The Eurosystem's monetary policy strategy

The Eurosystem's monetary policy strategy is the overarching conceptual framework within which the ECB and national central banks take concrete monetary policy decisions. The main elements of the strategy are the operationalisation of price stability, the policy approach to safeguarding price stability, and the framework for assessing and processing the relevant information for monetary policy decisions and communication to the public.

The ECB Governing Council last reviewed its strategy in 2003. Since then, however, many new developments and challenges have materialised. The most important of these is the further decline in the equilibrium real interest rate. In combination with an effective lower bound on short-term nominal interest rates, this development leads to a substantial reduction of the monetary policy space.

The Governing Council published its new monetary policy strategy in July 2021. A key new element is the symmetric inflation target of 2% over the medium term. The slightly higher level ensures the right balance between the benefits of a safety margin against deflation and the costs of higher inflation rates. Symmetry means that the Governing Council considers negative and positive deviations of inflation from its target to be equally undesirable. To ensure this symmetry, the Governing Council recognises the importance of taking into account the implications of the effective lower bound. When interest rates are close to this effective lower bound, especially forceful or persistent monetary policy actions are necessary to avoid negative deviations from the inflation target becoming entrenched. This may also imply a transitory period in which the inflation rate is moderately above target.

The Harmonised Index of Consumer Prices (HICP) remains the preferred measure of inflation against which to judge the achievement of the policy objective. However, the Eurosystem aims to improve the quality of the HICP by including the cost of owner-occupied housing. The Eurosystem will also maintain its medium-term orientation. Furthermore, a comprehensive assessment of all relevant factors will continue to underpin monetary policy decisions taken by the ECB Governing Council, including the review of the proportionality and potential side effects of its decisions. This assessment builds on two interdependent analyses: the economic analysis and the monetary and financial analysis. In the future, the Eurosystem intends to fully take into account the interdependence between these two analytical perspectives, in addition to explicitly accounting for how financial stability aspects affect price stability and having due regard for the importance of observing the transmission mechanism for the calibration of monetary policy instruments.

Nominal key interest rates will remain the primary monetary policy instrument. However, the Eurosystem will keep using a combination of unconventional measures as a way of retaining its policy space close to the effective lower bound.

Within the scope of its mandate, the Eurosystem will fully take into account the implications of climate change and the transition to a low-carbon economy. While responsibility for climate protection lies primarily with national governments, climate change will also affect macroeconomic price developments. The Eurosystem will therefore significantly expand its analytical and modelling capacities in this area. It will furthermore adapt the design of its monetary policy operational framework in relation to disclosures, risk assessment, corporate sector asset purchases and the collateral framework.

Introduction

The Eurosystem's primary objective is price stability

Safeguarding price stability is the primary objective of the Eurosystem.[1] This mandate is enshrined in the Treaty on the Functioning of the European Union (TFEU). While the TFEU sets out the Eurosystem's mandate, it is up to the Eurosystem itself to decide how it goes about operationalising and achieving this objective. For this purpose, the Governing Council of the European Central Bank (ECB), in its capacity as the Eurosystem's supreme decision-making body, develops a monetary policy strategy. This strategy defines how the primary objective of price stability in the euro area is to be achieved and which monetary policy instruments and indicators are suitable for this purpose. The strategy thus stakes out a systematic framework within which the ECB Governing Council takes monetary policy decisions geared towards price stability and explains these decisions to the public.

Monetary policy strategy defines how to achieve the objective

Eurosystem reviewed its strategy and adopted a new one

The Eurosystem's monetary policy strategy was first drawn up in 1998 and last reviewed in 2003. Since then, the euro area economies have experienced numerous developments. Combined with the persistent challenges to the implementation of monetary policy, these warranted an update of the strategy. The review process lasted one-and-a-half years and culminated in the ECB Governing Council publishing its new monetary policy strategy on 8 July 2021.

This article offers an explanation of the Eurosystem's new monetary policy strategy beginning with the previous monetary policy strategy and the key changes that have taken place in the macroeconomic environment. Given that many topics were addressed during the strategy review, it is impossible for this article to cover the review in its entirety.[2] The article will instead focus on three selected aspects that form the essence of the monetary policy strategy: the operationalisation of price stability, the policy approach to safeguarding price stability, and the framework for assessing and processing the relevant information for monetary policy decisions and communication to the public.

Main elements of the Eurosystem's previous monetary policy strategy

Previous strategy rested on three main elements

The previous monetary policy strategy, which was adopted by the Eurosystem in 2003, essentially rested on three main elements:

1. Operationalisation of price stability by means of a quantitative definition and an explicit policy objective

– First, the strategy was based on a double-key formulation of the price stability objective. The first component was a quantitative definition of price stability. According to this definition, prices were considered stable if the year-on-year increase in the Harmonised Index of Consumer Prices (HICP)[3] was below 2% over the medium term. The second component was the policy objective, which was to maintain HICP inflation "below, but close to, 2%" over the medium term within the definition of price stability. On the one hand, this was intended to provide a sufficient safety margin against deflation, i.e. an environment of persistently falling prices that can result in severe economic damage.[4] On the

1 The Eurosystem is made up of the European Central Bank and the central banks of EU Member States whose currency is the euro.
2 See the box on pp. 19 f.
3 The HICP is a price index harmonised across the Member States of the euro area that measures changes over time in household spending on a representative basket of goods.
4 Deflation is primarily an issue in cases where it sets in motion a self-perpetuating downward wage-price spiral. People expecting prices to decline further in the future might decide to hold back on spending, which could force enterprises to throttle their output, depressing wages and eliminating jobs. In an extreme scenario, this can send the economy as a whole into a downward spiral, with price and wage cuts, shrinking output and rising unemployment all reinforcing one another. A deflationary situation can furthermore significantly increase enterprises' and households' real debt burden to the point of looming overindebtedness because, whereas deflation drives down the prices of the goods offered by enterprises and tends to depress wages, nominal loan repayments remain unchanged. Hence, the real burden of existing repayment obligations increases in an environment of generally falling prices. This can increase the incidence of payment defaults and also the volume of non-performing loans carried on commercial banks' balance sheets (a phenomenon known as debt deflation), which can ultimately jeopardise financial stability and cause further damage to the economy.

Organisation of the Eurosystem's strategy review

At its meeting on 23 January 2020, the ECB's Governing Council decided to launch a review of the Eurosystem's monetary policy strategy, which it completed on 8 July 2021. At irregular intervals during this period, the Governing Council discussed a broad range of topics relating to its monetary policy strategy. These discussions formed the basis for the Governing Council's decisions on the new monetary policy strategy.[1]

The discussions incorporated feedback from numerous events with stakeholders from various sections of society, organised in a variety of formats:

– Listening events: At numerous events hosted by the ECB and national central banks (NCBs), a wide range of civil society organisations described how they are affected by, and what they expect of, monetary policy.[2]

– Online portals: Here members of the general public were invited to express their expectations and concerns by participating in surveys on price stability, economic developments and central bank communication.[3]

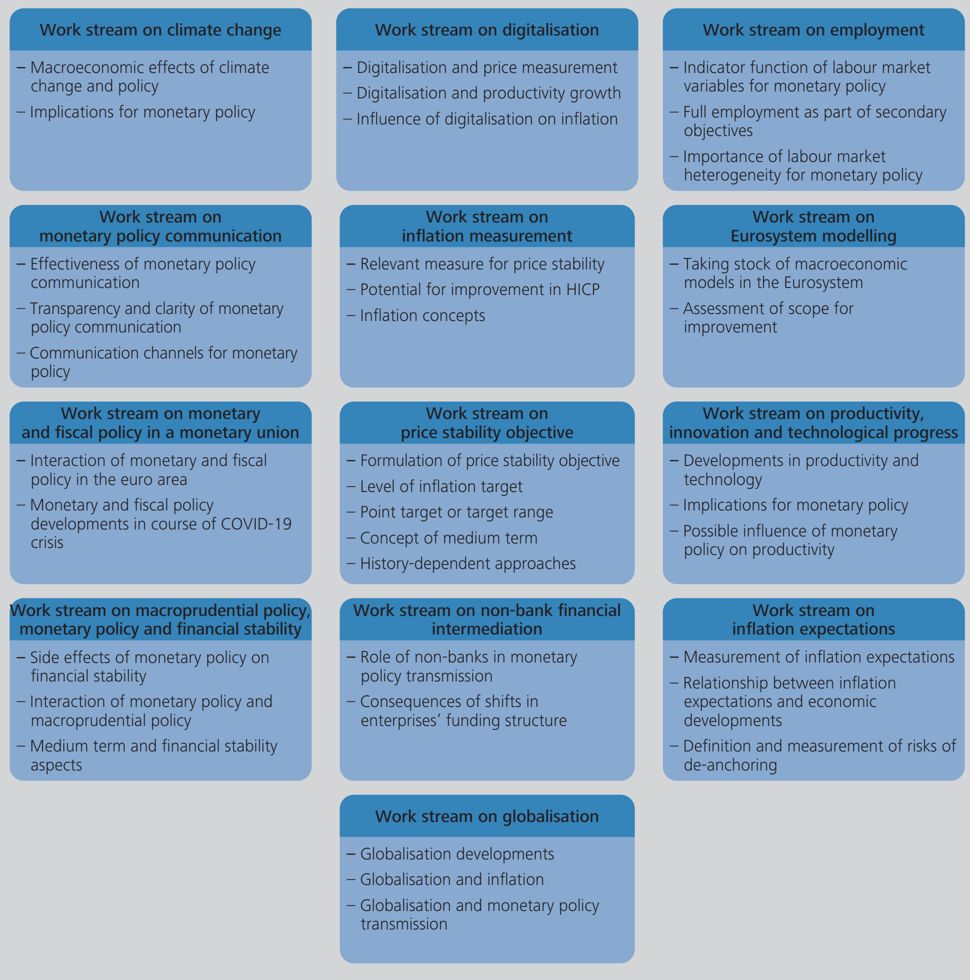
– Specialist conferences: Representatives of academic institutions, research facilities and the financial sector held presentations and discussed these with a broad specialist audience.[4]

– Dialogue with the European Parliament: In hearings of the Committee on Economic and Monetary Affairs, regular discussions were held about the topics and the status of the strategy review.

In addition, information collected by separate work streams set up to look at key topics fed into the Governing Council's deliberations. These work streams, comprising employees from the ECB and the Eurosystem's NCBs, prepared analyses tailored to the strategy review and worked through the relevant literature, paying attention to interdependencies and connecting factors between the individual topics. Based on their findings, the work streams drew up reports and background documents, which were incorporated into the

1 The decisions were communicated in the form of a monetary policy strategy statement (European Central Bank (2021a)), a slightly more detailed overview of the monetary policy strategy (European Central Bank (2021b)), a press release on the ECB's action plan to include climate change considerations in its monetary policy strategy (https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html, accessed on 13 August 2021, 10:35) and a press release on the new monetary policy strategy (https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708~dc78cc4b0d.en.html, accessed on 13 August 2021, 10:40).
2 Participants included trade unions, employee associations, environmental protection organisations, industry groups, interest groups representing various sectors and taxpayer associations. For an overview of all listening events held across the euro area during the strategy review as well as links to video recordings and summaries, see https://www.ecb.europa.eu/home/search/review/html/all_events.en.html, accessed on 24 September 2021, 10:35.
3 A summary of responses from the ECB Listens Portal may be found at https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview002.en.html, accessed on 24 September 2021, 10:40.
4 For example, the conferences "The ECB and its Watchers XXI" on 30 September 2020 (https://www.imfs-frankfurt.de/en/events/imfs-conferences/the-ecb-and-its-watchers/2020.html, accessed on 11 August 2021, 16:15) and "ECB Forum on Central Banking" on 11-12 November 2020 (https://www.ecb.europa.eu/pub/pdf/sintra/ecb.ecbforumoncentralbanking202011~5078c37a89.en.pdf, accessed on 11 August 2021, 16:15) formed part of the Eurosystem's strategy review.

Work streams in the Eurosystem's strategy review



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Governing Council's discussions. The above chart gives an overview of the work streams and the key topics they covered. The reports prepared by the work streams have been published as ECB Occasional Papers.[5]

5 See Altavilla et al. (2021), Work stream on the price stability objective (2021), Work stream on employment (2021), Work stream on monetary policy communications (2021), Work stream on monetary-fiscal policy interactions (2021), Work stream on macroprudential policy, monetary policy and financial stability (2021), Work stream on climate change (2021), Work stream on non-bank financial intermediation (2021), Work stream on productivity, innovation and technological progress (2021), Work stream on Eurosystem modelling (2021), Work stream on digitalisation (2021), Work stream on inflation measurement (2021), Work stream on inflation expectations (2021) and Work stream on globalisation (2021).

other hand, the policy objective also addressed possible measurement bias in the HICP[5] and the implications of inflation differentials within the euro area.

2. Medium-term orientation of the policy objective

– The second main element of the previous monetary policy strategy was the medium-term orientation. It gave the ECB Governing Council a flexible time horizon within which to bring consumer price inflation consistently in line with the price stability objective. Consideration was thus given to the fact that monetary policy measures have variable transmission lags and that monetary policymakers calibrate their measures to suit the nature of the shocks hitting the euro area.[6] Since different types of shocks affect price developments and the real economy in different ways, eliminating all the ups and downs in the short term is not warranted, as that could produce unnecessary cyclical volatility and thus put price stability at risk.

3. Two-pillar strategy: economic and monetary analysis

– Third, the risks to price stability were assessed using a two-pillar approach relying on an economic analysis and a monetary analysis. Insights gained from these two pillars were cross-checked by the ECB Governing Council to form a unified overall judgement. The economic analysis examined the short to medium-term factors in the real economy that had a bearing on price developments, and looked primarily at developments in the real economy and cost factors that might be driving prices. Meanwhile, the monetary analysis took a medium to long-term perspective. During the early years of the monetary union, it focused on the longer-term relationship between money and prices. More recently, particularly in the aftermath of the financial crisis and the introduction of unconventional monetary policy measures, the monetary analysis has shifted in focus towards monetary policy transmission through the financial sector.[7]

Why review the monetary policy strategy?

Strategy was revisited because macroeconomic environment has changed, …

The macroeconomic environment has changed substantially since the last strategy review in 2003. In addition, the financial crisis has demonstrated the importance of financial stability as a precondition for price stability.[8] It was a major catalyst for the introduction of the banking union and macroprudential policy, heralding lasting changes to the institutional set-up of the Eurosystem. Globalisation and digitalisation as well as the ongoing process of climate change are additional key drivers of economic trends and developments that also spill over into price developments.

