NBB Economic Review

2023 No 7

Inflation expectations and monetary policy

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National Bank OF BELGIUM
Eurosystem

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Introduction

Following the Covid-19 pandemic, inflation in the euro area surged due to an unprecedented combination of factors, including pent-up demand, persistent supply chain disruptions, and soaring food and energy prices triggered by Russia's invasion of Ukraine. Inflation hit a record high of 10.7 % in October 2022. Although it gradually fell back to 5.3 % in August 2023, the current inflation rate still far exceeds the European Central Bank's (ECB) medium-term target of 2 %, designed to ensure price stability.

In response to these developments, the ECB started to change its monetary policy stance in December 2021, moving away from the accommodative position adopted in previous years when inflation was too low. After stopping net asset purchases, it began to raise interest rates, pushing them into restrictive territory. Throughout this process, the ECB has closely monitored developments in inflation expectations. For instance, in June 2023, ECB President Christine Lagarde warned at the ECB Forum on Central Banking in Sintra (Lagarde, 2023) that "[m]onetary policymakers need to address this dynamic [persistent inflation] decisively to ensure that it does not lead to a self-fulfilling spiral fed by a de-anchoring of inflation expectations". In essence, the significance of inflation expectations for monetary policy lies in the fact that when a swift return to the 2 % target is generally expected, consumers and businesses are less likely to react to a steep rise in inflation, making it easier for the ECB to fulfil its mission of maintaining price stability.

This article provides a detailed assessment of current inflation expectations and their implications for monetary policy. Based on a review of different measures of inflation expectations, we conclude that longer-term expectations have thus far remained broadly anchored at the ECB's target rate. Nevertheless, points for attention have arisen, meaning heightened scrutiny is called for. Indeed, if economic agents start to form expectations that diverge from the ECB's objective, this could put the credibility of monetary policy at stake. The remainder of this introduction briefly reviews the theoretical arguments for keeping a sharp eye on changes in inflation expectations and the main challenges monetary policymakers face when doing so.

Why do inflation expectations matter for monetary policy?

Inflation expectations play a fundamental role in ensuring macroeconomic stability. History has shown the potential consequences of letting these expectations go awry. The US experience from the beginning of the 1960s through the 1970s, when inflation rose from around 1 % to more than 10 %, is most relevant in this regard. After many years of high inflation, inflation expectations in the US became entrenched. In 1979,

shortly after the end of his final term as chairman of the Federal Reserve, Arthur Burns acknowledged his failure to control "inflation psychology", i.e. widespread expectations of high inflation (Burns, 1979). His successor, Paul Volcker, was only able to correct this psychology at great cost, through extraordinarily tight monetary policy (Goodfriend and King, 2005). As a result, GDP growth dropped significantly, implying a negative output gap, while unemployment surged during two pronounced recessions. This was the price to pay for maintaining monetary policy credibility. Eventually it paid off, however. Inflation returned to lower levels, unemployment subsided, and GDP growth rebounded.

Specifically, inflation expectations matter for monetary policy for two main reasons. First, they are crucial in determining the appropriate monetary policy stance. Although monetary policy relies on nominal interest rates to steer price developments, it is real interest rates, i.e. the nominal rates adjusted for expected inflation, that truly matter for consumption and investment decisions (Visco, 2023; D'Acunto *et al.*, 2023). Therefore, a comprehensive understanding of expectations of price developments is necessary when it comes to setting and assessing the monetary policy stance.

Second, aside from their direct impact on real rates, inflation expectations play a key role further down the monetary policy transmission chain. In fact, these expectations shape economic decisions of households and firms, which in turn influences current inflation. For instance, when workers anticipate higher inflation, they may seek to negotiate wage increases in order to protect their purchasing power. However, in response, firms may raise prices to compensate for a higher wage bill, thus fueling inflation. Similarly, firms may face certain rigidities, such as menu costs or staggered price contracts, which hinder their ability to adjust prices promptly. Consequently, when given the opportunity to reset prices, firms consider not only current but also expected cost increases which, in turn, reflect their expectations of price pressures. In both examples, higher inflation expectations contribute to the emergence of inflation. Moreover, in a feedback loop, high inflation can lead to expectations of further price increases, resulting in a self-fulfilling spiral in which inflation and inflation expectations feed off each other.

Given these dynamics, anchoring inflation expectations as closely as possible to the ECB's 2 % target is critical in order to achieve price stability. In a high-inflation environment, a strong monetary policy response – possibly entailing significant economic costs – will be required if inflation expectations become de-anchored (see the US experience in the 1980s). Conversely, a de-anchoring of inflation expectations at levels below the central bank's target will also endanger price stability. In the aftermath of the great financial crisis, the main concern was the possibility of long-term inflation expectations becoming too low. Central banks feared that a fall in long-term expectations could lead to a decline in the inflation rate, perpetuating a cycle of low inflation and compressing policy space (Deroose and Stevens, 2017).

Practical challenges in assessing inflation expectations

While the importance of inflation expectations for monetary policy is well understood in theory, monetary policymakers face certain practical challenges when it comes to assessing these expectations. As summarised by Visco (2023), these pertain to the intricacies involved in measuring and interpreting expectations.

A first challenge is that there is no single measure of inflation expectations. Over the years, a wide variety of data has become available through financial markets and surveys, confirming that different economic agents (households, firms, professional forecasters, financial market participants) have heterogeneous perceptions of future price dynamics. In addition, the available measures allow expectations to be captured over different time horizons, which raises the question of which forecast horizon should be used. Short-term expectations naturally provide valuable insight into near-term price developments while long-term expectations are typically considered the "anchor indicator" par excellence.

Measuring the anchoring of inflation expectations to the target rate presents a separate challenge. Ball and Mazumder (2011) and the ECB (2021) distinguish between "level anchoring" and "shock anchoring".

Level anchoring refers to the mooring of expectations to the target rate (i.e. 2 % for the euro area). In contrast, shock anchoring refers to the impact of transitory shocks on inflation expectations. A comprehensive assessment of de-anchoring risk requires considering all measures, as focusing on only one could lead to misleading conclusions. For instance, evidence of shock de-anchoring when expectations are below target could indicate a favourable re-anchoring in level terms. Conversely, observing solely average expectations in the vicinity of the target could result in an underestimation of the risk of de-anchoring if expectations were to respond to unexpected shocks.

In order to interpret measures of inflation expectations, it is necessary to understand how these expectations are formed. The dominant assumption in modern macroeconomics is that expectations are rational. According to this assumption, inflation expectations incorporate all information useful to forecasting future inflation, thus implying they are accurate on average (i.e. absent further shocks, inflation will converge towards the reported expectation figures). However, an increasing body of empirical evidence suggests the presence of systematic forecasting errors, indicating that at least some economic agents form expectations with imperfect knowledge. This is a critical consideration, as imperfect knowledge could cause reported measures of inflation expectations to overlook important information and thus misjudge future developments.

Taking these challenges into account, this article is structured as follows. Section 1 addresses the challenge posed by the multifaceted nature of inflation expectations and takes a closer look at the various measures available to euro area policymakers to gauge these expectations, including market-based measures and surveys of both professional forecasters and consumers and firms. The strengths and weaknesses of these measures are covered, along with their level anchoring in relation to the 2 % target amidst the currently high inflation. Section 2 assesses the shock anchoring of inflation expectations and provides insight into the potential dynamics of these expectations in response to changing economic conditions. The role played by the formation of expectations in the interpretation thereof and the implications for monetary policy are addressed in Section 3. In contrast to the first two sections, the analysis in this section is more conceptual. Using a stylised model, we demonstrate the potential implications of changes in how expectations are determined for the assessment of de-anchoring risk. An empirical analysis of actual changes in the formation of expectations is an intriguing avenue for future research. The final section sets out our conclusion.

1. Measures of inflation expectations and assessment of level anchoring

This section covers the main measures of inflation expectations : those derived from financial markets, surveys of professional forecasters, and surveys of consumers and firms. We analyse recent developments in these measures, in particular their implications in terms of level anchoring to the ECB's 2 % target rate amidst the currently high inflation.

We also examine their strengths and weaknesses so as to determine their value in assessing the risk of de-anchoring. For instance, market-based measures are available at higher frequency than survey-based ones, allowing for a more timely assessment. However, a drawback of the former is that they include inflation risk premia, meaning they are not necessarily aligned with *genuine* inflation expectations. And while expectations of consumers and firms may be considered to best reflect the perceptions of price and wage setters in the economy, they present their own challenges, namely they can vary across surveys and the latter often lack questions related to long-term expectations.

1.1 Market-based measures

Inflation-linked swap (ILS) rates are one of the most commonly used market-based measures to infer inflation expectations. Regarding the euro area specifically, their main advantage is that they are readily available for the area as a whole (as opposed to break-even inflation rates which are available at the Member State level only). Like standard swaps, inflation swaps exchange fixed payments for floating ones, with the specificity that the floating payments are linked to the harmonised index of consumer prices (HICP). Concretely, floating payment recipients receive the average inflation rate observed over the lifetime of the swap (applied to a notional principal amount) while fixed payment recipients receive the (market-determined) ILS rate (applied to the same notional principal amount). As payments occur only at maturity (there is no down payment), the value of the fixed payment must be equal to the expected value of the floating payment, so that:

$$\left(1+\pi_{t,M}\right)^{M} = E_t\left[\frac{HICP_{t+M\ years}}{HICP_t}\right],$$

where $\pi_{t,M}$ is the M-year annualised ILS rate observed at time t, $E_t[.]$ denotes expectations conditional on information available up to time t, and $HICP_{t+M\ years}/HICP_t$ refers to the percentage increase in the price index over M years.[1]

The primary advantages of ILS rates are that they are frequently available (daily and even intra-daily data) and provide an entire term structure for inflation expectations (short-, medium- and long-term horizons). For example, the left graph in Figure 1 shows daily ILS rates with maturities ranging from one to 30 years. As can be seen, ILS rates dropped during the global financial crisis but relatively quickly converged back to 2 %. Between 2012 and 2020, they essentially followed a downward trend, reaching a trough shortly after the outbreak of the pandemic in Europe. More recently, ILS rates surged in the context of supply shocks related to damaged global value chains and energy price increases exacerbated by Russia's war in Ukraine. In particular, short-term ILS rates (e.g. those with a maturity of one year) climbed to above 8 % before dropping back to close to the ECB's target rate. Longer-term ILS rates (e.g. those with a maturity of 10 or 30 years) remained more stable, as they embed longer-term inflation expectations which should in principle be anchored at the ECB's objective.

