schools, the Oesterreichische Nationalbank visited primary schools, the Nationale Bank van België/Banque Nationale de Belgique held events to explain its annual reports and the Central Bank of Ireland engaged with local communities.

The ECB and NCBs continued to attract increasing numbers of guests to their visitor centres, museums and other exhibitions. During the pandemic years, the number of visitors declined significantly. However, following the easing of restrictions their numbers recovered beyond the levels seen before the pandemic. NCBs increased their guest numbers by a quarter between 2019 and 2024, from 409,000 to 513,000.

General interest media reach large audiences and allow central banks to engage effectively with the wider public. Television remains by far citizens' primary source of information about the ECB and NCBs, followed at some distance by newspapers and radio.[254] Since 2021 Eurosystem central banks have increased their focus on general-interest media, and particularly on television and radio. For example, ECB and NCB representatives gave 258 interviews and statements in 2024, of which 114 were on radio or television – the highest annual figure to date.

The Eurosystem has adjusted its approach to social media by enhancing direct communication, with the ECB and NCBs establishing nine new channels

[254] See the ECB knowledge and attitudes survey.

and gaining 1.17 million new followers overall since 2021. X and LinkedIn are the most important platforms for the ECB and NCBs, reaching 1.08 and 1.61 million accounts respectively, with LinkedIn attracting 660,000 new followers since 2021. These platforms continue to target largely expert audiences via traditional content. However, as the social media landscape continues to evolve as a result of geopolitical developments, as of early 2025 half of the Eurosystem central banks have stopped or reduced their activity on X. The majority have opened accounts on BlueSky as a substitute or supplement. On YouTube and Instagram – which feature more entertaining formats – the Eurosystem finds relatively little attention, highlighting the importance of further efforts in this area, given the prominence of these platforms. The ECB's new YouTube channel Espresso Economics takes on that challenge. In international comparisons of average following and newly acquired followers across all platforms, the ECB is less prominent than the Federal Reserve but more prominent than other major central banks, such as the Bank of England and the Bank of Japan.

5.5.5 The road ahead – conclusions and takeaways

The Eurosystem has improved its communication and outreach to experts and the wider public through both new and traditional formats – but challenges remain. The ECB and NCBs have about 3.2 million followers on social media, and over the past four years 6.3 million citizens have participated in events or visited Eurosystem museums and visitor centres. These efforts are valuable: ECB research conducted within its visitor centre indicates that direct communication with the public increases monetary literacy and helps to anchor non-experts' medium-term inflation expectations (Jung and Mongelli, forthcoming). However, in relation to the euro area population, direct reach is still small. At best, about three in 100 people have had a direct encounter with the Eurosystem over the past four years.

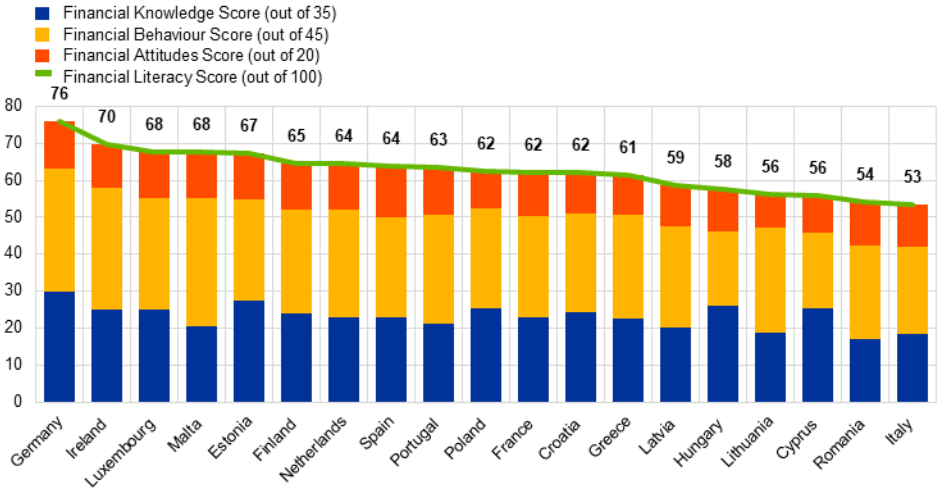
Looking ahead, it will be important for the Eurosystem to continue adapting its communication approach to the evolving communication landscape. Research highlights the value of deepening and broadening the public's understanding of monetary policy. Consumers' (and firms') inflation expectations and the evolution of the economy affect financial behaviour, as visible for instance in data from the ECB's Consumer Expectations Survey (**Box 5**). Monetary policy transmission could be more effective if consumers had a better understanding of the economy and the role of central banks (see **Section 5.5.1**). That makes enhancing communication and fostering a better understanding of the economy – i.e. financial literacy – a key area of interest for the Eurosystem. After all, as Reis (2023) points out, "Households and workers are often those that need more convincing, as opposed to markets". New data – especially from the Consumer Expectations Survey – offer growing evidence on levels of financial literacy across segments of population. The uneven levels of understanding of how the economy and the financial sector work (see **Chart 70**) are increasingly seen by EU policymakers as acalling for attention and action. For instance, the Council Conclusions on Financial Literacy from the informal ECOFIN Council meeting in Ghent on 24 May 2024 stress, not least in the context of driving forward capital markets union, "the importance of further cooperation involving

relevant national authorities to improve the level of financial literacy in the EU through information, knowledge and best-practices sharing, as well as via targeted communication campaigns". Many NCBs are already making crucial contributions in this respect, which could potentially be further enhanced by reaping synergies and benefits from cooperation across the Eurosystem.[255] Recent initiatives by the ECB and NCBs – such as the five commitments to push forward the financial literacy agenda – are promising first steps.