… the equilibrium real interest rate, which has a major bearing on policy space, declined, …

However, the main new challenge that has emerged for monetary policymakers is that structural changes[9] contributed to a noticeable decline in the equilibrium real interest rate.[10] This real rate decline also plays a decisive role in

5 Measurement bias can occur, for instance, if quality improvements are not suitably factored into goods price developments. Furthermore, the empirical finding of downward nominal wage rigidities was seen as another reason to strive for a positive rate of inflation.
6 Furthermore, the monetary policy transmission process is fraught with uncertainty. This process describes how monetary policy impulses are transmitted to the real economy and comprises a number of different mechanisms and responses on the part of economic agents at various stages of the transmission process.
7 The Eurosystem's previous monetary policy strategy is presented in detail in European Central Bank (2011), Chapter 3, and Rostagno et al. (2021).
8 One threat during the financial and sovereign debt crisis was that negative feedback loops between the financial system and real economy caused by looming shortages in the supply of credit and the like might set a downward spiral in motion and jeopardise price stability.
9 These developments include the decline in productivity growth, demographic factors and persistently higher demand for safe and liquid assets in the wake of the global financial crisis.
10 This is the short-term real interest rate that, in the long run, is consistent with aggregate production at potential and stable inflation. The precise level of the equilibrium real interest rate is unobservable, and estimating it is fraught with considerable uncertainty. Studies nonetheless agree that the equilibrium real interest rate is trending downwards, not only in the euro area but worldwide. See, for example, Brand et al. (2018), Holston et al. (2017) and Deutsche Bundesbank (2017b).

the trend decline in nominal interest rates.[11] A low interest rate environment is particularly problematic because it increases the likelihood that policy rates will hit the lower bound in the event of negative shocks.[12] This prevents monetary policy from further rate cuts in order to generate additional upside pressure on the inflation rate.[13]

… and asymmetry under previous strategy made it harder to achieve policy objective

The low inflation rates observed in recent years were the backdrop for mounting criticism of certain components of the previous strategy. For example, the previous operationalisation of price stability contained an asymmetry that might have contributed to a persistent negative deviation of inflation expectations from the inflation target. Permanently lower inflation expectations – in addition to depressed real interest rates – contribute to declines in nominal interest rates and thus further limit the policy space.

This asymmetry arose from setting the policy objective (below, but close to, 2%, medium term) at the upper limit of the range that defines price stability (below 2%, medium term). As a result, upside deviations of the inflation rate from the policy objective were compatible neither with the definition of price stability nor with the policy objective itself. By contrast, downside deviations of the inflation rate were generally consistent with the price stability definition, though not necessarily with the policy objective. This meant that, as long as deviations to the downside did not lead to deflation, they were deemed less problematic than those to the upside. Even if they were not compatible with the policy objective, they were still consistent with the definition of price stability. This asymmetric operationalisation of price stability thus left some room for interpretation in the event of downside deviations: at what level did the inflation rate still satisfy the policy objective criterion of being “close to 2%”?

This design possibly also implied an asymmetric monetary policy response, whereby policymakers responded more vigorously to positive than to negative inflation rate deviations from the policy objective. Viewed in isolation, this could have been read as implying that negative deviations from the intended inflation rate can be larger and longer-lasting than positive ones, potentially culminating in persistent episodes of low inflation rates. Combined with the effective lower bound, the previous operationalisation of price stability – particularly in an environment of adverse shocks to demand – thus had the potential to depress longer-term inflation expectations. If true, this would have complicated the Eurosystem’s efforts to achieve the policy objective on a lasting basis.[14]

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11 Arbitrage considerations can be used to derive what is known as the Fisher equation, which states that the level of nominal interest rates can be computed by adding together the equilibrium real interest rate and the expected rate of inflation. Assuming monetary policy is credible, the inflation expectation in the long-run equilibrium will equal the central bank’s inflation target. Hence, a falling equilibrium real interest rate lowers the level of nominal interest rates for a given inflation target.

12 Since currency holdings are unremunerated, the nominal short-term interest rate cannot fall infinitely below zero. From a certain point, which depends inter alia on cash transaction and storage costs, non-banks will withdraw their deposits and hold them as cash. In this scenario, further monetary policy rate cuts will largely be powerless to affect inflation and, because of the deposit withdrawals they induce, can in fact jeopardise financial stability. Furthermore, banks might feel compelled by the deeply negative interest rates to curb their supply of credit, which would be counterproductive in monetary policy terms. The interest rate level at which the initially accommodative effect of negative rates turns contractionary is called the reversal rate (Brunnermeier and Koby (2018)). However, this de facto, or effective, lower bound for interest rates is unobservable, changes over time and can only be roughly approximated. This article also uses the term “effective lower bound” in the following.

13 This is why the Eurosystem has deployed unconventional instruments such as forward guidance (since 2013) and extensive asset purchases (particularly since 2015). Forward guidance is generally understood to mean communicating the expected deployment and path of monetary policy instruments.

14 The real interest rate is crucially important for stabilising demand. When economic agents expect declining inflation or even deflation, the real interest rate rises, when taken in isolation (via the Fisher equation), slowing down investment and growth. The central bank can temporarily lower the real interest rate by reducing the nominal interest rate. If, however, it is unable to cut interest rates any further at the effective lower bound, the real interest rate will ultimately be determined, approximately, by inflation expectations. In principle, this can produce a deflationary spiral, because the expectation of deflation pushes up the real interest rate, which in turn reduces demand and hence the inflation rate, potentially causing deflation to become entrenched.

Latest review aimed to align monetary policy strategy with new challenges

The idea behind the strategy review was to align the existing strategy with these new challenges. The box on pp. 19 f. outlines all the topics covered by the review, its components and how it was organised. This article now turns its attention to the operationalisation of price stability, the policy approach to safeguarding price stability, and the framework for assessing and processing the relevant information for monetary policy decisions and communication to the public.

The new Eurosystem monetary policy strategy

Overview of key decisions

New monetary policy strategy …

This section begins by presenting the key decisions on the new monetary policy strategy – the background to, and intentions of, the decisions will be discussed in the subsequent sections.

… retains HICP as measure of price stability, but augments it with costs of owner-occupied housing, …

– The Governing Council of the ECB confirmed the Harmonised Index of Consumer Prices (HICP) as the appropriate measure for assessing the achievement of the price stability objective in the euro area. In its future monetary policy assessments, the Governing Council wishes to also use measures of inflation which include the costs of owner-occupied housing. While only initial estimates of these costs are available in the short term, the aim is for full inclusion of the costs of owner-occupied housing in the HICP in the long term (see the "Harmonised Index of Consumer Prices" section).

… sets annual HICP inflation rate of 2% over the medium term as symmetric point target, …

– The Governing Council considers that price stability is best maintained by aiming for a 2% annual HICP inflation rate over the medium term. The Governing Council's commitment to this target is symmetric. Symmetry in this context means that negative and positive deviations of inflation from the target are considered to be equally undesirable. To maintain the symmetry of its inflation target, the Governing Council recognises the importance of taking into account the implications of the effective lower bound. When nominal interest rates in the euro area are close to the effective lower bound, especially forceful or persistent monetary policy action should be taken to avoid negative deviations from the inflation target becoming entrenched.[15] This may imply a transitory period in which inflation is moderately above target[16] (see the sections below entitled "Point target for the inflation rate of 2%", "Symmetry of the inflation target" and "Medium-term orientation retained").

… retains policy rates as primary monetary policy instrument, but will consider use of unconventional measures in pursuit of policy objective and …

– The primary monetary policy instrument of the Eurosystem is the set of ECB policy rates. In recognition of the effective lower bound on policy rates, the Governing Council will employ asset purchases, longer-term refinancing operations and forward guidance, as appropriate. As before, the combined and calibrated use of various instruments is intended to ensure that the Eurosystem remains able to react even when close to the effective lower bound on interest rates (see the sections entitled "Unconventional measures at the effective lower bound" and "Asymmetric monetary policy response to deviations from the inflation target").

… is based on an economic analysis and an expanded monetary and financial analysis

– The basis for the Governing Council's monetary policy decisions, including the evaluation of proportionality and possible side effects, is an integrated assessment of all factors relevant to price stability. This assessment builds on two interdependent analyses: the economic analysis and the monetary and financial analysis. The economic analysis will continue to focus on real and nominal economic developments. The original "monetary pillar" will, however, become an expanded monetary and financial analysis. Its main focus will now be the analysis of monetary policy transmission via the financial sector and the possible risks to medium-

15 See European Central Bank (2021a), p. 10.
16 See European Central Bank (2021a), p. 10.

The relationship between the equilibrium real interest rate, the level of the inflation target and monetary policy space

The euro area and other leading industrial countries have seen a decline in the general interest rate level over the past decades. There is a broad consensus that this has not been caused primarily by monetary policy but that it is more a reflection of long-term structural trends. Indeed, an ageing population, shifts in the distribution of income and wealth, and slower growth in productivity (and thus in potential output) have, since the 1980s, been reflected in a downward movement in the equilibrium real interest rate, not only in the euro area but worldwide.[1]

These developments pose considerable challenges for monetary policy because the level of the equilibrium real interest rate, in combination with the level of the inflation target, is what determines average nominal interest rates. If the equilibrium real interest rate declines, so, too, does the safety margin between policy rates and the effective lower bound for a given target inflation rate. Put another way, there is a reduction in the monetary policy space available for expansionary action through lowering the short-term nominal interest rate. As a result, the incidence and duration of episodes at the effective lower bound tend to increase,[2] leaving monetary policy less able to safeguard price stability via the policy rate alone.

Compared with the situation in 2003, when the Eurosystem last reviewed its monetary policy strategy, there has been a big change in the assessment of the level of the equilibrium real interest rate. This is why the latest monetary policy strategy review paid particular attention to how the level of the equilibrium real interest rate influences monetary policy space. Consideration was also given to the potential scope for increasing monetary policy space by raising the inflation target. Setting a higher inflation target would push up the average nominal interest rate level provided that inflation expectations adjust to the inflation target.[3] Viewed in isolation, this would widen the safety margin to the effective lower bound and thus also reduce the likelihood of hitting that effective lower bound.

Below, we provide a quantitative illustration of the relationship between the equilibrium real interest rate, the level of the inflation

1 The equilibrium real interest rate is the real interest rate level that is compatible with a closed output gap (when aggregate output is equal to its potential) and with price stability. Being unobservable directly, the level of the equilibrium real interest rate can only be estimated using appropriate macroeconomic techniques. That is why any statements on the equilibrium real interest rate are fraught with considerable estimation and model uncertainty. Nonetheless, most empirical research papers conclude that the equilibrium real interest rate has fallen over the past decades. See Deutsche Bundesbank (2017a), Brandt et al. (2018) and Mian et al. (2021).
2 Schematically, this relationship can be described as follows: viewed in isolation, the decline in the equilibrium real interest rate leads to a fall in nominal interest rates via the Fisher equation (see footnote 11 in the main article), thus narrowing the margin between nominal interest rates and the effective lower bound. A smaller margin to the effective lower bound implies in turn that deflationary shocks will be associated with more frequent and longer-lasting episodes at the effective lower bound. If these shocks are large enough to trigger a decline in nominal interest rates, the narrower margin means that the effective lower bound will be reached sooner.
3 This follows from the Fisher equation. The analysis here disregards possible changes in the behaviour of economic agents in an environment of higher inflation rates. For example, interest rate cuts have a less expansionary effect in an environment of higher inflation rates. In addition, the risk of inflation expectations becoming unanchored increases. See Deutsche Bundesbank (2018) for further details.

target, and monetary policy space[4] using a dynamic stochastic general equilibrium (DSGE) model estimated with euro area data. The present model[5] is simulated for different assumptions of the level of the equilibrium annual (net) real interest rate r^* and for different assumptions of the level of the annual (net) inflation target Π^*, assuming an annual (net) nominal effective lower bound of $R_{ELB} = -0.5\%$ throughout. Above the effective lower bound, the central bank sets its policy rate based on an interest rate rule that uses the lagged interest rate level, deviations in inflation from its target, and output growth as inputs. Hence, the interest rate is set as follows:

$R_t = \max \{R_t^S, R_{ELB}\}$, where R_t^S is given by:

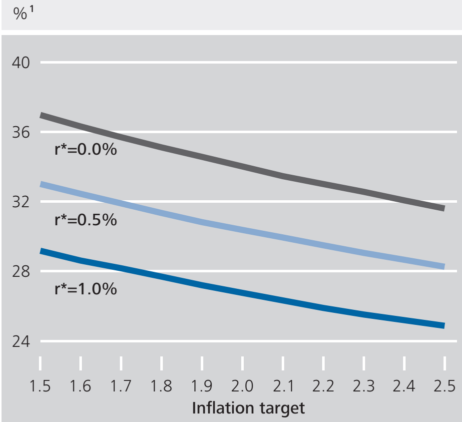
$$R_t^S = 0.85R_{t-1}^S + 0.15(r^* + \Pi^* + (Y_t - Y_{t-1}) + 1.5(\Pi_t - \Pi^*)).$$

Here, R_t^S stands for the annual (net) shadow interest rate that would be set in the absence of the effective lower bound, R_t for the annual (net) policy rate that is actually set, Π_t for the annual (net) inflation rate, and $(Y_t - Y_{t-1})$ for the (net) output growth rate, with Y_t standing for output (in logs).

2,500 model simulations are carried out to identify the frequency with which the central bank hits the effective lower bound with its policy rate. The model is subject to unexpected economic developments (shocks) in each period and simulated for 200 periods in each case.[6]

The above chart shows the incidence of the binding effective lower bound (y-axis) for different inflation targets (x-axis) and real interest rates (differently coloured lines). In essence, three conclusions can be drawn from the simulations.

Effective lower bound incidence



1 Incidence of periods in which the effective lower bound is binding for different levels of r* and inflation targets.
Deutsche Bundesbank

– First, a lower equilibrium real interest rate r^* for a given inflation target increases the frequency with which the policy rate hits the effective lower bound. This is shown by the upward shift in the lines plotted in the chart above when a lower real interest rate is assumed. Given an assumed inflation target of 2%, say, a decline in the equilibrium real interest rate from 1% to 0.5% increases the inci-

4 The following analysis disregards the possibility of the central bank being able to implement alternative monetary policy measures at the effective lower bound, such as forward guidance or asset purchase programmes. The aim here is merely to provide a quantitative description of the expected monetary policy space with respect to the traditional policy rate instrument depending on the level of the equilibrium real interest rate and the inflation target.
5 See Gerke et al. (2020) for a detailed description of the underlying model and how it is calibrated. In essence, the model resembles the generally known and widely used model of Smets and Wouters (2007), but differs in that it also features a financial market modelled as in Carlstrom et al. (2017). The model furthermore includes a heterogeneous household sector, one section of which is unable to smooth its consumption over time because of the assumption that it is unable to borrow or save (see also Galí et al. (2007) and Bilbiie (2008)).
6 The simulations are described in detail in Gerke et al. (2021). The model is simulated using a version of the algorithm developed by Fair and Taylor (1983), which allows non-linearities such as those created by the effective lower bound to be taken into account. Technical implementation is based on the Dynare software platform; see Adjemian et al. (2011).

dence of episodes at the effective lower bound by around 4 percentage points, from roughly 26.5% to around 30.5%. A further decline in the equilibrium real interest rate to 0% raises that incidence to approximately 34%.