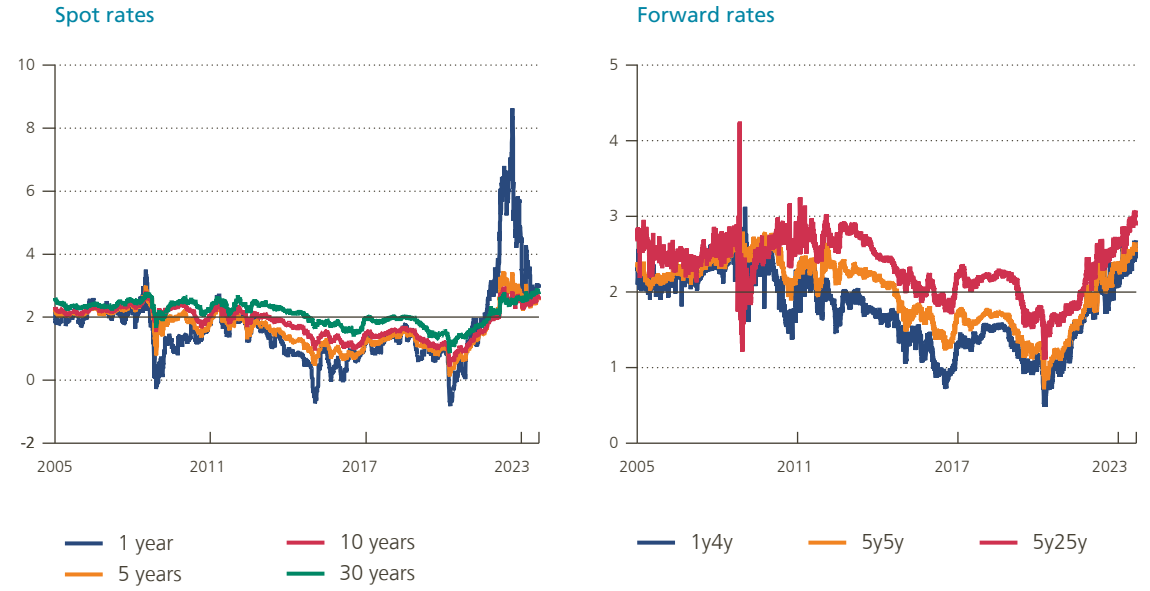
Forward ILS rates, i.e. the rates applicable to swaps that will start in the future, are more suitable for gauging the anchoring of market-based inflation expectations at the ECB's objective, as they take some distance from short-term expectations and thus *de facto* from recent inflation developments. Forward ILS rates are plotted on the right graph in Figure 1. Forward rates have broadly followed the same pattern as spot ILS rates but with movements of lesser amplitude. That being said, longer-term forward ILS rates, such as the five-year forward ILS rate five years ahead and the five-year rate 25 years ahead, have recently ventured away from the 2 % level, which could be considered a tentative sign of the de-anchoring of expectations. The former rate is often favoured when assessing de-anchoring as this horizon broadly corresponds to the "medium-term" horizon of the price stability objective and rests on the most liquid segments of the ILS market (Böninghausen *et al.*, 2018; Boneva *et al.*, 2019).

1 This definition of ILS rates glosses over the fact that the reference price index is the HICP excluding tobacco and that there is a three-month indexation lag meaning ILS rates observed in a given month measure expectations over a period that started three months earlier.

Figure 1

Inflation-linked swap rates

(euro area, %)



Sources: Bloomberg and own calculations.

One drawback of market-based measures is that they include inflation risk premia and hence are not necessarily aligned with genuine inflation expectations (Camba-Méndez and Werner, 2017; Burban *et al.*, 2021). Inflation risk premia arise when risk-averse market participants face uncertainty regarding future inflation. However, positive (or negative) inflation risk premia are not necessarily associated with upside (or downside) risks to the inflation outlook. Using a simple consumption-based asset pricing model, the sign of inflation risk premia can be determined by the type of shock prevailing in the economy (Rostagno *et al.*, 2021). If supply-side shocks prevail, inflation risk premia will tend to be positive: as inflation correlates or is perceived to correlate negatively with economic growth, it rises when consumption (economic activity) goes down, implying a double hit for consumers who will then demand a premium to invest in nominal assets. On the other hand, if demand-side shocks prevail, inflation risk premia will tend to be negative, following the same lines of reasoning.[2]

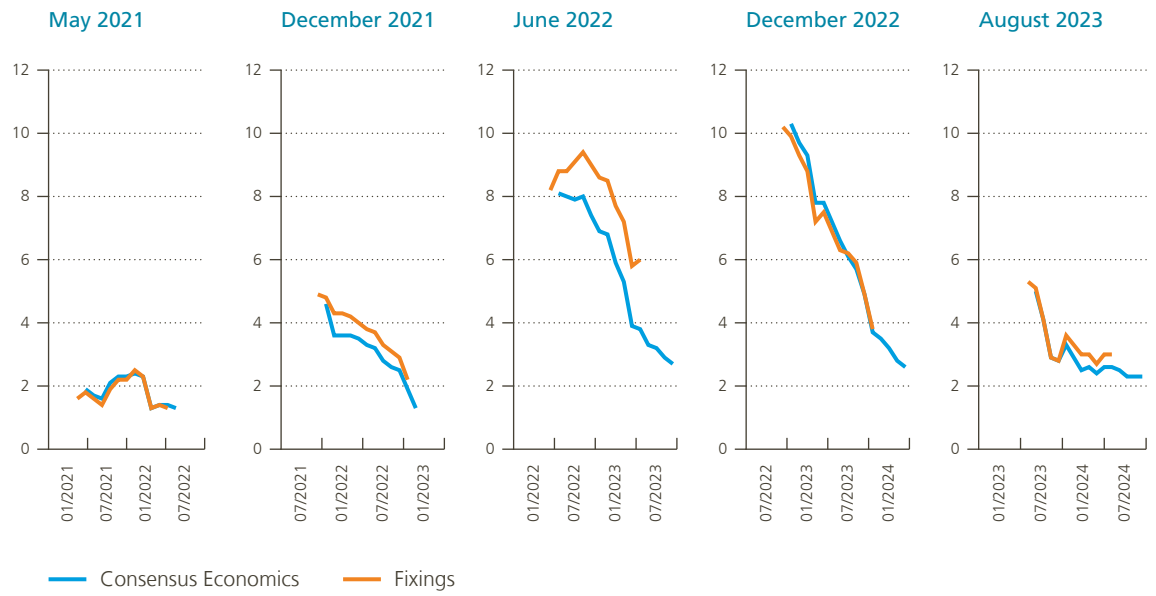
The presence of inflation risk premia in market-based measures is well illustrated by developments observed at the end of 2021 and the beginning of 2022. Figure 2 compares inflation implied by so-called fixings, which are essentially inflation swaps but with shorter maturities (less than a year), and forecasts based on Consensus Economics surveys. Forecasts from surveys (covered in more detail in the next sub-section) do not contain inflation risk premia, as survey respondents do not engage in financial transactions when submitting their forecasts. In the second half of 2021, inflation implied by fixings started to exceed Consensus Economics forecasts, indicating positive inflation risk premia. This outcome reflected the emergence of bottlenecks in apathetic global supply chains, which were struggling to cope with pent-up demand accrued during the post-pandemic economic recovery. Inflation risk premia continued to rise in the first half of 2022 after Russia's invasion of Ukraine caused further supply chain disruptions, including substantial energy supply shocks (leading to skyrocketing oil and gas prices). Since then, inflation risk premia have fallen again amidst receding energy prices.

2 For more information on inflation risk premia, see the reasoning of Narayana Kocherlakota as reported by De Long (2016). Inflation risk premia also provide relevant signals for central banks. Changes in inflation risk premia can reflect demand shocks triggered by monetary policy decisions. In addition, the size of these premia depends on the level of economic uncertainty, to which central banks may contribute.

Figure 2

Fixings and Consensus Economics[1]

(euro area, %)



Sources: Bloomberg and Consensus Economics.

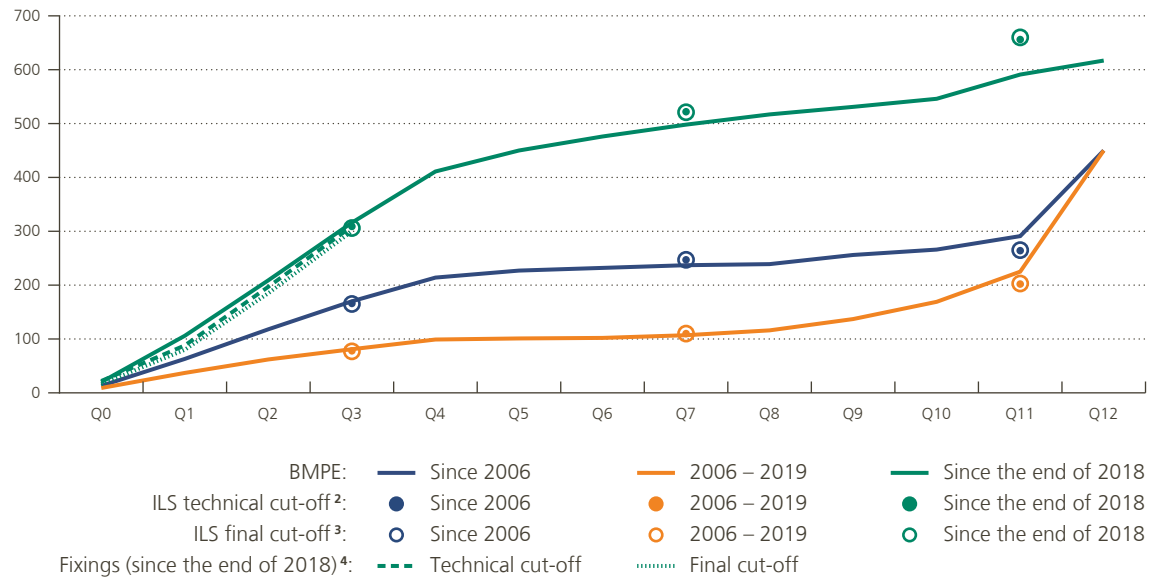
1 Fixings are recorded on the Consensus Economics survey dates: 3 May 2021, 9 December 2021, 16 June 2022, 8 December 2022, and 7 August 2023.