Chart 70

Financial literacy across the EU

(average financial literacy scores (out of 100) and average components of financial literacy scores)



Source: OECD/INFE 2023 International Survey of Adult Financial Literacy.
Notes: The overall financial literacy score is computed as the sum of the scores on financial knowledge, financial behaviour and financial attitudes. The overall financial literacy score was scaled to range between 0 and 100.

[255] Eurosystem NCBs invest major efforts in educating the public on issues of central banking and beyond. For instance, the Deutsche Bundesbank publishes a textbook on "Money and Monetary Policy", Latvijas Banka, the Banca d'Italia and the Oesterreichische Nationalbank have financial literacy websites, Suomen Pankki – Finlands Bank operates a financial literacy centre at its museum, and Lietuvos Bankas created an award-winning educational boardgame on data protection. As the forerunner in the euro area, the Banque de France inaugurated Citéco in 2019 as the first European museum for economic education.

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Annex

Table 6 lists the suite of macroeconomic models for the euro area economy which are used in the optimal policy counterfactuals for the historical performance of ECB monetary policy since the strategy review 2021 (**Section 2.3.3**). The suite of models – which draws on and extends the work of the WGEM-WGF Expert Group on Monetary Policy Transmission – comprises primarily structural dynamic stochastic general equilibrium (DSGE) models but also some semi-structural and identified time-series models. It contains both closed and open economy models, models with a role for energy prices and models which allow for deviations from the rational-expectations assumption typically maintained in structural models. Besides these differences in model structure, there are differences in the estimation/calibration approaches and the set of variables covered. For the structural DSGE models, the expectation formation is adjusted if necessary to avoid the "forward guidance puzzle" based on the approach by De Groot and Mazelis (2020).

Table 6

The suite of models used in the optimal policy counterfactuals

Model/institution	Type of model	Documentation
Suomen Pankki – Finlands Bank	Forward-looking DSGE model	Kortelainen (2024)
Banca d'Italia	Forward-looking DSGE model	Burlon et al. (2015)
Deutsche Bundesbank – EAGLE	Forward-looking DSGE model	Extension of Gomes, Jacquinot and Pisani (2012)
Deutsche Bundesbank – DTANK	Forward-looking DSGE model	Gerke et al. (2022)
Central Bank of Ireland	Forward-looking DSGE model	Jacquinot et al. (2018)
De Nederlandsche Bank – BVAR	Time-series Bayesian VAR with two identified monetary policy shocks	
De Nederlandsche Bank – GEM	TANK model, featuring Ricardian and non-Ricardian households	Ascari et al. (forthcoming)
ECB – BASE	Semi-structural model, using the version with backward looking expectations	Angelini et al. (2019)
ECB – MMR	Forward-looking DSGE model	Mazelis et al. (2023)
ECB – NAWM	Forward-looking DSGE model	Coenen et al. (2018)
Latvijas Banka	Forward-looking DSGE model	Bušs and Grüning (2023)
Nationale Bank van België/Banque Nationale de Belgique	Forward-looking DSGE model with preferences over safe assets	Rannenberg (2024)
Oesterreichische Nationalbank	Forward-looking DSGE model	

Glossary

Term	Meaning	Alternative formulations
Forward guidance	A monetary policy communication strategy used by central banks to influence economic expectations and financial conditions by conveying information about the future path of monetary policy actions such as interest rate decisions or asset purchases.	
Time-based forward guidance	A monetary policy communication strategy in which explicit information provided on the future path of policy actions is based on predetermined dates or timelines rather than contingent on evolving economic conditions.	Date-based, or calendar-based forward guidance
State-based forward guidance	A monetary policy communication strategy in which a central bank conditions its policy actions on specific economic indicators or outcomes, committing to adjust its policies on the basis of incoming economic data and changing macroeconomic circumstances.	Data-dependent or conditional forward guidance
Sequencing commitment (of monetary policy instruments)	A monetary policy strategy in which a central bank takes different policy actions in a predetermined order on the basis of specific conditions or objectives. In the context of this paper, sequencing refers to a commitment to end net asset purchases (such as in a quantitative easing programme) before starting to raise policy rates (lift-off).	Chain-linked forward guidance
Escape clause	Provisions in a central bank's forward guidance that allow deviations from previously communicated policy commitments under certain conditions such as significant changes in economic circumstances. Escape clauses provide flexibility at the possible cost of reduced clarity and (perceived) commitment.	Knock-out clauses
July 2021 state-based rate guidance	Strategic monetary policy communication introduced by the ECB in July 2021 to operationalise the principle of "especially forceful or persistent" actions near the effective lower bound by setting out three jointly required conditions – two outlook-based and one outcome-based – for considering an increase in policy interest rates.	

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