- Second, a higher inflation target reduces the incidence of policy interest rates hitting the effective lower bound. For example, if the inflation target is raised from 1.5% to 2%, given an equilibrium real interest rate of 0.5%, this reduces the incidence from around 33% to roughly 30%.

- Third, scenarios in which both the equilibrium real interest rate and the inflation target are low are particularly daunting. Thus, a real interest rate of 0% combined with an inflation target of 1.5% puts effective lower bound episodes at an incidence of roughly 37%.

In summary, we can conclude the following. For a decline in the equilibrium real interest rate, the simulation results show a notable increase in the incidence of effective lower bound episodes. As the level of the equilibrium real interest rate in the euro area has fallen since the 2003 strategy review (even though the precise level is subject to great uncertainty), there is a greater risk, when viewed in isolation, that policy rates will hit their effective lower bound more frequently in the future. This is one reason why the Eurosystem, in the latest review of its monetary policy strategy, agreed, amongst other things, to set an inflation target of 2%, which is slightly above the target inflation rate selected in 2003.

term price stability that may arise from financial imbalances and monetary factors. The pervasive role of macro-financial linkages in economic, monetary and financial developments requires that the interdependencies across the two analyses are fully incorporated (see the section entitled "Preparation of information for monetary policy decisions: economic and monetary perspectives on price development").

Operationalising price stability

Harmonised Index of Consumer Prices

HICP confirmed as measure of price stability

Price stability has been measured on the basis of the HICP for the euro area ever since the original monetary policy strategy was formulated in 1998.[17] The choice of the HICP for measuring price stability was reaffirmed during the recent strategy review.[18] The HICP measures price developments in a timely and reliable way and is comparable across countries.[19] It is designed as a cost of goods index which captures the purchasing power of consumers based on the price of a representative basket of goods. HICP weights are updated annually to ensure that the index is underpinned by the most up-to-date consumption structures at all times. The basket of goods contains only goods and services that can be obtained on markets through actual monetary transactions.[20] The HICP is published monthly and is, in principle, not

17 The EU treaties specify price stability as the objective of the European System of Central Banks (Official Journal of the European Union, 2012/C 326/01, in particular Article 127). It was operationalised by the Governing Council of the ECB in 1998 and refined in 2003; see European Central Bank (1999 and 2003).
18 For more background information on the following remarks, see also Work stream on inflation measurement (2021).
19 See also Camba-Mendez (2003).
20 Estimated (imputed) prices are included only in exceptional cases, e.g. when extrapolating prices for food that is only seasonally available, or when extrapolating prices for products that could not be offered during the coronavirus pandemic. See, for example, Eurostat (2018), particularly pp. 23 ff.

revised.[21] The euro area index is obtained by aggregating country data derived from the national consumer price indices (CPIs), incorporating certain harmonisations.[22] These properties of the HICP ensure that households view it as representative of their purchasing power.[23] This creates the basis for an understandable monetary policy. Other indicators, such as measures of underlying inflation[24] or the GDP deflator, do not meet these requirements to the same degree.[25] However, they can help identify the medium-term trend in the HICP rate and therefore continue to play an important role in the economic analysis.

HICP quality to be further enhanced, especially by incorporating costs of owner-occupied housing …

To strengthen the HICP and thus the credibility of monetary policy, it is important for Eurostat and the national statistical offices to maintain and steadily enhance the quality of the HICP even in a changing environment (e.g. increasing online sales, dynamic and personalised pricing). To this end, a focus of the strategy review was the inclusion of owner-occupied housing (OOH). It has so far been absent from the HICP but is material to enhancing the representativeness of the HICP and its cross-country comparability. Living in one's own home is an important element of household consumption, but the costs of this have not been included in the HICP thus far. The main reasons for OOH being excluded up to now were unresolved issues surrounding the specific measurement concept and a lack of data sources, even though OOH is integrated into the national consumer price indices of certain countries – albeit using different methods.[26] After the first strategy review in 2003, during which the wish to include OOH had been reaffirmed, work began on the development of harmonised OOH price indices (OOHPIs). These price indices have been published by Eurostat on a quarterly basis for all euro area countries (except Greece) for some years now.[27] They start in 2010 and follow the net acquisition approach, meaning that they capture monetary expenditures for OOH and are thus consistent with the HICP methodology.

… using the net acquisition approach …

As an outcome of the most recent strategy review, the Eurosystem has voiced its express wish to Eurostat that the existing OOHPIs be linked to the HICPs for the euro area and all Member States, initially on a quarterly basis. OOH-augmented quarterly HICPs could be provided by statistical offices as experimental statistics from 2023 and as official statistics from 2026. Providing them as official statistics will require a time-consuming change to the European legal framework. In parallel, work is to be undertaken on the data sources, on the one hand, in order to achieve full integration into the monthly HICP without sacrificing timeliness. On the other hand, unresolved methodological issues are to be investigated further with the support of the Eurosystem. These issues primarily relate to the fact that OOH – as well as being used as a consumer good – also has the quality of an asset.[28]

21 One exception to this rule was, in particular, the revision of the "package holidays" component of the HICP for Germany in 2019, which also affected the inflation rate for the euro area. See Deutsche Bundesbank (2019a).
22 These harmonisations relate, for example, to the standard inclusion of certain goods and services (without harmonising the national baskets of goods, however), the treatment of discounts and the price collection period. See Eurostat (2018), particularly pp. 16 ff. Harmonisation makes the data for the individual countries comparable. This is why the HICP also serves as a convergence criterion.
23 See also Issing (2003a), particularly p. 12.
24 These include, for example, core rates, trimmed means or estimated trends; see Work stream on inflation measurement (2021), in particular Section 6.
25 The last strategy review already came to this conclusion as well; see, for example, Camba-Mendez (2003). Core rates, for instance, exclude certain HICP components and thus do not represent total purchasing power. Conversely, the GDP deflator contains the prices of export goods, for instance, which have virtually no bearing on the purchasing power of domestic consumers.
26 For example, OOH is included in Germany's national CPI using the rental equivalence approach, but is not included at all in the national CPIs of Belgium, France, Italy and Spain. The Bundesbank has always advocated efforts to harmonise the measurement of OOH and to integrate it into the HICP; this wish was also expressed by the public at numerous listening events held during the latest strategy review.
27 The European Commission's (2018) key reasons for rejecting the integration of OOH into the HICP were that OOHPIs are not produced frequently enough, are published too late and partially include the price of land.
28 In addition, weights must be calculated to integrate the OOHPIs into the HICP. OOH is likely to account for around 10% of the euro area HICP.

Preliminary analyses by the Eurosystem[29] show that the inflation rates of internally computed analytical HICPs including OOH would, in principle, fluctuate somewhat more strongly than those without OOH. They could experience phases in which they are around one-quarter of a percentage point higher or lower than the official HICP rate. The mean of both series would be more or less identical, though.[30]

… and further increasing transparency

Aside from including OOH, it is important to further enhance the quality of the HICP and continually adapt it to new conditions. This is particularly the case when it comes to harmonising the integration of new products, the application of quality adjustment procedures and the selection of samples when collecting prices. At the same time, the inclusion of new data sources and methods in particular places high transparency requirements on the communication of HICP figures.[31] This is particularly true in times of shocks, which can lead to significant fluctuations in the HICP, as experience of the recent pandemic has shown, for example.[32]

Uncertainty about HICP measurement bias in euro area remains high

Even though the HICP is of a high quality and is constantly being refined, price measurement using the HICP – just the same as with other statistical variables – is subject to a certain degree of uncertainty and is likely to somewhat overestimate inflation on average.[33] This was an important reason for defining price stability as a positive annual HICP rate and establishing an inflation buffer in 2003.[34] There are no more recent findings on the size of the bias arising from all sources of measurement bias (including aggregation procedures and weighting, incomplete quality adjustment, delayed inclusion of new products and changed distribution channels, sampling errors),[35] meaning that the measurement bias problem, in and of itself, does not necessitate any adjustment to the price stability objective.[36] With a view to future strategy reviews, in particular, it would be important to close this gap in our knowledge. To this end, the microdata underlying the price statistics should be made more widely available to researchers and transparency about detailed methodologies should be established.

Similar picture of inflation differentials as in 2003

The inflation differentials between the euro area countries – another important reason for the establishment of an inflation buffer following the 2003 strategy review – have barely changed over the past two decades; taken in isolation, they likewise do not imply any need for an adjustment to the price stability objective.

Point target for the inflation rate of 2%

ECB Governing Council considers price stability maintained with HICP inflation rate of 2% over medium term

The level of the target inflation rate is the result of weighing the pros of low inflation against the cons of setting too low a target for inflation. The Governing Council of the ECB considers that price stability is best maintained by aiming for a 2% HICP inflation rate over the medium term. The formulation of the price stability objective as a specific quantitative target replaces the previous double-key formulation of the objective.

No explicit definition of price stability

In a departure from the previous monetary policy strategy, the Governing Council's new strategy does not contain an explicit formal definition of price stability. Instead, it sets a target

29 See, for example, Work stream on inflation measurement (2021) or European Central Bank (2016). Preliminary analyses by the Bundesbank also show similar results. The analytical series were backcast to 1999 in some cases.
30 A similar picture emerges for Germany, according to the Bundesbank's preliminary analyses.
31 See, for example, Eiglsperger (2019a).
32 In Germany, for example, there is a great need for transparency, particularly in relation to the package holidays HICP sub-index in combination with the HICP's chain-linking principle. See Deutsche Bundesbank (2017b, 2019a, 2019b and 2021a) and Eiglsperger (2019b).
33 See, for example, European Central Bank (2014).
34 See, for example, European Central Bank (1999 and 2003) and Camba-Mendez (2003).
35 There are, however, findings on the size of the bias from individual sources of measurement bias. For example, Herzberg et al. (2021) showed that the bias stemming from the assumption of a temporarily fixed basket of goods (representativity bias) in Germany and the euro area is only slightly positive; at the same time, updating the weighting scheme more frequently using provisional data to calculate the weights would potentially result in new measurement uncertainties (vintage bias).
36 See Work stream on inflation measurement (2021), in particular Section 3.

inflation rate of 2% and considers this to best maintain price stability. Compared with a target inflation rate of 0%, a 2% target offers crucial advantages when it comes to maintaining price stability. Some of these advantages were already key reasons for the policy aim set during the last strategy review in 2003 and continue to exist today.

Inflation target of 2% provides necessary balance between safety margin against deflation …

One such advantage of a 2% inflation rate is that it provides a necessary safety margin against deflation, i.e. a setting of persistently falling prices.[37] This kind of setting can lead to severe economic losses and should therefore be avoided. A higher target inflation rate increases this safety margin, on the one hand. On the other, it raises the average nominal interest rates.[38] This, in turn, gives interest rate policy more space to avoid deflationary outcomes.

The equilibrium real interest rate has fallen further since the last strategy review, which in and of itself suggests implementing a higher target inflation rate, in order to increase the interest rate policy space and be able to better stabilise inflation at the target inflation rate.[39] The new operationalisation of price stability (2%, medium term) is, in fact, a slight increase compared to the previous policy aim (below, but close to 2%, medium term). The Governing Council of the ECB is thereby taking into account the reduced equilibrium real interest rate.

… and costs of higher inflation rates, such as inefficient allocation of resources, …

The Governing Council of the ECB decided against raising the target inflation rate more markedly, however. A marked increase in the monetary policy target inflation rate would entail a host of disadvantages.[40] For example, the problem of inflation-induced bias in relative prices would become greater. As a result, the steering function of relative prices would become less efficient and could thus lead to inefficient allocation of resources. Higher inflation rates also cause other inefficiencies, such as higher inflation risk premia in the interest rates on longer-term loans, distorting effects in the nominal tax and transfer system, or arbitrary redistribution of nominal income and wealth.[41]

… a potential narrowing of monetary policy space …

Furthermore, higher target inflation rates may also narrow the newly-acquired interest rate policy space once more; given high target inflation, the central bank may have to adjust monetary policy interest rates more aggressively in order to stabilise the inflation rate. Higher target inflation results in the inflation rate being shaped by expectations for future inflation to an even greater degree, meaning that it is less influenced by the current level of economic capacity utilisation. The central bank then has to generate stronger economic stimulus by means of correspondingly marked interest rate changes in order to steer inflation in the desired direction through macroeconomic capacity utilisation.[42]

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37 The arguments in favour of a positive inflation buffer over the longer term are not just based on the existence of a sufficient margin against the lower bound on interest rates or possible measurement bias which distorts inflation statistics. In particular, alongside a persistent inflation differential between the euro area countries, the existence of downward nominal price and wage rigidities is also considered relevant to the justification for an inflation buffer. Setting the policy objective at 2% can therefore also be seen as a contribution to facilitating any labour market adjustments and creating enough scope to facilitate relative price adjustment in the monetary union.
38 These are composed of the equilibrium real interest rate and the inflation rate targeted by the central bank.
39 The box on pp. 24 ff. shows the relationships between the equilibrium real interest rate, the target inflation rate and interest rate policy space in a quantitative model.
40 The costs of higher inflation are also likely to rise disproportionately with the level of the target inflation rate. See, for example, Ascari and Sbordone (2014).
41 See Deutsche Bundesbank (2019c).
42 This relationship can be illustrated using a New Keynesian Phillips curve (NKPC). Based on firms' optimal pricing conditions, it describes the relationship between the inflation rate, the aggregate output gap and inflation expectations. According to the NKPC, average higher inflation rates may have the following macroeconomic implications (for more information, see Deutsche Bundesbank (2018)): for one thing, any differences in relative prices between enterprises grow larger. The greater shifts in demand associated with this lead to a reduction in the quantity of goods produced by firms. Furthermore, demand becomes less important for firms' price setting in relative terms, as they now give a stronger weighting to the inflation path when they set their prices. Given a higher target inflation rate, then, the output gap loses significance as a determinant of price developments. That is, with a higher target inflation rate, the NKPC becomes flatter and aggregate demand, taken in isolation, accordingly becomes less important as a determinant of price developments. As a result, the price adjustment in the wake of an interest rate hike is less pronounced. In line with this, a cut in interest rates in the event of an economic downturn has less of an effect on aggregate demand than it would if the inflation rate were lower. See also Ascari and Sbordone (2014).