Despite being affected by inflation risk premia, market-based measures have proved to be competitive forecasters of inflation. In fact, the forecasting performance of these measures is similar to that of the ECB/Eurosystem staff, as shown in Figure 3. The latter produce quarterly inflation forecasts within a broad macroeconomic projection exercise (BMPE). The longer-term staff forecasts can be compared to inflation implied by the one, two- and three-year ILS rates, while shorter-term forecasts (less than one year ahead) can be compared to fixings. The forecasting ability of both ECB/Eurosystem staff and market-based measures depends on the timing (e.g. larger-than-usual forecast errors were reported during the COVID-19 pandemic and ensuing period of high inflation), but overall the forecast errors of the two are comparable, indicating that market-based measures convey relevant information on future inflation developments. These results are in line with those of Grothe and Meyler (2018) and the ECB (2021), finding that market- and survey-based measures have broadly similar forecasting ability.

Figure 3

Root mean squared forecast errors [1]

(basis points)



Sources: Bloomberg, ECB and own calculations.

1 Q0 corresponds to the quarter during which a BMPE is conducted. Q1, Q2, etc. denote the quarter-ahead forecast horizons. The number of BMPE forecasts decreases with the horizon, especially in the third forecasting year: 70 forecasts are available for Q0, 62 for Q8, 51 for Q9, 35 for Q10, 19 for Q11, and 4 for Q12.

2 "Technical cut-off" refers to the cut-off date for technical assumptions in a BMPE, such as for oil prices and exchange rates. The month-specific ILS rate forecasts are assigned to their respective quarters: 67 forecasts at the one-year horizon, 63 at the two-year horizon, and 59 at the three-year horizon.

3 "Final cut-off" refers to the date on which euro area forecasts are finalised in a BMPE. The distinction between technical and final cut-off dates is made as from 2006 in ECB/Eurosystem staff reports.

4 Month-specific fixings forecasts are aggregated by quarter so as to match the BMPE quarterly forecast horizon. There are 19 forecasts for Q0, 18 for Q1, 17 for Q2, and 16 for Q3. Data on fixings have been published since 2018 by Bloomberg.

1.2 Measures based on surveys of professionals

Surveys of professionals gather market intelligence on expectations of monetary policy and the economy, including inflation. The respondents are professionals employed by financial and non-financial institutions, such as banks and economic research institutes, who use various forecasting methodologies and integrate expert judgment into their forecasts.

Aggregate measures suggest that long-term inflation expectations remain well anchored

As underlined by Grishchenko *et al.* (2019), survey-based measures are closely monitored and used to assess the anchoring of inflation expectations. Their primary advantage over market-based measures is that they are not affected by inflation risk premia. Furthermore, survey expectations have been shown to be successful in forecasting inflation compared with various time-series models. Consequently, they serve as valuable input in empirical models of inflation (as demonstrated by e.g. Stevens and Wauters, 2021). However, survey expectations are less frequently available, making them less suitable than market-based data for day-to-day monitoring, and typically cover a more limited range of horizons. In addition, survey-based measures present challenges related to the aggregation of individual forecasts (mean versus median), potentially different aggregate forecasts across surveys (in part due to the sometimes small group of respondents), and potential "careless reporting".

Of the survey-based metrics, special attention is paid herein to the ECB Survey of Professional Forecasters (SPF). The survey was conducted for the first time in January 1999 and is now the longest-running survey of euro area macroeconomic expectations. It is carried out four times a year, in January, April, July and October. The number of respondents is around 50, depending on the survey round and the questions asked. The survey gauges expectations of annual HICP inflation (and annual core HICP inflation) in the euro area at several horizons, for different purposes. Shorter-term expectations allow the tracking of how professionals assess new information about shocks to the economy, for instance from incoming data (de Vincent-Humphreys *et al.*, 2019), and inference of the path inflation is expected to follow when converging back to 2 %. Longer-term inflation expectations provide insight into the credibility of the Eurosystem's inflation objective.

The left graph in Figure 4 presents expected headline inflation at different horizons. One-year-ahead expectations are the most volatile of the horizons considered, following closely on the heels of observed inflation figures. SPF short-term expectations peaked at 4.8 % in the fourth quarter of 2022. At that time, respondents had observed the September 2022 inflation rate, which reached almost 10 % before exceeding this threshold the following month. In the first half of 2023, short-term expectations dropped below 3 % amidst easing energy price pressures. Medium-term expectations are illustrated by the SPF two-year-ahead expectations. Historically, these have closely followed the short-term series, albeit with less marked peaks and troughs.

While in theory assessing the anchoring of inflation expectations should be a relatively straightforward exercise, entailing a direct comparison of measures of expectations with the central bank target, it is not always that simple in practice (ECB, 2021). Before the 2021 ECB strategy review, the euro area's price stability objective was defined as "below, but close to, 2 %" over the medium term. The precise meaning of the wording "close to" and "medium term" was not defined. An ad hoc question was thus included in certain SPF surveys (Q4 2020 and Q3 2019), the results of which suggested that respondents generally consider the ECB's price stability objective to be between 1.7 % and 2.0 %. In July 2021, the ECB's Governing Council modified the concept of price stability and clarified it in its strategy review : price stability is best maintained by aiming for 2 % inflation over the medium term, with negative and positive deviations from the 2 % target considered equally undesirable. As regards the definition of medium term, it is a flexible concept as the optimal monetary policy response to a deviation of inflation from the target depends on the origin, magnitude and persistence of the shock. For instance, supply shocks, which create a trade-off between inflation and economic activity, do not call for a strong monetary policy response, which would weigh on economic activity, as long as the effects on inflation are expected to be temporary. The lengthiest horizon in the SPF is about five years ahead, which is often referred to as the "long term" as it is reasonable to assume that the effects of most shocks to the economy will have vanished by that time. If the 1.7 %–2 % inflation benchmark is used, average long-term expectations have been de-anchored for only a short period of time in the history of the euro area, i.e. when they reached a low of 1.6 % in Q3 2020. More recently, average long-term expectations have exceeded the 2 % target set in the strategy review, but only slightly (2.1 %–2.2 %). Neri *et al.* (2022) see the recent increase in long-term expectations as a re-anchoring at the ECB target.

Alongside the SPF, the ECB conducts a Survey of Monetary Analysts (SMA) eight times a year, corresponding to the Governing Council's monetary policy meeting cycle. The purpose of this survey is to collect information on financial institutions' expectations of monetary policy instruments, financial markets and the economy (Brand and Hutchinson, 2021). The number of respondents is between around 30 and 40 depending on the survey round and the questions. The publication of aggregate results started in June 2021. The SMA forecast horizon goes up to ten years ahead for some variables which, for the sake of simplicity, can be interpreted as representing long-term expectations. According to the SMA, the lowest median expected long-term inflation rate, of 1.75 %, was reported in June 2021, after which time it gradually returned to 2 % (like the SPF median expectations), as shown in the right graph in Figure 4.

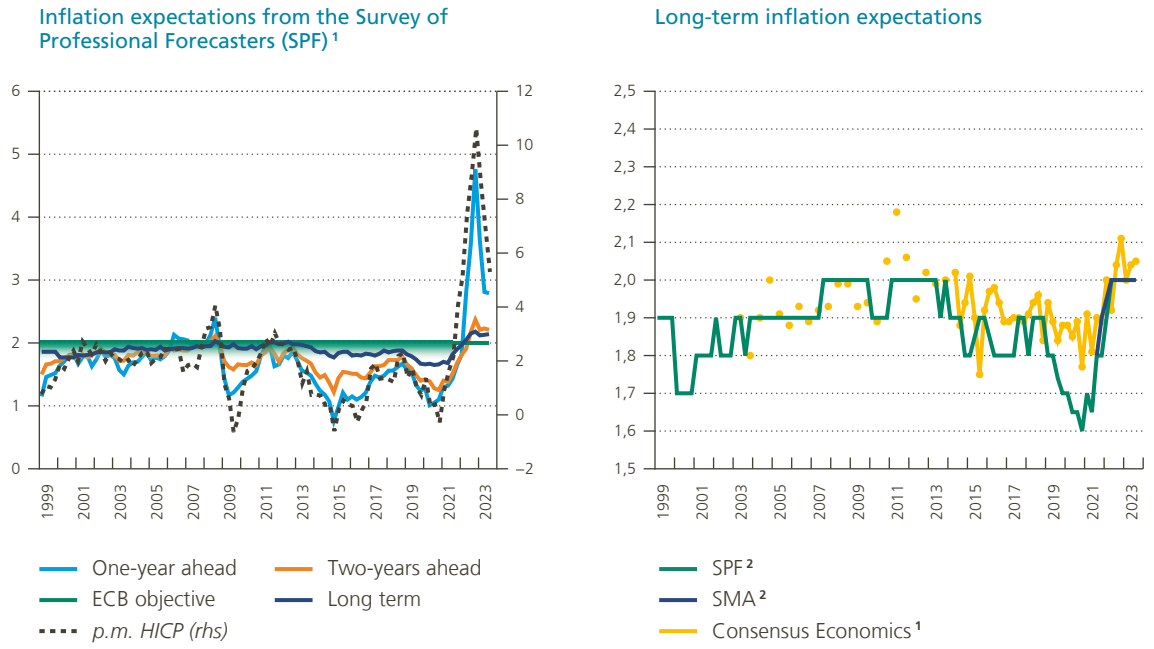
Finally, Consensus Economics also publishes "long-term" inflation expectations for the euro area, based on a quarterly survey of around 30 financial institutions. In the Consensus Economics survey, the long-term horizon refers to average inflation six to ten calendar years ahead. This long-term forecast has remained quite stable over time and, as from 2022, respondents have almost invariably returned an answer of 2 %.

All told, aggregate survey indicators suggest that despite the recent surge in inflation, longer-term expectations have remained well anchored thus far. However, for a more comprehensive assessment of the risk of de-anchoring, the entire distribution of inflation expectations should be considered as it could provide valuable insight beyond what is indicated solely by central tendencies.

Figure 4

Survey-based inflation expectations

(euro area, %)



Sources: ECB and Consensus Economics.
1 Average point forecasts.
2 Median point forecasts

Looking beyond the central tendency, distributions reveal some risk of de-anchoring

Reis (2022) suggests that in order to effectively assess whether inflation expectations are unmoored or not, it is crucial to look beyond central tendency measures and to consider those of "disagreement" amongst forecasters. Drawing from past inflationary and deflationary episodes, along with the 2021-2022 period in the US, Reis notes that during periods of sharp inflationary (or deflationary) movements, the distribution of expectations – as derived from survey responses – goes through a specific sequence of changes. Initially, there is a shift in the skew, where the "tail" of the distribution moves to the right (or the left). Subsequently, the standard deviation increases, causing the distribution to widen. Finally, the median shifts to the right (or left), completing the transformation of the distribution of responses.

As shown in the left graph in Figure 5, in the period from 2003 (when the ECB's first monetary policy strategy review set the medium-term inflation objective at "below, but close to, 2 %") to the beginning of 2014, the distribution of individual longer-term inflation expectations from the SPF peaked at 2 %, with significant mass at 1.9 % and 1.8 %. This changed significantly between the second quarter of 2014 and the second quarter of 2021, with expectations becoming more dispersed and falling more often below 2 %. This trend reflected the period of low inflation in the euro area and the first waves of the COVID-19 pandemic. Notably, since 2022,

there has been a clear return of expectations to 2 % amid mounting price pressures related to the post-pandemic recovery and Russia's invasion of Ukraine. However, what makes this rebound different is the accumulation of mass on the right tail, indicating an increasing share of respondents reporting longer-term inflation expectations of 2.5 % or higher. In other words, the distribution has become increasingly skewed, signaling a greater prevalence of upside risks to inflation. The high-inflation portion reached a peak of 17 % in the third quarter of 2022 (representing 8 of the 46 respondents who provided longer-term inflation expectations). While the "tail group" of respondents has somewhat diminished in the meantime, it has not disappeared.

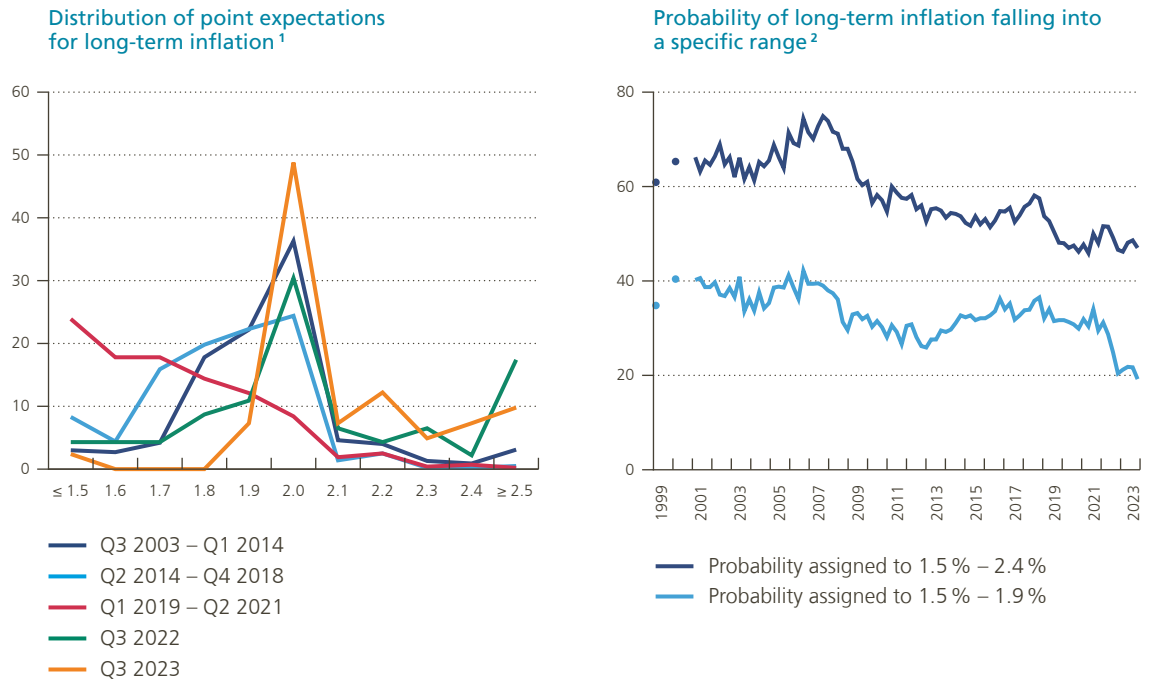
These recent shifts in the SPF's distribution of inflation expectations could signal an ongoing de-anchoring of aggregate expectations. To test this more formally, Górnicka and Meyler (2022) conducted Granger causality tests on the tail group's average expectations and those of the rest of respondents for both the long term and next year. The results did not provide clear evidence of Granger causality in either direction, which tempers the possible de-anchoring signals resulting from shifts in the distribution of inflation expectations.

Relatedly, Grishchenko *et al.* (2019) aimed to better capture the uncertainty underlying the concept of anchoring by measuring it as the probability of future inflation falling within a certain range consistent with inflation targets. We approximate their approach by directly using the SPF results for the euro area. In addition to reporting point forecasts, the SPF asks respondents to assign probabilities to different ranges of inflation outcomes expressed in bins of 0.5 percentage points (e.g. 0.5 % to 0.9 %, 1 % to 1.4 %, etc.). In Q3 2023, the aggregate probability of longer-term inflation in the 1.5 %–2.4 % range was only 47 %, as shown by the dark blue line on the right graph in Figure 5. This low mass of inflation expectations close to the ECB target suggests significant de-anchoring risk. This risk should however be qualified. First, although the probability of inflation expectations being between

Figure 5

Long-term inflation expectations according to the SPF

(euro area, %)



Source: ECB.

1 This graph shows the distribution of point forecast responses. The y-axis represents the percentage of respondents and the x-axis the inflation rate.

2 Respondents were asked to assign probabilities of long-term inflation falling into specific bins.

1.5 % and 2.4 % has historically been higher than at present, respondents have never completely excluded low or high inflation in the long term. For instance, aggregate probability in the 1.5 %-2.4 % bin hovered between 60 % and 70 % prior to the global financial crisis, while probability in the 1.5 %–1.9 % bin (more aligned with the ECB's objective at that time) was barely above 40 %. Second, based on the distribution of individual point estimates, the share of respondents expecting long-term inflation to fall between 1.5 % and 2.4 % remains high, above 85 % in Q3 2023.

In sum, analysis of SPF probability distributions points to moderate risk of inflation de-anchoring, which does not appear from the mean or median of point forecasts.

1.3 Surveys of consumers' and firms' inflation expectations

Press coverage often focuses on the inflation expectations of financial market participants and professional forecasters. However, the expectations of these groups may not be indicative of those of others. Traders and forecasters form a minority of all economic agents; they are also more sophisticated and well informed on economic matters than the general public.

This subsection discusses the inflation expectations of consumers and firm managers. As discussed above, the latter set prices in the economy, and economic theory posits that price setting depends on inflation expectations. Moreover, to the extent household inflation expectations affect wage demands, firms will (partially) pass on higher production costs (wages) to their sales prices (Reis, 2023).

While measures derived from consumers and firms are relevant to gauging the anchoring of inflation expectations, the interpretation thereof poses a challenge. According to recent studies, the expectations of households and firms indeed differ remarkably from those of traders and professional forecasters. Below several stylised facts that illustrate these differences are discussed.

Consumer inflation expectations differ from those of professional forecasters

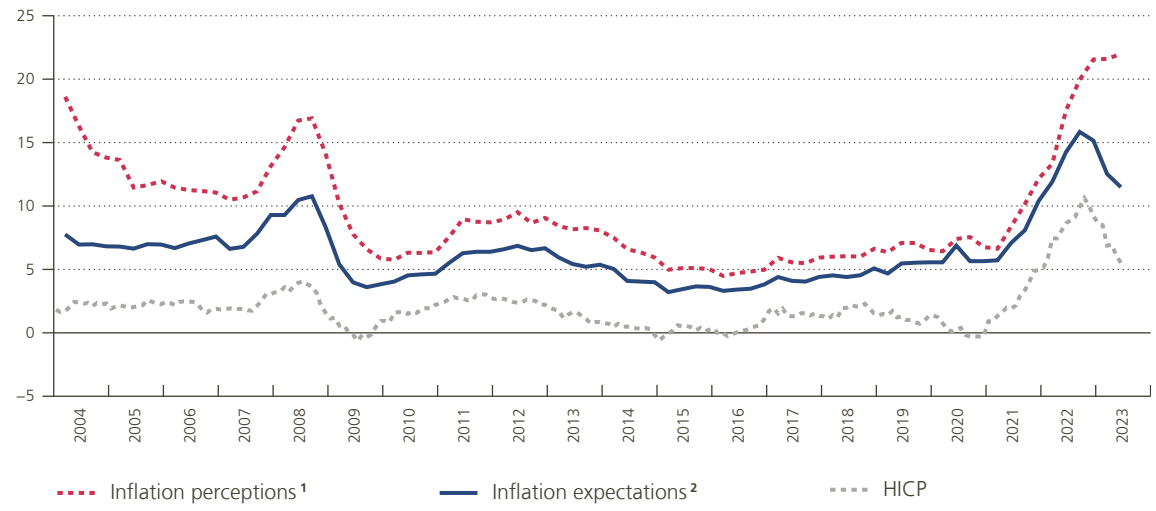
The European Commission (EC)'s consumer survey provides the longest available time series on consumer inflation expectations in the euro area. This harmonised survey is carried out monthly in the EU member states and is used to gauge, amongst other things, consumer confidence. The survey database contains summary measures of *qualitative* questions on perceived inflation developments over the last 12 months and expected inflation developments in the coming 12 months. These monthly series are publicly available for 30+ EU countries and start in the mid-80s. Since 2003, consumers have been asked about their *quantitative* inflation perceptions and expectations. Quarterly aggregates for the EU and the euro area, starting in 2004, are publicly available.