… or an unanchoring of inflation expectations

A high target inflation rate might also increase the risk of inflation expectations becoming unanchored. Should this occur, inflation expectations might deviate from the monetary policy target inflation rate over the long term, too, making it considerably more difficult to reach this target.[43] Furthermore, in view of the potential costs of a higher target inflation rate, it must be taken into account that the Eurosystem, like other central banks, has expanded its toolbox to include unconventional instruments that may mitigate the constraints imposed by the effective lower bound. However, unconventional instruments such as asset purchases may also potentially have undesirable side effects that must likewise be taken into consideration when setting the target inflation rate.[44]

Having weighed up the numerous pros and cons, the Governing Council of the ECB has come to the conclusion that a target inflation rate of 2% is appropriate.

Target range instead of 2% point target could indeed make it clear that monetary policymakers lack full control over inflation …

The choice to set an inflation target of 2% simultaneously represents a decision for a point target and against a target range for the inflation rate. On the face of it, it seems that a target range would offer some advantages. In the form of an uncertainty band, possibly with a focal point in the middle, it would implicitly signal that the inflation process is not perfectly controllable by monetary policy at all times. This could help enhance the credibility and comprehensibility of monetary policy. In addition, an "indifference range" within which no or a weak monetary policy response occurs could provide a certain degree of flexibility in responding appropriately to unforeseen developments.

… but would also increase the risk of a worse anchoring of inflation expectations

A target range, however, would engender the risk of inflation expectations settling at the upper or lower bound of the range following a series of uniform shocks. This could occur if the economic agents had expected either no monetary policy response at all or only a weak monetary policy response within the range. This risk would emerge particularly for disinflationary shocks, due to the effective lower bound. Consistent with this is the fact that simulation studies imply worse inflation stabilisation given a target range than given a point target.[45] Empirical studies indicate that a point target anchors long-run inflation expectations more firmly than a target range, at least when the latter is perceived as an indifference range.[46] Lastly, the concept of medium-term orientation also fulfils the function of creating monetary policy flexibility (see the section "Medium-term orientation retained"), with the result that the ECB Governing Council continues to deem a target range less than ideal in this regard.

Symmetry of the inflation target

Asymmetry of previous strategy fit for purpose at start of monetary union due to inflationary risks, …

As discussed in the section "Why review the monetary policy strategy?", the previous operationalisation of price stability was asymmetrical. This was appropriate to the situation at the time of the 2003 strategy review; in view of the high inflation rates and predominantly inflationary shocks at the start of monetary union, it was particularly important to the ECB Governing Council to anchor inflation expectations at a low level at that time.

However, over the past few years, disinflationary and deflationary shocks have tended to

43 Economic agents' inflation expectations play a prominent role for monetary policy because they affect individual economic agents' wage and price setting behaviour, and are thus themselves an important determinant of the path of inflation. If inflation expectations are not firmly anchored, this makes it harder to stabilise the inflation rate. In a worst-case scenario, the central bank would fail to achieve its inflation target even in the medium term. A higher inflation target may increase the probability of inflation expectations becoming unanchored and, in extreme cases, result in them being inconsistent with the central bank's new target even in the long term. For a detailed explanation of this relationship and a risk-benefit analysis of aiming either for a higher target inflation rate to act as a buffer for the effective lower bound or a lower target inflation rate to prevent inefficiencies, see Deutsche Bundesbank (2018).
44 For information on the impact and potential side effects of monetary policy asset purchases, see Deutsche Bundesbank (2016).
45 See Coenen et al. (2021) or Le Bihan et al. (2021).
46 A summary of this study and a broad overview of the differences between a point target and a target range can be found in Work stream on the price stability objective (2021).

… but unsuited to current macroeconomic environment of low inflation

exert downward pressure on inflation. Against this backdrop, the Eurosystem faced the challenge of ensuring higher inflation rates. The asymmetry in the operationalisation of price stability increasingly proved to be a hindrance, as it potentially signalled a lower degree of monetary policy commitment in this context. In this respect, the ECB Governing Council's intentions were not the decisive factor. Rather, the perceived asymmetry in terms of the effective lower bound particularly heightened the risk of persistently lower inflation rates.

Policy aim is now explicitly symmetrical …

For these reasons, the ECB Governing Council has now decided to introduce an explicitly symmetrical inflation target. This means that negative and positive deviations of inflation from the target are considered to be equally undesirable.[47] The focus is not on temporary, smaller deviations, which are unavoidable in an environment characterised by myriad and unforeseeable events (see the section "Medium-term orientation retained"), but rather on larger and more persistent deviations from the medium-term inflation target of 2%.

… in order to anchor inflation expectations firmly at the target

With its symmetrical stance, the ECB Governing Council aims to anchor inflation expectations firmly at the 2% inflation target. This symmetry implies that forceful action will be taken in response to persistent positive or negative deviations in order to counteract any failure to meet the inflation target in the medium term. Economic agents can therefore expect that the medium-term inflation target will be met. In turn, such anchored expectations make it easier to reach the inflation target as they result in wage and price-setting decisions that are compatible with the aim of price stability. Firmly anchored inflation expectations remain a significant prerequisite for actually reaching the inflation target.

Medium-term orientation retained

Medium-term orientation is credible and transparent …

Although monetary policy instruments can influence price developments, they do so with time-varying lags. Short-term fluctuations in the inflation rate are therefore beyond the control of monetary policy. If monetary policymakers nonetheless attempted to offset these fluctuations, this would likely increase interest rate volatility and real economic activity without effectively stabilising inflation.

… and allows for a flexible response to economic shocks

The medium-term orientation also allows monetary policy to respond flexibly to different kinds of shocks. When demand shocks occur, inflation and real economic activity move in the same direction. Thus a monetary policy response that stabilises inflation also stabilises production and employment. By contrast, in the case of a supply-side shock, inflation and real economic activity move in opposite directions. An example of this is oil price increases. They lead to higher costs and thus higher prices, but at the same time decrease economic activity. In its attempts to stabilise the inflation rate, a highly restrictive monetary policy response would temporarily trigger an even sharper slump in real economic activity.[48] It may therefore prove wise to initially "look through" supply shocks, i.e. to show either a weaker monetary policy response or none at all, thereby accepting slightly longer deviations from the inflation target.[49] The medium-term orientation therefore allows monetary policy stabilisation to come about either more quickly or more slowly, depending on the nature of the shock.

Medium-term orientation therefore still part of strategy

For these reasons, the ECB Governing Council has decided to retain its medium-term orientation. This preserves the necessary flexibility to respond to deviations from the inflation target depending on the economic context. The Governing Council can therefore take all relevant factors into consideration when making policy decisions aimed at achieving price stability.

47 See European Central Bank (2021a), p. 7.
48 Due to repercussions for the inflation rate, however, strong real economic fluctuations would make it more difficult for monetary policymakers to ensure price stability.
49 This is particularly true when such supply shocks only have a temporary effect and do not cause any second-round effects in wage and price negotiations on account of firmly anchored inflation expectations.

Achieving the inflation target in view of the lower bound

Effective lower bound is key challenge for monetary policy, …

The decline in the equilibrium real interest rate and the higher likelihood of a more frequently binding effective lower bound (described in the section "Why review the monetary policy strategy?") present a key challenge for monetary policymakers, particularly during periods of predominantly disinflationary shocks. If monetary policy is restricted by the effective lower bound, it runs out of policy space at precisely the moment this would be most crucial in order to prevent a potential slide into deflation. By contrast, policymakers do, in principle, possess unlimited space for raising rates and stabilising inflation when positive deviations from the inflation target occur.

… as it induces asymmetry in interest rate policy space and implies negative inflation bias

The effective lower bound thus induces asymmetry in interest rate policy space. This results, if unconventional monetary policy measures are abstracted, in an inflation rate that lies substantially below the inflation target on an average of a longer period. The effective lower bound thus results in what is known as a negative inflation bias. If inflation expectations become anchored below the inflation target because of this bias, it becomes significantly more difficult for monetary policymakers to ensure price stability in terms of the target inflation rate. In addition, the lack of interest rate policy stabilisation options at the effective lower bound increases inflation volatility. These relationships are examined in more detail in a quantitative model on pp. 34 ff.

Unconventional measures at the effective lower bound

Unconventional measures have generated upside pressure on the inflation rate

Since the financial crisis, the ECB Governing Council has implemented a series of unconventional monetary policy measures to generate upward pressure on inflation in the face of disinflationary shocks.[50] So far, these measures have proven effective in combating disinflationary pressures.[51] In situations where interest rates are close to the effective lower bound, they will thus remain a key component of the Eurosystem's toolbox in future, too.

Effectiveness of these measures fraught with uncertainty, however

However, high uncertainty remains with regard to the exact magnitude of the impact of unconventional measures. On account of the relatively recent history of such measures, there are currently insufficient data available to reach a robust assessment of any kind. Furthermore, the magnitude of the measured effects very much depends on the policy design and the models used for the assessment.[52] This is particularly true for monetary policy purchase programmes. However, the impact of forward guidance on interest rates is also difficult to estimate as it is strongly reliant on the credibility and concrete formulation of the measures.[53]

Risk of undesirable side effects, as well

The extensive implementation of unconventional measures may also bring about undesirable side effects and foster wrong incentives for both the private and public sectors, for example.[54] Although potential side effects can be mitigated through suitable policy design, this is also likely to reduce the effectiveness of the

50 Specifically, these measures included asset purchases, negative policy rates, targeted longer-term refinancing operations and forward guidance on interest and purchasing policies as well as the reinvestment policy. See Rostagno et al. (2021).
51 In the literature on monetary policy, it is widely agreed that unconventional measures such as negative interest rate policies, asset purchase programmes and forward guidance can have a positive impact on the inflation rate, in principle. For an overview of the literature, see, for instance, Work stream on the price stability objective (2021), Chapter 2, and Altavilla et al. (2021).
52 See Deutsche Bundesbank (2016).
53 A credible announcement that interest rates are going to stay at their effective lower bound tends to increase economic agents' inflation expectations. This reduces real interest rates and stimulates the inflation rate by means of higher aggregate demand. Given a less credible monetary policy, these effects would be correspondingly less pronounced. See Coenen et al. (2021).
54 Generally speaking, an expansionary monetary policy that results in low financing costs over a long period of time on account of announced asset purchases or interest rate forward guidance may have negative incentive effects on the indebtedness of euro area countries. The longer governments are able to assume that financing conditions will remain attractive, the more likely the incentive to implement economic policy reforms and pursue fiscal discipline is to decrease, while the vulnerability to a future rise in interest rates increases. For more information on this, see Röttger and Gerke (2021), who illustrate such a relationship using a quantitative model.

measures. For example, under the Eurosystem's public sector purchase programme (PSPP), asset purchases are subject to certain upper purchasing limits to prevent, amongst other things, central banks from becoming the dominant creditors of governments. Taken in isolation, limits of this kind reduce the efficacy of asset purchase programmes by restricting the potential volume of possible asset purchases and hence the degree of monetary policy accommodation.[55] They are nevertheless necessary in order to ensure, inter alia, that the monetary policy measures are compatible with the monetary union's institutional framework and the functioning of the affected markets.

For these reasons, individual unconventional measures by themselves are likely to be poorly suited to completely eliminating the negative inflation bias created by the effective lower bound. In the context of the Eurosystem's strategy review, therefore, a range of alternative, complementary means of reducing the negative inflation bias through monetary policy have been discussed.

Arguments for and against history-dependent monetary policy approaches

History-dependent approaches, as a possible alternative, …

History-dependent monetary policy approaches represent an additional way of anchoring inflation expectations more firmly at the inflation target. In monetary policy practice, past inflation developments do not usually have a bearing on the current monetary policy stance. Rather, monetary policy focuses on the current and expected inflation rates. As some would put it, monetary policymakers "let bygones be bygones". In the wake of tightened restrictions resulting from the effective lower bound over the past few years, however, the focus has increasingly shifted to history-dependent monetary policy approaches.

Such approaches are based on the idea of "making up" for past deviations from target through future deviations in the opposite direction. Take average inflation targeting as an illustrative example:[56] in this case, the target variable is the average inflation rate, with the central bank setting the time horizon for the averaging window. Should the average inflation rate fall below its target, monetary policy must temporarily increase the inflation rate above target to ensure that the average inflation rate returns to the target. This means that monetary policy is intentionally seeking to overshoot the inflation rate (or vice versa in the opposite scenario).

… use the expectation channel as an automatic stabiliser, …

History-dependent approaches use inflation expectations as automatic stabilisers: after a sustained period of below-target inflation, forward-looking economic agents anticipate that the future will bring a temporarily more expansionary monetary policy and thus higher rates of inflation for as long as it takes for average inflation to return to the desired target level. This reduces the real rate of interest and stimulates inflation via expansion of macroeconomic demand (the same applies in reverse when inflation overshoots the target for a prolonged period of time). The academic literature refers to this mechanism as the "expectation channel". At times when the monetary policy rates are constrained by their effective lower bound, this expectation channel is a particularly valuable way of providing additional monetary policy stimulus.

In analyses based on theoretical models, history-dependence performs very well in terms of the stabilisation outcomes it produces. Among other things, the results show that the negative inflation bias is reduced or even eliminated entirely – despite taking into account the effective lower bound constraint. The box

55 The influence of upper purchasing limits on the efficacy of asset purchase programmes is illustrated in the box on pp. 34 ff. in the form of a quantitative model.
56 See, for example, Nessén and Vestin (2005). Price level targeting (PLT) can be viewed as a special case in which the average inflation rate is targeted over an infinite time horizon in order to calculate this rate (again, see Nessén and Vestin (2005)). For a thorough comparison of inflation targeting and price level targeting, see Deutsche Bundesbank (2010). A model-based comparison of history-dependent approaches is carried out in the box on pp. 38 ff.

How limits affect the efficacy of asset purchase programmes

Central banks use asset purchase programmes to provide expansionary monetary policy stimulus even when operating at the effective lower bound on interest rates. In principle, the larger the asset purchase programme, the more expansionary its effect should be. However, extensive asset purchases also increase the risk of undesirable side effects. To give an example, there is the possibility that large-scale purchases of government bonds make the central bank a dominant creditor of governments. This could blur the boundaries between monetary and fiscal policy, thereby harming the independence of monetary policy.[1]

In order to mitigate these, and other, undesirable side effects, asset purchase programmes are, in practice, subject to built-in and/or legal limits, as is the case with the Eurosystem's public sector purchase programme (PSPP).[2] Limits of this kind reduce the efficacy of asset purchase programmes if they restrict the level of possible asset purchases and hence the degree of monetary policy accommodation. This interaction is illustrated in quantitative terms below using a model, which reveals the extent to which limits could reduce the efficacy of asset purchases. Possible side effects – and thus the reasons for limits – are not part of the model analysis below.