Figure 6 shows the evolution of average inflation perceptions over the past 12 months, average inflation expectations for the next 12 months, and actual HICP inflation. Several key points emerge. First, household inflation perceptions are upward biased, meaning the perception of inflation over the past 12 months systematically exceeds actual inflation. This bias is substantial: average HICP inflation over the sample (January 2004 to June 2023) is about 2.1 %, while average inflation perceptions are 9.5 %. Second, despite the bias, inflation perceptions move in tandem with price inflation. Arioli *et al.* (2017) show that this series of euro area inflation perceptions correlates well with inflation, with positive correlation peaking at a lag of three months. Third, inflation perceptions are a good predictor of inflation expectations for the next year. Both series are strongly correlated, yet expectations remain below perceptions and above actual inflation (the average for the sample is 6.4 %). Inflation expectations are thus also upward biased.

Figure 6

Consumer inflation perceptions and expectations and current headline inflation

(euro area, %)



Source: European Commission.
1 Over the past 12 months.
2 For the next 12 months.

This upward bias of consumer expectations is widely observed and differs amongst demographic groups (see e.g. D'Acunto *et al.*, 2023). Specifically, inflation expectations are generally higher for women and consumers with low income or less education. This stylised fact also bears out in the EC's expectations data. The reason for the gender effect is that consumers base their expectations mainly on prices they observe when shopping. Women are primarily responsible for grocery shopping and are thus more exposed to food prices, which tend to be more volatile than other prices. As consumers attach more weight to positive price changes than negative ones, women's inflation expectations are more affected by upward bias. In families where shopping responsibilities are more or less equally shared amongst male and female heads of household, the gender gap disappears.

Consumer inflation expectations differ notably from those of professional forecasters in terms of the shape of the distribution. For one thing, the distribution of consumer expectations typically skews to the right, which pushes the mean above the median. Moreover, the dispersion of point forecasts is much larger for consumers. For example, the interquartile range of one-year-ahead inflation point forecasts in the EC sample is 11 percentage points for Q2 2023. In comparison, the corresponding figure for the ECB's SPF dataset is only 0.6 percentage points.[3] This large variation in consumer expectations also reflects the fact that consumers are generally less well informed about inflation and the central bank's inflation target, actions and communication.

Consumers also perceive the relationship between economic activity and inflation differently (Candia *et al.*, 2020; Weber *et al.*, 2023). The data show a negative correlation between the inflation and unemployment expectations of forecasters. This view aligns with the famous Phillips curve, according to which strong demand should cause inflation to rise and the unemployment rate to fall and vice versa when demand is weak (Cordemans and Wauters, 2018). Forecasters thus have a worldview in which *demand-side* shocks dominate and the Phillips curve is negatively sloped. By contrast, household expectations indicate a *positive* correlation between inflation and

3 Interquartile range of the June 2024 point forecasts from the Q3 2023 SPF survey. A caveat to this illustration is that the inflation expectations from the EC survey reflect a weighted average of *domestic* inflation expectations for different countries. In contrast, the SPF survey asks directly about euro area inflation expectations.

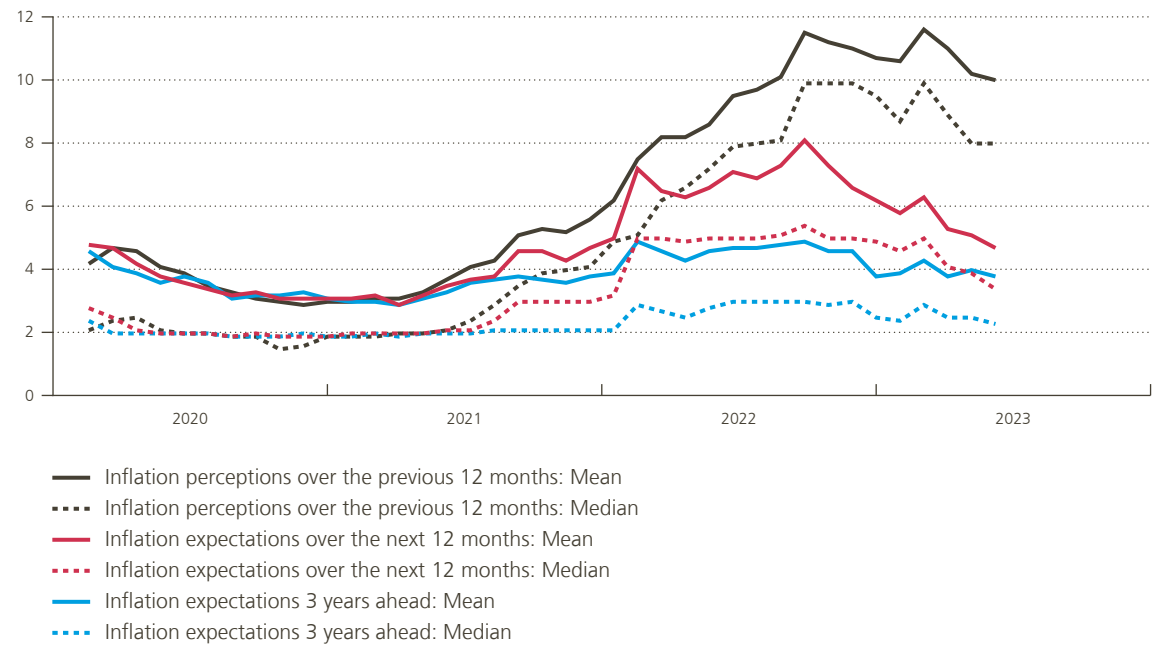
unemployment rates, corresponding to a view where *supply-side* shocks dominate and the Phillips curve slopes upwards. To illustrate these differences, consider what happened at the start of the COVID-19 pandemic. As bad news spread, SPF forecasters lowered their one-year-ahead inflation expectations in Q2 2020, anticipating that weak demand would drag down inflation. However, as shown in Figure 6, households *raised* their inflation expectations in the same quarter. The takeaway from this is that households may associate higher expected inflation with bad news about the economy. Therefore, policy communication intended to raise consumer inflation expectations could fail to stimulate additional household spending.

Other relevant datasets of consumer inflation expectations are the ECB's Consumer Expectations Survey (CES) and the Bundesbank's Online Panel Survey of Households. These surveys differ from the EC survey in that they are conducted fully online, allow respondents to participate more than once, and started in 2020 and 2019, respectively. Moreover, they also provide inflation expectations at longer horizons than one-year ahead. Figure 7 illustrates the evolution of inflation perceptions and expectations at the one- and three-year horizons for the euro area based on the CES. The average perceptions and expectations from this survey tend to be lower than in the EC survey. In addition, median expectations were at 2 % before starting to rise in the post-pandemic recovery. This increase could signal the unmooring of longer-term expectations. Since the end of 2022, however, inflation expectations have dropped somewhat amidst receding observed inflation outcomes.

Figure 7

Consumer inflation perceptions and expectations at different horizons

(euro area, %)



Source : ECB.

Overall, it is challenging to determine whether consumer inflation expectations are anchored to the central bank's target. As shown above, expectation measures can vary across surveys that have different methodologies (e.g., held online or via telephone). Moreover, measures of long-term expectations are often lacking.

That said, three-year-ahead median expectations from the CES, which were well anchored from mid-2020 to early 2022, rose during the period of high inflation, suggesting some risk of de-anchoring. Moreover, Galati *et*

al. (2023) studied long-term expectations at the ten-year-ahead horizon using a Dutch consumer survey from December 2019 to September 2020. They found that in September 2020, median long-term expectations for the euro area were at 4 %. When respondents were provided with information about the ECB's target, the median was one percentage point lower (3 %) albeit still higher than the target. These points contrast with the findings set out in the previous sections that long-term expectations of professional forecasters and financial market participants are currently close to the ECB's 2 % inflation target.

Evidence of firms' inflation expectations is more limited

While data on firms' inflation expectations are scarcer, the available series reveal important distinctions compared to the inflation expectations of households and forecasters. In their overview, Candia *et al.* (2023) show that firms' inflation expectations are above those of professional forecasters but below those of households in several countries. The same holds true when considering the level of disagreement (or dispersion) amongst firms. In countries with a recent history of low and stable inflation, firms also display a large degree of dispersion concerning perceived inflation and appear uninformed about the central bank's inflation target. By contrast, firms from countries with high and volatile inflation appear more attentive to the phenomenon and the central bank's target. Being out of sync with domestic price developments is likely more costly for firms in such countries.

Evidence is mixed concerning the relationship between inflation and economic activity (the Phillips curve) that emerges from firms' responses. Again, firms' views appear to lie between those of professionals and households as, in some countries, there is a negative correlation between businesses' inflation expectations and the unemployment rate while in others this correlation is positive.

Data sources on euro area firms' inflation expectations are limited.[4] Quantitative inflation expectations are available for Italy via the Survey on Inflation and Growth Expectations for several horizons starting around 2010. According to the Q2 2023 survey, Italian firms expect on average the inflation rate to be 5.8 % one year ahead, 5 % two years ahead and 4.5 % over the three- to five-year horizon. The Banque de France recently launched a similar survey of French firms (Savignac *et al.*, 2021). In the second quarter of 2023, the median inflation rate expected by French businesses stood at 4 % one year ahead and 3 % over the three- to five-year horizon.

2. Assessment of the shock anchoring of inflation expectations

In the previous section, we examined various measures of inflation expectations available for the euro area and concluded that the longer-term expectations of both professional forecasters and financial market participants are currently close to the 2 % target. This suggests a fairly robust level anchoring of longer-term inflation expectations. In this section, we examine several measures of shock anchoring. More precisely, we assess whether inflation expectations react to inflation surprises and whether changes in short-term inflation expectations pass through to longer-term ones. If longer-term inflation expectations are in fact anchored, they should not respond to drivers of actual inflation and short-term inflation expectations.

It is important to carry out level and shock anchoring assessments simultaneously. Even if inflation expectations appear close to 2 %, a positive response of these expectations to macroeconomic developments signals potential de-anchoring risk. By contrast, low inflation expectations accompanied by sensitivity to macroeconomic news could signal re-anchoring.

4 The ECB's Survey on the Access to Finance of Enterprises included an ad hoc question on firms' inflation expectations in the July 2023 wave, the results of which had not been published at the time of writing.

2.1 Responsiveness of inflation expectations to inflation surprises

Empirical studies of shock anchoring often rely on market-based measures of inflation expectations – such as ILS rates – as these data are available with a high degree of frequency and hence fluctuations can easily be linked to specific macroeconomic surprises. We follow the approach of Miccoli and Neri (2019), which is broadly in line with that of Speck (2017) and Beechey *et al.* (2011), to gauge the responsiveness of market-based inflation expectations to inflation surprises. Inflation surprises are measured by the difference between Eurostat's monthly flash estimate on HICP annual inflation and the median expectation of analysts as polled by Bloomberg surveys carried out in the days immediately preceding release of the estimate. We estimate the degree of responsiveness of the entire term structure of spot ILS rates (that is, for maturities between one and ten years) and of forward rates, namely, one-year forward rates up to nine years ahead ("1y9y") and the five-year forward rate five years ahead ("5y5y"). While ILS rates are observed intradaily and daily, it may take more than one day for these rates to reflect macroeconomic news due to limited liquidity on the ILS market (Boneva *et al.*, 2019). Hence, we take the average of ILS rates over the five working days prior to release of the HICP flash estimate as well as the average over the five working days after the release and calculate the difference between the two.[5]

Our empirical analysis is based on the period from January 2005 to April 2023 and includes the global financial and sovereign debt crises and subsequent low inflation period as well as the high inflation period starting after the COVID-19 pandemic. It thus comprises significant inflation surprises and changes in inflation expectations, making it particularly suitable for study of the responsiveness of ILS rates to inflation surprises.

We estimate a linear model regressing the changes in ILS (forward) rates to inflation surprises:

$$\pi^{k}_{t>t0} - \pi^{k}_{t<t0} = \alpha + \beta(\pi_{t0} - \pi_{t0}|I_{t<t0}) + \varepsilon_t, \quad (1)$$

where $\pi^{k}_{t>t0}$ refers to the average k-year ILS rate over the five days following release of the HICP flash estimate (at time $t0$) and $\pi^{k}_{t<t0}$ is the average over the five days preceding the release.[6] Expectations of current inflation $\pi_{t0}|I_{t<t0}$ incorporate all relevant information available to market participants ($I_{t<t0}$).

As shown in Figure 8, inflation surprises have a significant impact on spot ILS rates of all maturities. The longer the maturity of the rate, the weaker the effect (β) as longer-term rates average out the impact of the surprise over multiple years. In terms of interpretation, the coefficient of 0.44 for the one-year ILS rate implies that, on average, a positive inflation surprise of 0.25 percentage points raises inflation expectations by around 11 basis points. At the five-year and ten-year maturities, the response will be only 3 and 2 basis points, respectively.

By contrast, the impact of inflation surprises on forward ILS rates is close to zero and insignificant, including for the shortest-term forward ILS rate (the 1y1y rate). Therefore, inflation surprises appear to impact only very short-term inflation expectations (the 1y ILS rate) and in general not to influence longer-term expectations. Longer-term spot ILS rates (such as the 10y rate) do tend to react significantly to inflation surprises, but only because of the impact of surprises on the 1y ILS rate.

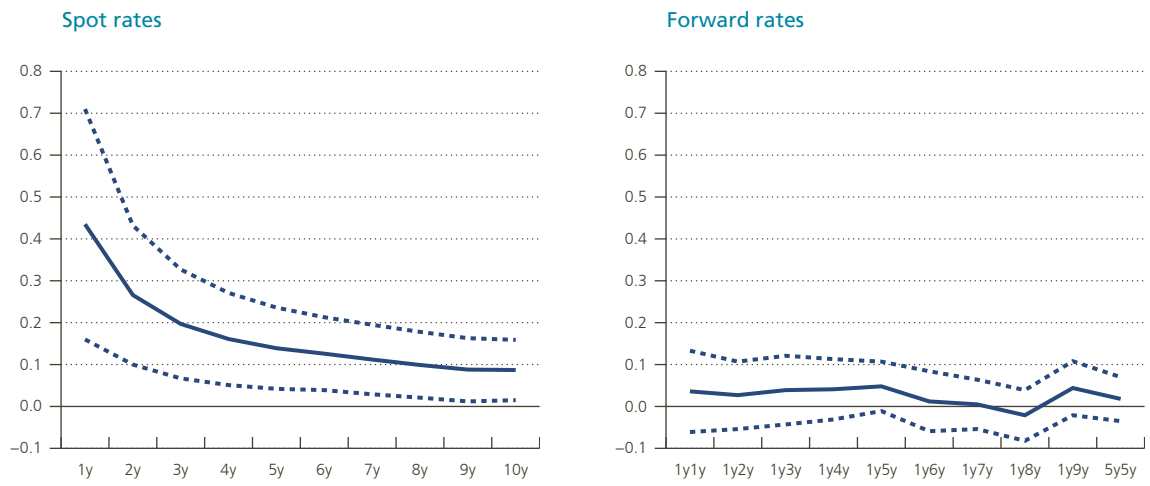
5 The results presented in this section remain unchanged if averages are taken over fewer days, although the responsiveness of ILS rates is less pronounced overall (as ILS rates take some time to reflect new information due to limited market liquidity).

6 We ran similar regressions with control variables, such as changes in oil prices, the €-coin indicator (see Altissimo *et al.*, 2010) and the Citigroup Economic Surprise Index, potentially accounting for the mismeasurement of inflation surprises. The coefficients of these variables were found to be statistically insignificant.

Figure 8

Impact of inflation surprises on ILS rates [1]

(β coefficients of regression 1 estimated by ordinary least squares, 95 % confidence intervals)



Sources: Bloomberg, own calculations based on Miccoli and Neri (2019).

1 Unlike Miccoli and Neri (2019), we did not use all available monthly data. There is sometimes a visible "base month effect" on the first business day of a month in an ILS series, i.e. when ILS rates switch reference period. This translates into a strong rise or fall in the rates. Therefore, if the HICP flash estimate was released on the first business day of a month, we dropped the observation when we considered the change in ILS to be an outlier resulting from technical effects. We used a threshold of 40 basis points, i.e. the 99th percentile of the distribution of daily changes in the one-year ILS rate. We dropped 21 ILS spot rates and 4 ILS forward rates out of 220 monthly observations. Period: January 2005 – April 2013.

Several authors have found that the responsiveness of ILS rates to news about euro area inflation and other macroeconomic variables is not stable over time (Galati *et al.*, 2011; Speck, 2017; Miccoli and Neri, 2019). We analyse the stability of the estimated coefficients over time in two ways: (1) by splitting the sample into sub-periods and (2) by estimating the coefficients on a rolling basis with 30-month windows.

With regard to the sample split,[7] we consider three sub-periods: the financial and sovereign debt crises (the period before 2014), the low-inflation period (2014-2020) and the high-inflation period (2021-2023). The coefficients obtained in the first two periods confirm the average results: spot ILS rates are significantly responsive to inflation surprises, with the magnitude of the coefficient declining with maturity. In the high-inflation period, the coefficients are no longer significant, including for short-term ILS rates, partly due to the limited number of observations, which renders estimates more uncertain owing to the presence of higher standard errors. Importantly, longer-term spot ILS rates are associated with impact estimates that are essentially zero during the highflation period, implying that inflation surprises were both statistically and economically insignificant. This hints at a limited risk of upward de-anchoring during this period. Moreover, the estimated coefficients are small and generally insignificant for forward rates in all sub-periods.

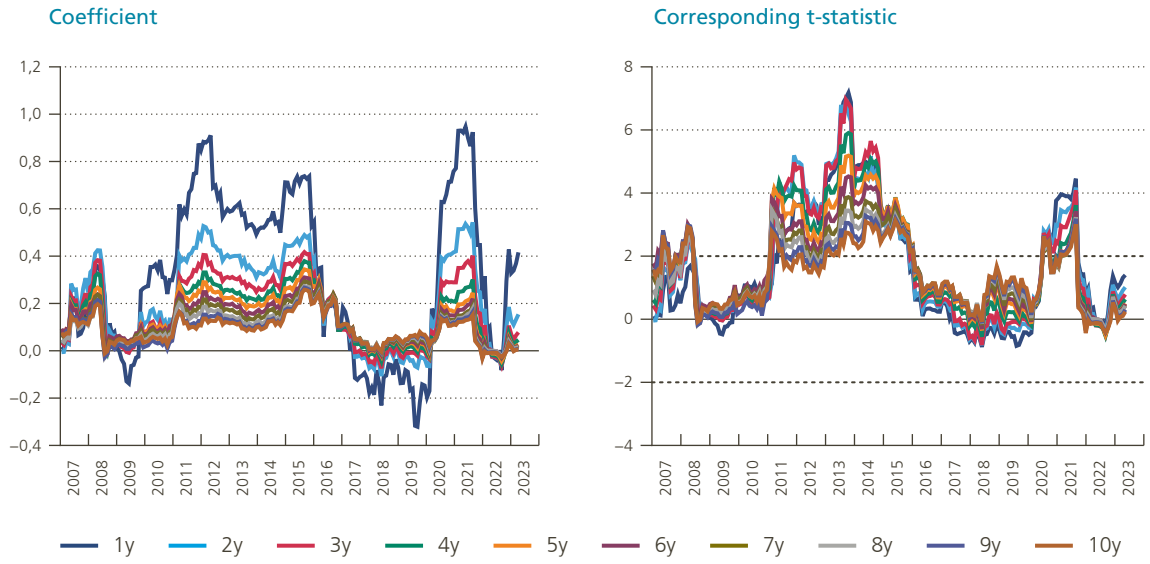
Turning to rolling regressions, estimated coefficients of the inflation surprises increase sharply in 2011, in particular for shorter spot rates, and remain large and statistically significant throughout the sovereign debt crisis and part of the low-inflation period, as shown in Figure 9. The rise observed for longer maturities is not negligible as it is statistically significant during that time as well. Estimated coefficients become smaller for estimation periods that end in 2016 and subsequently even negative (but insignificant) for short maturities. Miccoli and Neri (2019) attribute this decline to the introduction of the ECB's asset purchase programmes,

7 In the interest of space, the results of the sample split are not presented here.

suggesting these were effective in reducing the responsiveness of inflation expectations to inflation surprises and hence downward de-anchoring risks. In the period covering the pandemic, the estimated coefficients peak, especially for short maturities, and become significant again. In the case of forward rates (not presented here), the estimated coefficients are essentially insignificant throughout the period covered. These results are in line with Neri *et al.* (2022) who concluded, based on the responsiveness of the 5y5y ILS rate to macroeconomic surprises, that while between July 2021 and April 2022 inflation consistently exceeded analysts' expectations, financial market prices showed no signs of shock de-anchoring.