In principle, limits can reduce the efficacy of asset purchases without actually immediately restricting current purchase programmes. Limiting the future purchase volume already suffices. The reason for this is that the macroeconomic effect of an asset purchase programme materialises as soon as it is credibly announced (also referred to as a stock effect in this context). This means that the expansionary stimulus – assuming that economic agents are forward-looking – takes effect even before the central bank begins making asset purchases or before it has conducted all purchases.[3] The size of the expansionary effect is thus mainly determined by the expected sum of net purchases, i.e. the expected stock of asset purchases on the central bank's balance sheet.[4]

To quantify the effect of possible limits on the efficacy of asset purchase programmes, model simulations were used during the strategy review. Dynamic stochastic general equilibrium (DSGE) models are particularly suited to this purpose, as they can depict the core mechanisms of asset purchase programmes. They also allow for counterfactual simulations in order to analyse the effectiveness of asset purchase programmes with and without limits.[5]

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1 Large purchase volumes can additionally impair the smooth functioning of the market as well as price formation in the capital markets. See, for example, Deutsche Bundesbank (2016), Questions & Answers at https://www.ecb.europa.eu/mopo/implement/app/html/pspp-qa.en.html, or Altavilla et al. (2021).
2 For the PSPP, the Governing Council of the ECB set an issue and issuer limit; see Decision (EU) 2015/774 of the European Central Bank. However, such limits are not just applied in the euro area, but also by other central banks such as the Bank of England. See Consolidated Market Notice: Asset Purchase Facility: Gilt Purchases – Market Notice 11 June 2019.
3 By contrast, flow effects are the economic effects arising exclusively from the purchases actually made. In terms of relative efficacy, stock effects are regarded as the more significant effect by far. See, for example, D'Amico and King (2013) or Sudo and Tanaka (2021).
4 Other relevant factors are the precise path of purchases as the sum of net purchases, a possible reinvestment phase, and the reduction path. For an analysis of the extent to which a reinvestment policy can reduce the constraints imposed by limits, see Gerke, Kienzler and Scheer (2021).
5 The model used below is an estimated, medium-size New Keynesian model with a banking sector and simplified household heterogeneity. All details on the model framework, estimation, solution method (as briefly touched upon here) and simulation design can be found in Gerke, Kienzler and Scheer (2021).

A state-contingent purchase programme is assumed for asset purchases: the more the inflation rate deviates from its target, the higher the level of purchases and the greater the expected monetary policy stimulus. The asset purchase programme is formally denoted by:

$$\hat{b}_t = \rho_b \hat{b}_{t-1} + I_{R_t = ELB} \phi_b \hat{\pi}_t,$$

where $\hat{b}_t$ is the stock of government bonds on the central bank balance sheet and $\hat{\pi}_t$ is the (logarithmic) inflation rate, both given in terms of deviation from their long-term equilibrium.[6] The strength of state contingency, depicted by the coefficient ϕ_b, is estimated on the basis of past Eurosystem purchases under the PSPP. Furthermore, it is assumed that the central bank only conducts asset purchases if its conventional monetary policy instrument, the short-term interest rate, is constrained by the lower bound on interest rates (depicted in the above formula by the indicator function $I_{Rt = ELB}$). Once the effective lower bound ceases to bind, the central bank gradually reduces its balance sheet.[7]

For the stochastic simulations within the above-described model framework, one methodological obstacle is capturing the various non-linearities. In this model, they are the effective lower bound on the short-term nominal interest rate, the launching of a state-contingent asset purchase programme, and any limits of the asset purchase programme.[8] One approach to capture such multiple non-linearities is the piecewise linear approach, which was used and extended for the underlying simulations.[9]

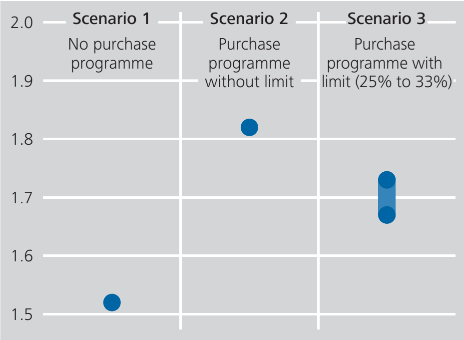
Three scenarios are compared, in each of which the short-term interest rate is constrained by the effective lower bound.[10] In the first scenario, the central bank has only the short-term nominal interest rate at its disposal. It cannot resort to an asset purchase programme as an additional monetary policy instrument. In the second scenario, the central bank can resort to asset purchases to provide further monetary policy stimulus at the effective lower bound, without being constrained by a limit on the purchase volume.[11] In the third scenario, the central bank also has to comply with a limit on asset purchases of 25% or alternatively 33% of all outstanding bonds.

The average inflation rate in the results for each simulation is mapped in the chart on p. 36. Three main results emerge. First, the effective lower bound on interest rates causes a notable negative inflation bias if the central bank has only the short-term nominal interest rate at its disposal. Accord-

6 This kind of process is also used in Bartocci et al. (2019) and Coenen et al. (2021). The latter condition the purchase programme on a shadow interest rate (i.e. on a latent variable) instead of the inflation rate.
7 For the sake of simplicity, a reinvestment policy, as used by the Eurosystem, is not considered (for inclusion of a reinvestment policy, see Gerke, Kienzler and Scheer (2021)). In principle, the operationalisation of the purchase process has an impact on the quantitative effects of the purchase programme. In contrast to the results below, alternative assumptions such as weaker state dependency and swifter balance sheet reduction could be made. In this case, the reported macroeconomic effects would be reduced accordingly.
8 State contingency has two meanings in this context. First, the central bank conducts higher net purchases if the inflation rate deviates more strongly from its target. Second, the central bank only conducts these purchases if the monetary policy interest rate is at the effective lower bound.
9 For the seminal work, see Kulish and Pagan (2017) and Guerrieri and Iacoviello (2015).
10 To generate the simulations, shocks are randomly drawn from the estimated distributions of the exogenous shocks. On this basis, 2,000 simulations with a length of 200 periods each are then generated, with the first 100 periods being discarded for the initialisation. To broadly match the current configuration in the euro area, the simulations assume an inflation target of 2%, a long-term equilibrium real interest rate of 0.5% and an effective lower bound of -0.5%.
11 The level of net purchases and the expected stock of bonds on the central bank balance sheet then exclusively stem from two endogenous factors. First, the state-contingent net purchases, if the short-term nominal interest rate is constrained by the effective lower bound. Second, the stock from past purchases.

Average inflation rates in different scenarios*

%



* Based on stochastic simulations. The inflation target is 2%, the effective lower bound is -0.5% and the equilibrium real interest rate is 0.5%.

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ingly, the average inflation rate settles below the inflation target. Second, asset purchases can reduce the inflation bias, but not eliminate it completely. Third, asset purchase programmes with limits – as compared with an unlimited purchase programme – increase the inflation bias. In other words, they reduce the efficacy of asset purchase programmes.

The left-hand section of the chart illustrates the first main result. It shows an average inflation rate of around 1.5% in scenario 1, the one with no asset purchase programme. According to the simulations, the effective lower bound thus causes the inflation rate to settle around 50 basis points on average, and hence notably, below its target of 2%. Taken in isolation, this could jeopardise the credibility of the central bank and make it harder to anchor long-term inflation expectations. This would further reduce the efficacy of monetary policy.

When the central bank resorts to unlimited asset purchases at the effective lower bound (scenario 2), the simulations show a marked increase in the average inflation rate towards the assumed target of 2% (middle section). The simulations underscore why asset purchase programmes have become an important component of non-standard monetary policy measures at the effective lower bound. Nonetheless, at just over 1.8%, the average inflation rate is still below the 2% target.

When monetary policy faces limits to its asset purchases (scenario 3), it becomes more difficult to achieve the inflation target as compared with a purchase programme without limits. The right-hand section of the chart illustrates the extent to which a limit on the purchase volume of 25% or 33% reduces the efficacy of asset purchase programmes. Depending on how tight the limit is, the average inflation rate falls by around 10 to 15 basis points compared with an asset purchase programme without a limit. Even though the inflation rate is closer to the 2% target as compared with the scenario with no asset purchase programme (scenario 1), at just under 1.7% it still falls further short of the target than in the scenario with unlimited asset purchases (scenario 2).

However, limits not only reduce the average inflation rate, they also increase macroeconomic volatility. For example, compared with a scenario without a limit, inflation rate volatility rises by 25% to 40%. It increases more strongly given a limit of 25% than for a limit of 33%.[12]

In summary, the following can be concluded from the illustrative simulations: the effective lower bound on interest rates con-

12 Similar results can also be found in simulations of the effect of limits in Work stream on the price stability objective (2021) or Mazelis et al. (2021). In the latter paper, however, the state dependency of the asset purchase programmes was implemented via a model-endogenous shadow interest rate (latent variable). Here, even a limit of 50% leads to a decline in the average inflation rate of up to 5 basis points and an increase in volatility of around 20% compared with an unlimited asset purchase programme.

strains the central bank in achieving the inflation target. Even using asset purchase programmes without limits does not necessarily suffice to achieve the inflation target if the empirically estimated strength of the state dependency of the purchase programme matches that of the PSPP. This is all the more true when limits restrict the possible purchase volume. For this reason, the Governing Council of the ECB decided on a comprehensive package of monetary policy measures at the effective lower bound: as part of the new strategy, the Eurosystem has agreed to continue providing expansionary stimulus at the effective lower bound using additional instruments such as forward guidance on interest rates and an asymmetric response function.[13]

13 For the impact of unconventional measures on the inflation rate, see Altavilla et al. (2021). The use of multiple instruments can also create additional synergy effects, e.g. when asset purchases are conducted in parallel to forward guidance on interest rates. For more on this, see also Gerke et al. (2020).

on pp. 38 ff. presents and explains some model results of this kind.[57]

… provided they are credible and comprehensible …

However, these benefits are only fully realised if history-dependent approaches are credible and well understood by economic agents and if those economic agents form forward-looking expectations to a sufficient degree.[58] Otherwise, they will adjust their adjustment expectations only partially or not at all. This, in turn, prevents the expectation channel from exerting its full stabilising effect, and the theoretical benefits of history-dependence diminish.[59] The box on pp. 44 f. illustrates in a model-theoretic context how a specific form of bounded rationality can considerably impair the stabilisation capacity of history-dependent approaches.[60]

… and economic agents behave in a sufficiently forward-looking manner

There is considerable uncertainty surrounding how economic agents actually form their expectations and how potent the effect of the expectation channel could be. For example, influences of a more backward-looking nature may be a dominant force in the formation of expectations if past personal experiences with varyingly high rates of inflation play an important role for inflation expectations.[61] Empirical

57 For a harmonised model analysis looking at history-dependent approaches and including a variety of models used in the Eurosystem, see Work stream on the price stability objective (2021), Chapter 4.
58 Simply put, this means that economic agents are capable of virtually unrestrictedly forming expectations about potential events far in the future. Only then can monetary policy measures that are announced today but will not be implemented until later on have a positive impact on current economic decisions.
59 See Work stream on the price stability objective (2021). In the case of strong forms of history-dependent approaches, like price level targeting, the stabilisation effect is so potent that even with hybrid expectations – a mixture of rational and backward-looking expectations – no negative inflation bias arises. Having said that, the degree of deviation from rational expectations in these simulations is small for technical reasons. Larger deviations from rational expectations or even fully backward-looking expectations could alter the results.
60 There is still no consensus in the academic literature as to the extent to which the ideal-typical preconditions for high effectiveness of history-dependent strategies actually need to be met.
61 See D’Acunto et al. (2019) plus Malmendier and Nagel (2016).

Potential stabilisation effects of history-dependent monetary policy approaches – insights from quantitative model analyses

To the vast majority of central banks, ensuring price stability means stabilising future inflation at the target value. The prime example of such a monetary policy approach is inflation targeting (IT).[1] This approach has helped many economies bring down inflation rates which were, at times, running high in the 1980s and 1990s. In an environment of low inflation rates and a falling equilibrium real interest rate, however, this approach poses challenges to monetary policy owing to the effective lower bound on nominal interest rates.[2]

In practice, central banks at the effective lower bound have attempted to compensate for the lack of space for further interest rate cuts by means of unconventional measures. However, owing not least to potential undesirable side effects of such measures, approaches above and beyond forward-looking inflation targeting are being discussed.[3] The focus is primarily on history-dependent approaches (also referred to as "make-up" approaches), which – according to monetary policy theory – can have advantages over conventional inflation targeting, especially in a low interest rate environment. This discussion is not purely academic in nature; in the aftermath of its strategy review, the US Federal Reserve switched to a version of average inflation targeting (AIT). The most salient feature of such an approach is that the monetary policy target is based on an average inflation rate – in contrast to approaches based on conventional inflation targeting. A certain monetary policy target (e.g. 2%) is set here and the average is formed over a period in the past to be defined. The potential advantage of credible and well-understood history-dependent approaches such as AIT – or its close relative, price level targeting (PLT) – lies in stabilising inflation automatically by managing private sector expectations.[4]

Central banks pursuing AIT commit, if the average inflation rate deviates negatively (positively) from the target, to aiming for a future inflation rate that is above (below) the average inflation target. On condition that the central bank's commitment is viewed as credible, the anticipated future monetary policy response, through the expectations channel, contributes to steering future inflation in the right direction in the present.[5] In this manner, the inflation rate is "automatically" stabilised by expected future actions, which lessens the central bank's need for forceful intervention. This, in turn, promotes a more effective stabilisation of inflation through corresponding effects on the short-term real interest rate.

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1 Under this approach, monetary policymakers commit, amongst other things, to meeting a numerical inflation target that is explicitly communicated to the public and to transparently explaining the measures designed to assure that this target is met. Although the inflation target is mostly adopted as a point target, it can also, in principle, be defined as a target range. This point is discussed in the main article. See also Ehrmann (2021).
2 For more, see the box on pp. 32 ff.
3 This box solely addresses the extent to which an alternative approach may enhance the effectiveness of monetary policy. Unconventional monetary policy is not discussed any further below. See pp. 34 ff. for more on the role of asset purchases at the effective lower bound.
4 The relationship between PLT and AIT is discussed in footnote 56 in the main text.
5 An average inflation rate below target triggers expectations of monetary policy expansion in the future. This, in turn, leads to an increase in future economic activity and inflation. Higher inflation expectations then push down the (expected) real interest rate in the previous periods, increasing aggregate demand and inflation in those periods. The reverse occurs if the average inflation rate is above target.

The automatic stabilisation property is helpful particularly when the effective lower bound prevents a stronger nominal interest rate response given a negative deviation from target. In this case, the central bank's commitment to "make up" the negative deviation from target by means of a more expansionary future policy allows it to increase current inflation expectations and step up the monetary expansion in the present through the consequent reduction in the real interest rate, despite the existence of a binding effective lower bound.

Alongside the aforementioned benefits, though, history-dependent approaches also have potential downsides. Chief among them is the potential amplification of monetary policy conflicts which already occur in the case of IT in connection with supply-side shocks. If, for example, under a regime of AIT, the inflation rate is above target owing to an inflationary supply-side shock (e.g. a positive oil price shock), the central bank is compelled to counteract this price movement by tightening monetary policy in the future. Since price developments are driven to a large extent by wage dynamics, aggregate activity, which is already being dampened by the supply-side shock, would have to be curbed further given sticky wages in order to achieve the desired impact on inflation. The long-run stabilisation of inflation under history-dependent approaches can therefore be associated with considerable losses in terms of macroeconomic stabilisation.[6] The scope of the aforementioned pros and cons of history-dependent approaches depends, amongst other things, on the shocks to which an economy is exposed and how they influence macroeconomic dynamics.[7] Ultimately, the net benefits can only be assessed quantitatively using counterfactual model analyses.

This box will summarise the results of a model-based comparison of various monetary policy approaches below, using two New Keynesian models.[8] They differ in terms of the macroeconomic importance of household heterogeneity, which has implications for the effectiveness of history-dependent monetary policy. In the first dynamic stochastic general equilibrium (DSGE) model, the household sector is modelled by a "representative household".[9] Models of this type, referred to below as representative agent New Keynesian (RANK) models, are currently the dominant type in the academic literature and monetary policy practice. However, this category of models possesses numerous weaknesses that could also be relevant for an assessment of history-dependent monetary policy. Above all, households' consumption and saving – compared with empirical estimates – is excessively sensitive to changes in interest rates, which means that monetary policy causes very strong direct consumption effects via the interest rate channel. This is also true for expected future interest rate changes;

6 See the main article for more on additional challenges in connection with history-dependent approaches.
7 Non-rational expectations formation can impact considerably on, for instance, the cost-benefit ratio of history-dependent approaches; see pp. 44 f.
8 Both models are DSGE models with sticky goods prices and wages. They contain, moreover, demand-side shocks which exacerbate the problems associated with the effective lower bound as well as supply-side disruptions which could potentially be problematic for history-dependent approaches given wage stickiness. Both models therefore capture key aspects which are of relevance to an assessment of history-dependent approaches in monetary policy. See Dobrew, Gerke, Giesen and Röttger (2021) for details of the model.
9 Differences between households, especially concerning labour income and wealth, are omitted here or do not affect macroeconomic developments or the monetary transmission process. A possible rationale for a representative household can be the assumption of complete financial markets. Under this assumption, households can negotiate financial contracts amongst each other which make idiosyncratic risks perfectly insurable. It can be shown for this case that inequalities between households do not affect macroeconomic variables. See, for example, Ljungqvist and Sargent (2018).

Simulation results for various interest rate rules based on RANK/HANK models

Interest rate rule[1]	Effective lower bound incidence		Inflation rate (%)		Output gap (%)	
	Frequency (%)	Average duration (quarters)	Mean	Standard deviation	Mean	Standard deviation
IT						
RANK model	22.29	9.17	1.81	3.74	− 0.16	2.46
HANK model	18.60	7.53	1.72	3.71	− 0.19	2.79
AIT (4-year average)						
RANK model	17.67	9.22	1.95	2.20	− 0.06	2.25
HANK model	14.44	7.23	1.95	2.29	− 0.04	2.31
AIT (8-year average)						
RANK model	14.69	6.95	1.99	2.26	− 0.02	2.20
HANK model	12.06	5.64	1.99	2.31	− 0.02	2.26
PLT						
RANK model	12.64	6.58	2.00	2.06	− 0.02	2.17
HANK model	10.18	5.34	2.00	1.99	− 0.01	2.21

1 IT: inflation targeting; AIT: average inflation targeting; PLT: price level targeting.
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consequently, RANK models are typically subject to the "forward guidance puzzle", which means that the effects of interest rate forward guidance are unrealistically strong.[10] Since history-dependent approaches make up for negative deviations of inflation from target during a phase at the effective lower bound through future positive deviations, i.e. accordingly lower interest rates, the interest rate channel generally has an unrealistically large impact in RANK models and thus potentially overstates the effects of history-dependent approaches.

The second DSGE model, hereinafter referred to as the heterogeneous agent New Keynesian (HANK) model, reflects households' behaviour more realistically, giving household heterogeneity in this model a relevant macroeconomic role.[11] The relationship between economic heterogeneity and monetary policy is mutual. On the one hand, the distribution of income and wealth affects how monetary policy impacts on macroeconomic variables. When analysing history-dependent monetary policy, it is particularly that share of households which cannot borrow as much as they wish owing to credit constraints which matters. The existence of such households tends to weaken the potential of history-dependent monetary policy. In particular, household consumption is less sensitive to expected future changes in interest rates.[12] On the other hand, the wealth distribution in the model is itself also a function of monetary policy. Since households' savings and debt are nominal in the model, a tighter monetary policy, for instance, will weigh more heavily

10 See Dobrew, Gerke, Giesen and Röttger (2021) and the references contained therein.
11 Unlike in the RANK model, financial markets in HANK models are incomplete, i.e. households are subject to uninsurable idiosyncratic risks. In conjunction with the existence of credit constraints, this implies that a household's individual income and wealth inform its decisions on consumption and saving. In this case, macroeconomic variables accordingly reflect wealth and income inequality.
12 The larger the share of credit-constrained households, the less strongly the average household tends to increase its consumption if it expects higher future income or a lower real interest rate. Given a plausible model specification, the expectations channel in the model thereby tends to be weakened relative to the RANK model (see Hagedorn et al. (2019)). In the HANK model, credit constraints also give rise to precautionary saving, impacting on the equilibrium real interest rate and the transmission of monetary policy. Neither of these aspects is captured in the RANK model.

on borrowers owing to the dampening effect on inflation. This is likely to affect, above all, credit-constrained borrowers. If this group is sufficiently large, aggregate consumer demand can additionally be lowered due to the high propensity of this group to consume. Such heterogeneities can therefore also amplify a history-dependent monetary policy, which means that it is not clear a priori whether, and if so, to what extent, a history-dependent approach in the HANK model is less effective relative to the RANK model.[13]

The monetary policy approaches being looked at here are IT, AIT and PLT. They are captured in both models by interest rate rules which determine the key monetary policy interest rate as a function of the inflation rate and the output gap. In AIT and PLT, monetary policy additionally responds to the average inflation rate and the price level, respectively. For AIT, scenarios with 4-year and 8-year averaging are simulated. The extent to which the effective lower bound constrains monetary policy in the models depends in large part on the distance between the average nominal interest rate and the effective lower bound.[14] The table on p. 40 shows the simulation results on the basis of selected statistics. The results do not show any qualitative differences between the models and are quantitatively similar. The aforementioned transmission channels contained in the HANK model, as opposed to the RANK model, therefore more or less cancel each other out.[15] Three general observations can be made.

– First: history-dependent monetary policy rules decrease macroeconomic volatility. The more history-dependent a monetary policy rule is, the more effectively monetary policy is able to stabilise inflation and real economic activity. Under AIT with 4-year averaging, for instance, the standard deviation of the inflation rate is just under 40% lower than under IT for both models. The standard deviation of the output gap – as a measure of real economic activity – is, in this case, approximately 9% lower for the RANK model and roughly 17% lower for the HANK model. In the case of PLT, which is even more history-dependent, inflation volatility decreases by just under 45% for both models, whereas the volatility of the output gap falls by 12% (RANK) or 21% (HANK). These comparisons illustrate the fact that the additional gains in stabilisation decrease in line with the history-dependence of monetary policy. Thus, changing from IT to AIT with 4-year averaging improves macroeconomic stabilisation more substantially than increasing the time window from 4-year to 8-year averaging.

– Second: the more history-dependent the rule, the lower the probability of monetary policy being constrained by the effective lower bound. This observation can be made in light of the frequency at

13 See Ferrante and Paustian (2019) for more about the redistributive effects between savers and borrowers in a structurally similar HANK model and the implications for forward guidance on interest rates. Since these effects tend to make forward guidance more effective, it stands to reason that they will enhance the effect of history-dependent monetary policy, which likewise operates through the expectations channel, as well.
14 The model parameters which are decisive for the distance are chosen to realistically capture the current situation in the euro area. This implies an inflation target of 2%, a steady-state real interest rate level of 0.5% and an effective lower bound of -0.5%. The box beginning on p. 24 illustrates the impact of this distance, which is a positive function of the inflation target and steady-state real interest rate, on the problem of the effective lower bound.
15 The two models abstract from fiscal policy, which in the HANK model would lead to additional distributional effects that may alter the transmission of monetary policy relative to the RANK model. The implications for history-dependent monetary policy are impossible to identify directly; this is ultimately another quantitative issue.

which the respective model economy is located at the effective lower bound for a given interest rate rule. For both models, the number of periods at the effective lower bound falls monotonically in line with the history-dependence of the monetary policy approach. In the process, this share falls by nearly one-half under PLT compared to IT and declines in the RANK (HANK) model from 22% (19%) to 13% (10%). As is the case for macroeconomic stabilisation, an increase in history-dependence is associated with smaller additional effects. This comes as no surprise, since the reduced incidence of a binding effective lower bound is a major factor in the improved stabilisation properties of history-dependent approaches.

– Third: the more history-dependent monetary policy is, the more closely the inflation rate converges towards target. More history-dependent monetary policy approaches temper the problem of the effective lower bound, thereby also improving monetary policy's ability to achieve the inflation target (of 2%). Whereas under IT the inflation rate, at 1.81% in the RANK model and 1.72% in the HANK model, is, on average, well below target, PLT enables the inflation target to be hit without any downside bias. Again, the additional improvements decline the more history-dependent monetary policy is, though AIT with a 4-year averaging time window already pushes the exchange rate exceptionally close to target.[16]

In summary, history-dependent approaches have the potential to establish more effective macroeconomic stabilisation, especially at the effective lower bound. This outcome can be derived both from DSGE models with a representative household and in models with household heterogeneity. In the latter, although the more realistic modelling of consumption and saving tempers the impact of expected future interest rate changes, history-dependent strategies can mitigate the negative influence of a binding effective lower bound under these conditions, too. However, policymakers should take into account the fact that market participants do not necessarily form rational expectations, which could dampen the stabilising impact of history-dependent approaches (see the main text and the box on pp. 44 f.)[17]

16 The smaller incidence of a binding effective lower bound also reduces the average strength of recessions, which is reflected in the higher mean output gap.
17 See Farhi and Werning (2019) for more on the interaction between incomplete financial markets and bounded rationality.

studies examining whether an average inflation targeting regime is fundamentally understood by the public at large reach different conclusions.[62] Furthermore, it is uncertain whether higher inflation expectations actually lead to increased spending and investment, as is often assumed in theory. Recent study results suggest, for example, that households may well associate higher inflation expectations with a pessimistic outlook on economic conditions.[63] The intended real interest rate effect of higher inflation expectations would then be counteracted by commensurately more cautious spending behaviour and thus a higher propensity to save.

In any case, a history-dependent approach would therefore have to be carefully communicated. Defining and communicating as precisely as possible the specifics of how such an approach is configured would lead to a better understanding and therefore raise its effectiveness. Among other things, details of such a communication include the length of the past period relevant in terms of making up for deviations from target and the duration and magnitude of future undershoots and overshoots. However, when it comes to monetary policy practice, there is a certain tension with the desire for policymakers to flexibly react to unforeseen circumstances. For example, if monetary policymakers refrained from adopting an expansionary stance in response to a recession because there had previously been a period of above-target inflation, they might find themselves in the difficult situation of having to justify their choices. Such concerns can be dealt with by appropriate configuration of the policy, for example stipulating that deviations will only be made up in the long term or that only negative deviations from target will be responded to. However, by the same token, designs of this kind increase complexity and make it harder to understand and communicate the history-dependent approach.

Moreover, reduced credibility of history-dependent approaches in current setting

In addition, the current environment of low inflation rates and persistently expansionary monetary policy measures constitutes a major hurdle towards switching to a history-dependent approach. Monetary policy rates have been fluctuating at or close to the effective lower bound for some years now. According to the current interest rate forward guidance they are set to remain there for a long time to come.[64] In such a setting it is questionable whether the promise of an overshoot, which would possibly require further expansionary measures, would be sufficiently effective.[65]

Having weighed up all of the pros and cons, the Governing Council decided against a history-dependent approach to monetary policy.

Asymmetric monetary policy response to deviations from the inflation target

Asymmetric monetary policy responses represent another option

An asymmetric monetary policy response to deviations from the inflation target represents another way of mitigating the constraints imposed by the effective lower bound. In this approach, monetary policy reacts more forcefully to negative deviations from the inflation target than to positive ones. The aim is to offset the asymmetry created by the effective lower bound by introducing an “opposing” asymmetry in the strength of monetary policy response to deviations from the inflation target. This is designed to eliminate any negative inflation bias stemming from the asymmetry of the monetary policy space arising from the lower bound.[66]

62 While Coibion et al. (2020) find in their survey-based study that US households by and large do not understand the concept of average inflation targeting, Hoffmann et al. (2021) come to a different conclusion for Germany.
63 See Candia et al. (2020).
64 See Deutsche Bundesbank (2021c).
65 The asset purchase programmes primarily exert their expansionary effect via the long-term interest rates. As explained above, these programmes are subject to certain constraints, meaning that they cannot be expanded infinitely. On top of this, consideration needs to be given to any undesirable side effects which may arise over time.
66 In simplified terms, this kind of asymmetric approach can be modelled in the form of an asymmetric instrument rule where the risk coefficient for deviations to the downside is bigger than that for inflation rate deviations of the same magnitude to the upside.

Limited effectiveness of history-dependent approaches under bounded rational expectations

For history-dependent monetary policy approaches to be able to generate welfare-enhancing effects via the expectations channel, economic agents must act with a sufficient degree of foresight. This means that economic agents need to be able to freely form expectations of future events. Only then can monetary policy measures that are announced today but implemented in the future have a positive impact on economic agents' current economic decisions.[1] Otherwise such approaches can even reduce welfare. They then do not generate stabilising effects by relying on forward-looking decisions, but instead lead to greater macroeconomic volatility through policy measures that are oriented to the past.