Figure 9

Rolling estimates of the β coefficient for inflation surprises



Sources: Bloomberg, own calculations based on Miccoli and Neri (2019).

1 The rolling estimates were calculated using a moving window of 30 months. The date on the x-axis represents the end of the rolling samples. The dashed lines on the right graph represent the 95 % confidence interval.

2.2 Pass-through of changes in short-term inflation expectations to longer-term expectations

A more general approach often used in the literature to assess the shock anchoring of inflation expectations is to look at the pass-through of shock-induced changes from short-term to longer-term expectations. The main idea is that when expectations are anchored, all sorts of temporary shocks (including inflation surprises) can influence short-term expectations but in principle they should not impact longer-term expectations. In other words, changes in short-term expectations should not pass through to longer-term expectations, regardless of the underlying shock that causes the change in short-term expectations.

Concretely, an econometric model like the following one can be estimated:

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta\Delta\pi_{it}^{ST} + controls + \varepsilon_{it,} \quad (2)$$

where $\Delta\pi_{it}$ refers to the change in inflation expectations of individual i at time t and superscripts LT and ST refer to the long term and the short term. As in the previous subsection, shock-anchored expectations imply a β coefficient that is economically small and statistically insignificantly different from zero.

Evidence from consumer and firm expectations

Stanislawska and Paloviita (2022) document evidence of consumer inflation expectations. They use the CES panel structure to estimate the pass-through of changes in short-term to medium-term consumer inflation expectations. They define the short-term horizon as the coming 12 months and the medium-term horizon as the 12-month period starting in two years. Their estimations control for consumer characteristics, inflation perceptions, and country and time effects.

Their results show that for each one-percentage-point change in short-term expectations, the average change in medium-term expectations is 0.28 percentage points. This effect was only marginally larger during the inflationary period in their sample (January 2021 to December 2021, effect=0.29) than in the non-inflationary subsample (April 2020 to December 2020, effect=0.26). Digging deeper, they show that sensitivity weakens for consumers with high trust in the ECB and those with a high degree of financial literacy.

Since the CES does not ask about inflation expectations at a horizon of more than three years, their analysis does not use a horizon typically associated with the long term. Hence, the authors state that their results are inconclusive regarding the anchoring of consumer inflation expectations, as requiring zero responsiveness could be too strict at the medium-term horizon. By contrast, Galati *et al.* (2023) estimated a regression model similar to equation (2) using ten-year-ahead expectations as π_{it}^{LT} and reported a significant β coefficient of 0.55. Hence, long-term consumer inflation expectations for the euro area do not appear anchored in the Netherlands.

There is little data available on firms' expectations. Nonetheless, Candia *et al.* (2023) revealed a strong positive correlation amongst US firms between one-year and five-year inflation forecast revisions. This correlation is stronger for firms than households and forecasters, for which they also found a significant relationship (see also below).

Evidence from market-based measures and surveys of professional forecasters

Several authors have tested the pass-through from short-term to longer-term inflation expectations using measures from surveys of professional forecasters, such as the SPF. Łyziak and Paloviita (2017) found that in the post-financial-crisis period, longer-term inflation expectations became somewhat more sensitive to shorter-term ones (and to actual HICP inflation). Also based on the SPF, Bulligan *et al.* (2021) and Corsello *et al.* (2021) have shown that long-term inflation expectations started reacting to short-term expectations after the 2013 disinflation. More recently, Neri *et al.* (2022) confirmed that during the 2013-2020 low-inflation period, the pass-through of short-term expectations to longer-term ones was positive, contributing to a downward de-anchoring of expectations. In addition, they showed that the exceptional revision of one-year-ahead expectations in the context of the post-pandemic recovery and mounting input cost pressures in 2022 passed through to a more limited extent to longer horizons.

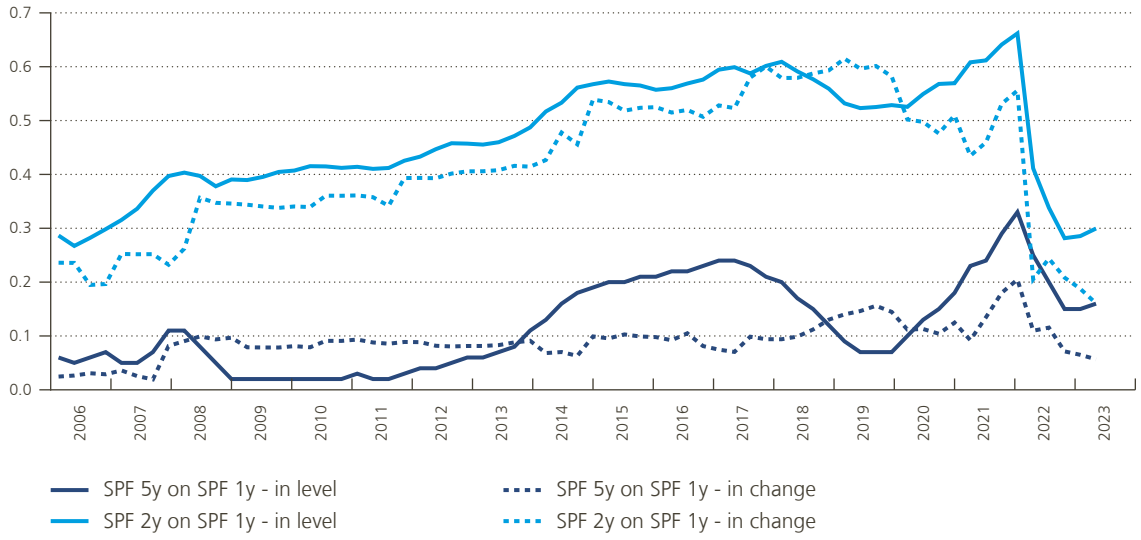
We confirm the historical evidence and update the survey-based results in the literature by analysing the pass-through of SPF short-term inflation expectations (one year ahead) to long-term ones (about five years ahead), as shown in Figure 10.[8] The coefficient β, estimated on a rolling basis, increases steeply during the low-inflation period suggesting a de-anchoring of inflation expectations (greater pass-through). There is a renewed upward trend as inflation started climbing above 2 % in the second half of 2021, which reverts once the SPF results from the second quarter of 2022 onwards are included in the rolling regression. The most recent estimate of

8 Our estimates are based on equation (2) but use aggregate time series, implying that the "i" subscript no longer applies.

β is found to be statistically significant but economically small (0.16). We also test the pass-through to two-year-ahead expectations, i.e. a horizon more similar to the medium-term horizon used in the CES. The rolling estimates follow a similar trend but the pass-through is stronger overall. The finding that pass-through decreases as the forecast horizon lengthens points to the importance of analysing long-term expectations before drawing strong conclusions on shock de-anchoring.

Figure 10

Rolling estimates of the β coefficient for pass-through from short-term to longer-term expectations [1]



Sources: ECB, own calculations.

1 We regress the SPF five-years-ahead and two-years-ahead inflation expectations on the SPF one-year-ahead inflation expectations (average point forecasts). The rolling estimates are computed using a moving window of 24 quarters. The date on the x-axis represents the end of the rolling sample.

Market-based measures offer the most complete term structure for inflation expectations, which makes it possible to study the pass-through from short-term expectations to virtually any horizon. We first look at the link between the 1y2y ILS rate and the 1y ILS rate, hence matching the horizons in the CES. The coefficient estimate indicates that a one-percentage-point change in the 1y ILS rate leads to a statistically significant 0.3 percentage points change in the 1y2y rate. Looking further ahead, the coefficient is still significant but much smaller: 0.15 for the 5y5y ILS rate and 0.12 for the 1y9y rate.

In conclusion, while inflation surprises do not seem to have had a significant impact on the term structure of market-based measures, changes in short-term inflation expectations (one year ahead) passed through to medium-term expectations (e.g. three years ahead) on average over the period under consideration, but the pass-through to longer-term expectations (five to nine years ahead) was more limited. In particular, the most recent estimate of pass-through to longer-term expectations was found to be economically small but statistically significant according to SPF data, suggesting that the risk of upward de-anchoring has not disappeared and warrants close monitoring in order to assess the appropriate monetary policy stance.

3. The role of expectations formation in assessing the risk of de-anchoring and the implications for monetary policy

Thus far, we have focused mainly on the challenge of measuring inflation expectations. As set out above, there are various measures of such expectations, and the perceptions of economic agents regarding future price dynamics may vary. Consequently, central bankers consider a wide range of indicators of inflation expectations, encompassing different groups and horizons, to address these challenges.

However, as highlighted by Visco (2023), there is a second challenge, one that pertains less to measurement per se and more to the interpretation of inflation forecasts. For instance, as previously discussed, relying solely on averages provides an incomplete picture, as there can be significant variations between forecasters beyond central tendencies. Moreover, some economic agents, e.g. financial market participants, have superior information compared to others, such as consumers. Conceptually, such heterogeneities reflect differences in the way expectations are formed.

The dominant approach in modern macroeconomics is to model expectations in accordance with the rational expectations paradigm. According to this paradigm, economic agents are fully knowledgeable and therefore make predictions consistent with the underlying economic model, implying expectations are on average unbiased and accurate. These assumptions, however, appear at odds with survey-based evidence (see e.g. Coibion *et al.*, 2018, for a review of recent studies), which reveals cases of systematic bias in expectations and the predictability of ex-post forecast errors. This evidence suggests that at least some households and firms form expectations with imperfect knowledge, whether deliberately or not. However, if knowledge is imperfect, this could also mean that reported measures of inflation expectations fail to reflect certain important information and misjudge the future. Therefore, it is relevant to investigate the potential impact of changes in the formation of economic agents' expectations on macroeconomic dynamics. Moreover, if such changes indeed pose a risk of de-anchoring, it is essential to explore what monetary policy can do to mitigate this risk.