The extent to which history-dependent approaches rely on the expectations formation of economic agents is illustrated below on the basis of model simulations. The analysis uses a New Keynesian model with sticky prices and wages and bounded rational expectations.[2] Monetary policy is occasionally constrained by an effective lower bound on interest rates caused by either supply or demand shocks.

Bounded rationality is modelled using the cognitive discounting approach developed by Gabaix (2020).[3] Under this approach, economic agents are partially myopic in their reaction to future events. They anticipate their effects only imperfectly even if they already have full knowledge of their occurrence. Therefore, they only partially react to known future events. At the same time, they are fully aware of the long-term macroeconomic relationships and thus also of the long-term economic equilibrium that arises in the absence of shocks.[4]

When agents form their expectations in a predominantly rational manner, history-dependent approaches are welfare-enhancing (see the box on p. 38). The chart on p. 45 illustrates this finding, comparing the welfare losses[5] of various monetary policy rules. If cognitive discounting is low ($M > 0.8$, $M = 1$ corresponds to the assumption of rational expectations), i.e. when economic agents show a high degree of foresight, history-dependent policy rules are associated with the smallest welfare losses arising from macroeconomic fluctuations. These rules can then effectively stabilise macroeconomic developments via the

1 Additional requirements are that such measures are credible and understood. Furthermore, economic agents must not otherwise be restricted in their decision-making, e.g. by credit constraints. See the section entitled "Arguments for and against history-dependent monetary policy approaches" on pp. 33 ff.
2 Within the model, households, firms and unions have the same bounded rational expectations. The central bank is assumed to maintain rational expectations. For further details, see Dobrew, Gerke, Kienzler and Schwemmer (2021).
3 Currently, most macroeconomic models are based on the assumption of rational expectations. Divergent, older approaches often formalise non-rational expectations by incorporating backward-looking components into the expectation formation process or via ad hoc rules of thumb which economic agents mechanically follow. In recent years, a newer body of literature has increasingly provided explicit microfoundations for non-rational expectations. This includes, inter alia, approaches in which economic agents learn (Evans and Honkapohja (2001)), have finite planning horizons (García-Schmidt and Woodford (2019), Woodford (2019)) or lack common knowledge with regard to macroeconomic shocks (Angeletos and Lian (2018)).
4 In mathematical terms, bounded rational expectations $\mathbb{E}_t^{BR}$ of an economic variable x_t are modelled as a weighted average of rational expectations $\mathbb{E}_t$ and the long-term equilibrium $\bar{x}$ of this variable, i.e. $\mathbb{E}_t^{BR} = M\mathbb{E}_t\{x_t\} + (1-M)\bar{x}$. M denotes the degree of rationality, whereby $M = 1$ is synonymous with rational expectations and a lower M implies greater cognitive discounting.
5 Welfare loss is measured as the representative consumer's utility loss resulting from deviations from the efficient allocation. Following the behavioural economics literature, it is assumed that consumers evaluate these utility losses objectively, i.e. under rational expectations, even if they tend to make economic decisions myopically.

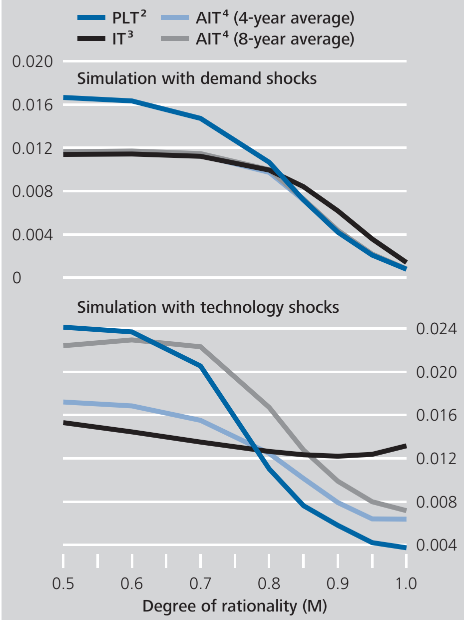
expectations channel as explained in the main article – even if monetary policy is constrained by the effective lower bound. This particularly applies to price level targeting (PLT) but is also the case for average inflation targeting (AIT).[6]

However, history-dependent approaches are welfare-reducing if economic agents tend to be myopic. A higher degree of cognitive discounting ($M < 0.8$) reverses the ranking of the various monetary policy rules. Inflation targeting (IT) now leads to the smallest welfare losses. By contrast, price level targeting is detrimental in the case of both supply and demand shocks.

Higher cognitive discounting weakens the expectations channel and therefore leads to larger welfare losses under history-dependent approaches.[7] The aim of these approaches is for inflation to overshoot its target following a low interest rate period. This in turn is supposed to have a positive impact on current inflation via the expectations channel. A high degree of discounting significantly reduces these positive expectational effects.[8] At the same time, the overshooting of inflation after a low interest rate period leads to greater fluctuations in the real economy and thus to greater volatility. With higher cognitive discounting the disadvantages of a history-dependent approach therefore outweigh the advantages.[9]

Comparison of monetary policy rules under bounded rational expectations

Welfare loss[1]



1 Welfare is based on a quadratic approximation of household utility. **2** Price level targeting. **3** Inflation targeting. **4** Average inflation targeting.
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6 For an explanation of PLT and AIT, see the section entitled "Arguments for and against history-dependent monetary policy approaches" on pp. 33 ff. and footnote 59 in the main article.
7 In a New Keynesian model with sticky prices and wages, a supply shock would always lead to welfare losses because a trade-off arises between stabilising inflation and stabilising output.
8 In addition, recessions induced by the effective lower bound are less pronounced under higher discounting. Through the weakened expectations channel, economic agents are less influenced by future recessions when making current decisions. Bounded rationality therefore not only reduces the positive effects themselves, but also the scope for potential positive effects.
9 Thus far, empirical estimates of the discounting factor are sparse and inconsistent, and therefore uncertain. In addition, structural estimates also depend on the specific model assumptions. They vary between $M=0.4$ and $M=0.95$, e.g. in Illabaca et al. (2020).

Stronger response to negative deviations from the inflation target can potentially even out the asymmetry of the effective lower bound

To understand how this concept works, it is helpful first to abstract from the effective lower bound and clarify the effect of the asymmetric reaction function in isolation. If monetary policy reacts more forcefully to negative deviations from the inflation target than to positive ones, the inflation rate will be stabilised more strongly at its target level after disinflationary shocks than after inflationary shocks. If disinflationary and inflationary shocks occur with the same frequency and strength, this would mean that, over the long-term average, an inflation rate above target would set in. If the effective lower bound is occasionally binding and hence produces negative inflation bias by itself, an asymmetric reaction function can therefore achieve the inflation target in the long run.[67] However, the right calibration is important here: if the reaction function is too asymmetric, it can ultimately even lead to positive inflation bias despite the constraints of the effective lower bound.

More flexible and less dependent on the expectation channel

From the perspective of monetary policy practice, asymmetric approaches offer a few advantages over history-dependent approaches. First, their efficacy does not primarily depend on the expectation channel and the associated uncertainties. Second, monetary policy retains a greater degree of flexibility than if it ties itself to the promise of an overshoot.

New strategy thus allows for more forceful and persistent monetary policy response to negative shocks

As the outcome of its strategy review, the ECB Governing Council communicated a form of asymmetric reaction function. It implies that, in the event of strongly negative inflation shocks, the monetary policy instruments are to be deployed particularly forcefully. If the policy rates are close to the effective lower bound, the Governing Council can also maintain its deployment of instruments more persistently. This is designed to safeguard on two fronts. First, the approach signals that persistent negative deviations from the inflation target will be taken equally as seriously as positive ones. In this regard, the effective lower bound necessitates a more forceful or persistent monetary policy response to negative shocks. Second, it should anchor inflation expectations firmly to the inflation target, which is a crucial precondition for achieving the monetary policy objective.

This may imply positive, temporary, smaller deviations from target without an active intent to overshoot

A more forceful or persistent deployment of monetary policy instruments in response to negative shocks has the potential to result in a transitory period in which the inflation rate is moderately above target. However, this is not to be confused with approving of or actually actively aiming for an overshoot. That is not how the Eurosystem's new monetary policy strategy is designed. Rather, an inflation rate that might be moderately above target for a transitory period can be the result of the inability of monetary policy to fine-tune the inflation rate.

Preparation of information for monetary policy decisions: economic and monetary perspectives on price development

Integrated analytical framework for monetary policy decisions

Increasing prominence of macro-financial linkages necessitates more deeply integrated economic and monetary analysis

As part of its strategy review, the Governing Council of the ECB decided to replace its previous two-pillar strategy with an integrated analytical framework. This is composed of two interdependent analyses: the "economic analysis" and the "monetary and financial analysis".[68] The past 15 years have shown that linkages between economic, monetary and financial developments have played a key role in price stability. This means that the economic analysis and monetary analysis do not constitute two separate ways of looking at inflation.

67 For simulations with an asymmetric reaction function, see Dobrew, Gerke, Giesen and Röttger (2021), Gerke, Giesen, Kienzler, Röttger and Scheer (2021) and Bianchi et al. (2021).
68 For more details on the changes to the analytical framework and the design of the two streams of analysis described here, see Holm-Hadulla et al. (2021).

Broadening of monetary analysis to encompass monetary and financial analysis

The ECB Governing Council also broadened the scope of the monetary analysis in its previous form to encompass monetary and financial analysis. In doing so, it is following analytical practice which has evolved over the past years and no longer concentrates primarily on money supply and credit aggregates but is instead informed by a much broader dataset. This includes, in particular, trends in the money, bond and stock markets as well as inflation expectations. Data on the resilience of the banking system, on lending by non-banks, and on the financing conditions of households and non-financial corporations are important as well.

Formal cross-checking of results from both analyses discontinued

When making monetary policy decisions, the ECB Governing Council weighs up the results from both streams of analysis in a comprehensive and situation-based manner. This involves reviewing the proportionality and potential side effects of its policy. However, in future there will no longer be a formal cross-check of the information from the two streams. This is why the “monetary policy statement”, which in July replaced the introductory statement given at the press conference following the ECB Governing Council’s monetary policy meetings, no longer specifically refers to cross-checking. Instead, the statement has been streamlined. Its focus now lies on those results of the economic analysis as well as of the monetary and financial analysis which were decisive in forming the assessment of inflation risks at the point in question.

Economic analysis

Economic analysis examines real and nominal economic developments

The economic analysis looks at developments in real terms and nominal terms. The goal is to obtain a comprehensive idea of where prices may be heading and the risks around these developments. In the years since the last strategy review in 2003, two aspects in particular have emerged to motivate a fundamental review of the economic analysis.

Structural trends and their effects increasingly important for monetary policy

First, the Eurosystem’s economy – like the global economy as a whole – has undergone profound structural change. Globalisation, demographic ageing, digitalisation, climate change and slowing technological progress have had an impact on potential growth, the natural rate of interest[69] and the inflation process. As a consequence, these structural trends need to be taken into account in the preparation of monetary policy decisions. In future, they and their effects on the inflation rate will therefore be analysed regularly and to an even greater extent than previously.

Macroeconomic projections are a central tool in the economic analysis

Second, the Eurosystem’s quarterly macroeconomic projections have become more and more important in the monetary policy decision-making process over time. They have evolved into the central instrument for structuring and summarising the wealth of economic data and information in a consistent fashion. Forming the key foundation for gauging short to medium-term fluctuations in economic and price developments around their long-term trend, they help the ECB Governing Council to detect any medium-term risks to price stability. Significant improvements in data sources, along with new econometric methods and model approaches, have propelled the projections into greater prominence. Furthermore, constant advances in IT have enabled the processing of larger data volumes and the use of more complex models requiring greater computational effort.

Economic analysis to be refined in various key directions

Future work to refine the economic analysis will continue to focus on tapping new information sources and using innovative methods for interpreting them. High-frequency data make it possible to assess the repercussions of abrupt shocks more quickly, for example. This was already visible during the COVID-19 crisis. Another goal is to use surveys and the interpretation of big data to obtain deeper insights into economic relationships and structures. Recognising the nature of shocks that hit the euro area economy is of particular importance for

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69 On the concept of the natural rate of interest see, for example, Deutsche Bundesbank (2017a).

the economic analysis. As discussed above, the monetary policy implications of supply-side shocks are different to those of demand shocks, for example. Another focal point lies in risk assessment, especially in terms of the medium-term outlook. Asymmetric risk distributions and the degree of uncertainty are highly relevant factors for monetary policymakers. Finally, the models used in the economic analysis need to be honed and augmented by new approaches in a targeted way, for example in respect of the effects of climate change (see the box on pp. 49 ff.). The past few years have demonstrated how crucial it is to pay greater attention to heterogeneities in the euro area, macro-financial interactions and non-linear relationships, too.

Monetary and financial analysis

Information content of monetary and financial variables remains indispensable

The monetary analysis which existed up to this point will be retained and augmented by financial aspects. This underlines the fact that the ECB Governing Council will continue to attach particular significance to monetary and financial indicators. At the same time, it is important to the Governing Council that the findings from this side of analysis feed more heavily into the economic analysis too, in order to make sure that due weight is accorded to the relationships between the real economic and financial spheres.[70] It should be noted, however, that the monetary analysis now spans a much broader range of content than it did in its infancy and incorporates short-term developments to a greater extent than before. These adjustments had previously been only partially reflected in the Eurosystem's public communications.[71] The strategy review was therefore an apt opportunity to close the gap separating public perception from the Eurosystem's analytical practice.

Transmission of monetary policy as a central component of the monetary and financial analysis

The growing importance of analyses into the transmission of monetary policy through the financial sector is a good example of the increased consideration being given to developments over the short-term horizon. In order to capture such transmission, the monetary analysis traditionally looks at bank balance sheet data and interest rate data. In its expanded form, however, it also takes into account the financing conditions of other market agents as well as financing structures of non-financial corporations and households. This makes it possible to evaluate in a timely fashion whether transmission channels – such as the bank capital, credit, interest rate and risk-taking channels – are in good working order.[72] Interest in analyses of this kind has grown considerably on the back of the increasing use being made of unconventional monetary policy measures, particularly since 2014. With this approach, the broadened monetary analysis has been able to identify disruptions in the transmission process over the past years. A credit crunch caused by weaknesses in the banking sector is one example. This allowed the ECB Governing Council to make decisive improvements to the formulation and efficacy of unconventional monetary policy.[73] On top of this, the expanded monetary analysis supplies important insights into factors which may constrain or alter the monetary policy space. These may be aspects such as potential negative effects of low interest rate policy, but also, for example, structural shifts such as the growing importance of non-banks as financial intermediaries.[74]

At the beginning of monetary union, the focus lay on the empirically observed, relatively close relationship between monetary growth and

70 Claessens und Kose (2018) provide an overview on the topic of macro-financial linkages.
71 The last broad-ranging public discussion of the monetary analysis took place in the period from 2007 to 2010, as part of a research programme initiated by the ECB Governing Council. For details, see, in particular, Papademos und Stark (eds., 2010).
72 On the monetary policy transmission mechanisms see, for example, Deutsche Bundesbank (2017c).
73 Examples of such adjustments to the suite of unconventional monetary policy instruments include the introduction of a two-tier system for remunerating excess liquidity held with the Eurosystem, as well as the exclusion of household mortgages in the targeted longer-term refinancing operations (TLTROs).
74 On the role of non-banks in the monetary policy transmission process in the euro area see, for example, Work stream on non-bank financial intermediation (2021).

Monetary policy challenges due to climate change

Climate change is going to impact noticeably on the European economy in the coming years and decades. Climate researchers consider it largely proven that the incidence of extreme weather events will increase in the future.[1] 2020 was the warmest year on record in Europe.[2] However, it is not only climate change itself but also the policy measures taken to mitigate climate change or adapt living conditions to it that will produce economic effects.

These developments pose new challenges for the Eurosystem in the achievement of its primary objective, which is to safeguard price stability. First and foremost, it is crucial to gain a better understanding of the economic implications of climate change and climate policy, and of the resulting risks to price stability, and to incorporate them into economic analyses, forecasts and models. The action plan published by the European Central Bank in July 2021 as part of the Eurosystem's monetary policy strategy review is one of the ways in which this task will be addressed.

Following the standard classification methodology, climate-related financial risks can generally be subdivided into physical risks and transition risks. Physical risks are risks resulting from climate change itself – i.e. from changes in the statistical distribution of weather variables. Examples of such changes include an increased incidence of extreme weather events (storms, heavy precipitation, floods, droughts, heatwaves, etc.), as well as a rise in the sea level, changes in the distribution of precipitation and in ocean currents, an increase in the average temperature and increasingly frost-free winters.

Physical risks affect the economy through a variety of channels of impact, a handful of which are discussed in this box as examples. One obvious example is the risk that extreme weather events will destroy parts of the capital stock of an economy, wipe out firms and thus jobs, or impair household consumption.[3] Another is that increased investment in measures to adapt to climate change (infrastructure measures such as flood defences, private investment in residential and office buildings, etc.) will crowd out other, more productive forms of investment. The same can be said of capital used to repair and recover from the damage caused by extreme weather events. Third, there are likely to be (both positive and negative) changes in the productivity of certain sectors (e.g. agriculture), while geo-

1 A detailed presentation of the climatological changes for all regions of the world, including Europe, can be found in the latest report by the Intergovernmental Panel on Climate Change (IPCC), published in August 2021. This report's findings include the following predictions for Europe (each with relatively high confidence): The average temperature in Europe will rise faster than the global average temperature in the coming years. The frequency and intensity of extreme heatwaves will continue to increase, with critical thresholds being exceeded given global warming of more than 2°C. Days of frost will continue to fall in number. The decline in the amount of precipitation in summer will increasingly affect northerly regions as well. With the exception of the Baltic Sea, the sea level in Europe will continue to rise at least as quickly as the global average. The reduction of glaciers, permafrost and snow at high elevations will continue. For western and central Europe in particular, the IPCC report predicts more heavy precipitation events, an increase in river floods and more hydrological and agricultural droughts.
2 According to data from the EU's Copernicus Climate Change Service, the average temperature in Europe in 2020 was more than 1.6°C above the long-term mean and 0.4°C above the highest temperature measured previously. The average temperature in autumn and winter 2020 was 3.4°C above the long-term mean and 1.4°C above the highest temperature measured previously.
3 For example, the EU's European Environment Agency estimates on the basis of data sourced from Munich Re AG that the economic losses caused by extreme weather events in all 27 EU Member States came to roughly €13 billion in 2019.

physical changes might also impair global trade routes or disrupt supply chains. And lastly, all these developments are fraught with heightened macroeconomic uncertainty, which in turn can impact on household and corporate consumption and investment patterns.

Many of these risks also concern the German economy, but there is no question that they affect the European economies as a whole and thus have a bearing on price stability. Positive or negative shifts in the inflation rate as a result of the aforementioned effects will depend on how shocks to supply and demand interact and on the uncertainty surrounding these shocks, which means that there is no single way to determine them. Even so, it appears plausible that the real economy, and also inflation, will experience greater volatility in the future as a result of extreme weather events. Recent consumer price dynamics in the euro area in response to the COVID-19 pandemic may serve as a point of reference here, even if the extreme shock that triggered them in this particular case is not directly related to climate change.

Transition risks, meanwhile, are understood to be risks that result from the ongoing shift to a climate-neutral economy. These can include risks resulting from climate action but also those prompted, for example, by changes in consumer behaviour or technological advances. Economic theory suggests that the pricing of carbon (and carbon-equivalent) emissions – ideally applied globally and across all sectors – would be the most efficient policy instrument for internalising the externalities associated with climate change. The EU Emissions Trading System (ETS) implements this instrument, albeit insufficiently, at the EU level. In addition to the ETS, however, the euro area countries have a great many additional national climate policies that often lack coordination within the country itself or with other Member States.[4]

It is the task of the Eurosystem to understand the economic implications of regulatory climate policies of this kind and take account of their effects on price stability in the euro area. These effects might include unemployment or growth losses in some sectors and regions or a boost to investment and innovation in others. There is also the danger of assets becoming stranded. This happens when the capital stock of an enterprise or sector abruptly or gradually loses value if that capital can no longer be used for production, or if production itself has ceased to be profitable on account of higher carbon prices. Lastly, potential global trade conflicts are another type of climate-related transition risk.

The aforementioned challenges were the backdrop against which the Eurosystem set about revising and expanding the methodological framework for its economic analyses and forecasts. Integrated assessment models (IAMs) are the most common type of climate-related economic models.[5] By internalising the externalities of climate change for an economy's factor productivity, IAMs enable both an optimal consumption and investment pathway and the associated carbon price and emissions pathway to be determined. Alongside these cost-benefit IAMs, cost-effectiveness models also play an important role in macroeconomic

4 Survey data gathered by the European Environment Agency in 2019 reveal that some EU Member States have as many as 100 different national regulatory policies on climate and environmental protection. OECD calculations show that the effective carbon tax resulting from regulatory policies of this kind for petrol, for example, varies across all 27 EU Member States between around €150 and €350 per tonne, while the effective carbon tax for coal is less than €50 per tonne across the bloc.
5 See, for example, Nordhaus (2017).

analyses. Put simply, cost-effectiveness models can be used to compute an economically optimal pathway under the constraint of a particular climate objective (such as the 1.5°C target under the Paris Agreement). While there is now a very advanced body of literature on IAMs, particularly on the modelling of key components such as the damage function, it remains difficult to calibrate or estimate such models with any degree of reliability.

Blending IAMs with traditional economic central bank models is not only a core element of the climate action plan adopted by the Eurosystem but also a challenge that will place great demands on all the national central banks and the European Central Bank. There has been a disconnect between climate-related IAMs and central bank macroeconomic models in two key respects hitherto. Traditional central bank models often lack the granularity needed to model the highly heterogeneous effects of climate change in different sectors and regions, while IAMs do not capture many of the monetary policy transmission channels or fail to do so adequately. The Eurosystem's action plan has identified both fairly rudimentary short-term solutions ("satellite approach") as well as substantial medium-term model extensions. Scenario analyses are also under consideration for certain situations.

Furthermore, the Governing Council of the ECB decided to adapt the models the Eurosystem uses for economic forecasting, which will involve examining aspects such as the economic forecasting quality of weather and climate data or the prices of emissions allowances. It will be crucially important here to take account of non-linearities and tipping points, which also means reviewing the existing methodological framework for forecasts.

Practical monetary policy implementation hinges on functioning financial markets. This is another area where climate change – through the channels of impact outlined above – can have implications that researchers still do not fully comprehend. For example, the aforementioned risk of asset stranding at the firm level might impair monetary policy transmission, lower banks' creditworthiness and ultimately reduce the supply of credit. Financial risks to the central bank balance sheet can arise if, within a very short space of time, the prices of assets used for monetary policy transactions exhibit severe volatility or necessitate write-downs as a result of climate change. Empirical evidence suggests that capital markets are already pricing in these risks. Even so, it remains difficult to assess whether or not those market price adjustments are adequate.

Furthermore, greening the economy generally implies that there will be a surge in corporate demand for capital that could well differ across countries and sectors. Little is known about how these capital needs will be covered and how global capital flows will change in this regard. Newly emerging financing instruments such as green bonds might also have a bearing on monetary policy transmission.

One final key point for practical monetary policy implementation is that climate change could further narrow monetary policy space. That would be the case if the aforementioned macroeconomic effects end up lowering the natural rate of interest (which is often referred to as r^* in models). The economy would then move closer to the effective lower bound, possibly necessitating the increased use of unconventional monetary policy measures.

It was for these reasons that the Governing Council of the ECB decided not only to deepen its macroeconomic analytical capabilities but also to roll out a raft of additional measures aimed at overcoming these practical challenges. First, the Eurosystem intends to improve the body of statistical data used to analyse financial risks from monetary policy transactions by playing an active role in developing climate risk indicators. In addition, the disclosure and transparency requirements for monetary policy counterparties are to be tightened, taking corresponding EU policies and initiatives in this field into account. The Eurosystem will furthermore conduct regular climate stress tests on its balance sheet to identify whether climate-related financial risks give any cause for concern. Internal and external credit ratings for monetary policy transactions (collateral framework and asset purchase programmes) will also be reviewed and developed further as appropriate. And lastly, the Eurosystem will analyse in the coming years whether the risks and externalities arising from climate change will necessitate an adjustment of the eligible universe for monetary policy purchase programmes and potentially for the monetary policy collateral framework.

Monetary analyses continue to provide valuable information on longer-term price risks, despite sharply weaker empirical money-price relationship

inflation when assessing longer-term risks to price stability. This is no longer the case. In an environment of low and stable inflation rates, as seen in the euro area in recent decades, the money-price relationship is empirically only very weak.[75] Nonetheless, monetary and financial variables still contain valuable information on future price risks and economic dynamics, especially in the longer term: the models used for monetary and financial analysis can, for instance, give indications of destabilising feedback mechanisms between the financial sector and the real economy. In addition, credit and other financial variables help to empirically predict tail risks to gross domestic product (GDP), often in connection with financial instabilities.[76] On top of that, financial shocks can be identified and their impact on future developments in GDP and inflation can be determined only in macroeconomic models that also contain monetary and financial variables such as monetary and credit aggregates as well as bank lending rates.[77]

Increased inclusion of financial stability aspects, but financial stability not a monetary policy objective in its own right

As part of its strategy review, the Governing Council of the ECB also decided that financial stability considerations would be given greater weight in the monetary policy debate going forward.[78] The idea is not to make financial stability an objective in its own right. Instead, the focus lies on the effects of financial imbalances on price stability in the medium term. The increased interest on the part of the Governing Council is motivated by the recognition that financial stability is a precondition for price stability. Moreover, the experiences of the past 20 years show that the interrelationship between price stability and financial stability has gained

75 For more on the weakening of the money-price relationship, see, for instance, De Grauwe and Polan (2005) and Teles et al. (2015). For potential structural causes, see, for instance, Benati (2009) and Sargent and Surico (2011).
76 For information on the associated growth-at-risk approach, see, for instance, Deutsche Bundesbank (2021b).
77 See, e.g., Deutsche Bundesbank (2020) and Mandler and Scharnagl (2019).
78 For further explanations, see, e.g., Work stream on macroprudential policy, monetary policy and financial stability (2021).

in importance. The experiences with the financial and sovereign debt crisis also demonstrate that financial crises can cause significantly higher costs than initially expected, both because of a failure to meet the objective of price stability and through disruptions to the monetary policy transmission process.

Financial stability considerations are taken into account on a case-by-case basis and flexibly

For these reasons, the Governing Council of the ECB expressly wants the option of incorporating financial stability aspects into its monetary policy decisions. It intends to do this on a case-by-case basis and flexibly. A systematic response to financial stability risks is not being considered. The evaluation of the information needed for such decisions will be integrated into the monetary and financial analysis.

Integration of financial stability considerations into the monetary and financial analysis

It is not new for financial stability aspects to be included in the monetary analysis. The main source of trend monetary growth is bank lending,[79] and excessive growth in such lending was already considered an early warning sign for potential instabilities in the financial system at the beginning of monetary union.[80] In addition, financial stability aspects have, for years, been taken into account in the monetary policy decision-making process through the analysis of the monetary policy transmission process. The significance of financial stability for monetary policy means that this field of analysis is to be expanded even further now: a key point is a systematic assessment of potential tail risks to output and inflation that could arise from the longer-term build-up of financial vulnerabilities and imbalances. There will further be more extensive analyses of the side effects of the unconventional monetary policy. Analyses are also needed on the extent to which macroprudential measures can contain financial stability risks with a bearing on monetary policy.

Complex interrelationships between monetary policy, financial stability and macroprudential policy not yet comprehensively researched

However, the complex interrelationships between monetary policy, financial stability and macroprudential policy have not yet been comprehensively researched, nor their interaction in various phases of economic and financial cycles. Here lies one area for development for future monetary and financial analysis.[81] Moreover, additional work is required in order to better assess the proportionality of the use of various monetary policy instruments in an environment of mounting financial stability risks.

Concluding remarks

The Eurosystem's new monetary policy strategy is designed to take into account the new and altered challenges that have arisen since the last review in 2003. With a new operationalisation of price stability, an altered monetary policy reaction function and greater recognition of the interconnectedness of the real economy and the financial system, the key elements of the new strategy reflect the challenges of recent years. The inclusion of climate change means that one of the main tasks for the future has now also been incorporated into monetary policy analysis and implementation in terms of its economic impact. This is intended to equip monetary policy with the necessary framework to combat both inflationary and deflationary tendencies.

As the economic, financial and institutional environment in which monetary policy acts is subject to constant change, the ECB's Governing Council has decided, however, to regularly review its monetary policy strategy going forward. The next assessment is scheduled to take place in 2025.

79 See, for example, Deutsche Bundesbank (2017d).
80 See, e.g., Issing (2003b).
81 For more on the methodological challenges of a joint analysis of economic developments and medium-term financial cycles, see, for instance, WGEM Team on Real and Financial Cycles (2018).

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