We analyse these questions using a small, dynamic stochastic equilibrium model that allows for heterogeneity in the formation of expectations by private agents. At its core, it is a calibrated, textbook three-equation New Keynesian model, featuring a Phillips curve (which relates inflation to inflation expectations and the output gap), a dynamic investment-savings (IS) curve (relating the output gap to the nominal interest rate and inflation expectations), and a monetary policy reaction function (specifying the nominal interest rate set by the central bank in reaction to inflation and output dynamics). Heterogeneous expectations are modelled – in the spirit of Cornea-Madeira *et al.* (2019) – by considering the economy to be populated by two types of agents which apply different forecasting rules when contemplating the future. The first type, referred to as forward-looking agents, possesses a sophisticated understanding of how the economy works and adopts forward-looking rules consistent with the standard rational expectations solution of the model. The second type, called backward-looking agents, have more limited knowledge and use the simplest backward-looking rule of thumb projecting future variables to be exactly equal to their latest realisation. More information about the model and its structure can be found in Annex A.1.

The share of forward-looking versus backward-looking agents in the economy is assumed to be exogenously given for the moment; this assumption is relaxed further on. If all agents are perfectly forward-looking, the model aligns with the conventional rational-expectations framework, in which expectations are model consistent. At the other extreme, expectations are fully adaptive, relying solely on extrapolating past outcomes. Intermediate scenarios arise when agents exhibit heterogeneity in their forecasting behavior, with some displaying more forward-looking and others more backward-looking tendencies.

The model is kept intentionally simple so as to focus on the main mechanisms of interest, i.e. the impact of changes in the forecasting behaviour of firms and households. However, this approach implies that many

empirically important real-world features are disregarded, meaning the results should be interpreted only in qualitative, not quantitative, terms.

The anchoring of inflation expectations may be called into question if expectations become more backward-looking

Using this model, we investigate what happens to the economy's dynamics as households and firms shift their forecasting behaviour from a purely forward-looking perspective (i.e. the standard rational expectations assumption) to a progressively more backward-looking stance. We focus on the dynamic response of the model to a so-called cost-push shock, which introduces an exogenous increase in prices beyond what would be expected based on domestic demand conditions. This type of shock is particularly interesting from an empirical perspective, as it captures essential drivers of the 2021-2022 surge in inflation, such as disruptions in global supply chains and energy price shocks. Furthermore, cost-push shocks are of particular interest for monetary policy considerations, as they induce a trade-off between stabilizing output or inflation, unlike demand-driven sources of inflation.

Figure 11 shows the reactions to a one-standard-deviation cost-push shock for three cases of the model economy which differ only in their share of backward-looking agents. The responses are presented as deviations from each variable's long-term equilibrium value, which for inflation corresponds to the central bank's target. The inflationary cost-push shock pushes up inflation and lowers output, but the effects are stronger (in terms of peak effects) and more persistent the more backward-looking agents are.[9] The underlying rationale is straightforward : when expectations are rational and based on all relevant information, businesses and households perceive the price shock as temporary, leading economic dynamics to quickly move back to long-term equilibrium values. By contrast, when an increasing share of households and firms anticipate future inflation and output to mirror their latest realisations, current economic conditions become entrenched in expectations. Expectations themselves then become a source of instability, causing inflation and output dynamics to shift further out and stay away from target for a prolonged period even in the absence of additional price shocks.

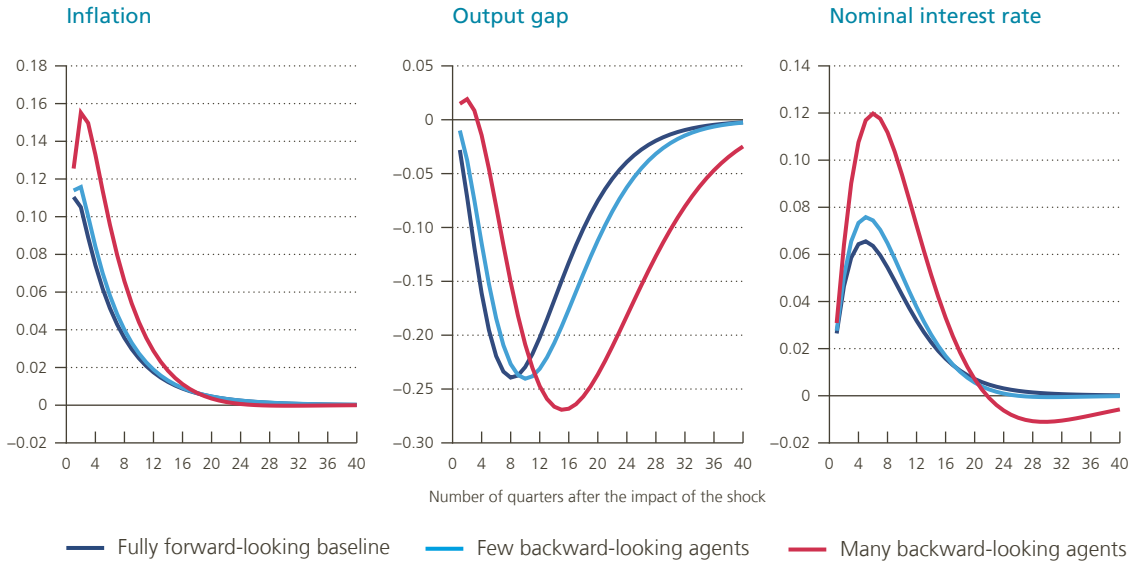
Monetary policymakers face a stabilisation trade-off between output and inflation : to claw inflation back to target, monetary policy must be tightened and interest rates raised, while to cushion a recession, a more accommodative stance and lower rates are called for. Inflation, however, is weighted more heavily in our model's monetary policy rule, meaning interest rates rise in all scenarios. Nevertheless, the central bank typically adopts a gradual approach to the tightening of monetary policy so as to avoid putting excessive strain on the economy and potential risks to financial stability. This sluggish behaviour implies real interest rates (i.e. nominal rates adjusted for inflation) first fall before rising, offering some temporary relief. Importantly, the stronger the initial increase in inflation, the more pronounced the initial decline in real rates. That's why the fall in output gets pushed further out in the more backward-looking scenarios.

9 This finding corroborates a well-known result in the adaptive learning literature, demonstrating that agents who need to learn about the structure of the economy and therefore continuously update their forecasting models in response to new information tend to exhibit increased persistence in their reactions to shocks (see e.g. Milani, 2006, 2007, and Orphanides and Williams, 2005).

Figure 11

Responses to an inflationary cost-push shock under varying degrees of backward-looking expectations formation

(percentage point deviation from long-term equilibrium values)



Sources: Own calculations.

Notes: Responses are generated using a simple three-equation New Keynesian model with heterogeneity in the degree of forward-looking versus backward-looking forecasting behaviour. The labels "fully forward-looking baseline", "few backward-looking agents" and "many backward-looking agents" refer to model variants in which the share of backward-looking agents is calibrated at zero, 40 % and 80 %, respectively. The choice of these values, away from the fully forward-looking baseline, is based on estimates in Cornea-Madeira et al. (2019) and Cornea-Madeira and Madeira (2022) finding that, for the US and the UK, respectively, the share of forward-looking agents has fluctuated between 20 % and 80 % for most of the past 50 years.

All in all, our central conclusion of reasonably anchored inflation expectations could thus be called into question if businesses and households were to become more backward-looking in their forecasting behaviour. Not only does more backward-looking behaviour prolong the inflationary impact of exogenous price shocks, but it also increases the cost of reining in inflation as it worsens the output-inflation trade-off.

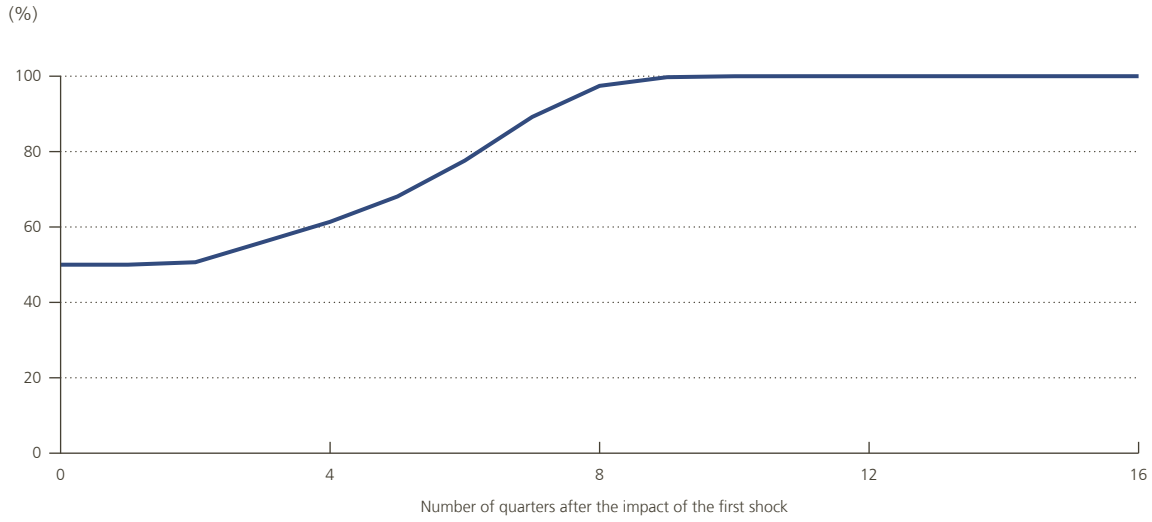
The longer inflation stays above target, the greater the risk of a shift from less to more backward-looking forecasting strategies and, ultimately, a de-anchoring of inflation expectations

What accounts for changes in forecasting strategies? Micro-evidence drawn from both survey and experimental data indicates that economic agents switch strategies in response to past forecast errors, with the best performing strategy receiving the most attention (see e.g. Frankel and Froot, 1991, Bloomfield and Hales, 2002, Branch, 2004, and Assenza *et al.*, 2011).

Figure 12 illustrates this endogenous shift in forecasting behaviour in the framework of our model economy. To do so, we first depart from the assumption of exogenously given levels of backward-looking behaviour and instead allow agents to endogenously switch between forecasting strategies based on their relative past forecast performances, akin to the approach of Cornea-Madeira *et al.* (2019). Starting from an equilibrium in which beliefs are evenly divided between forward- and backward-looking perspectives, we then track the evolution of the share of backward-looking agents when the economy is hit by a succession of inflationary cost push-shocks. While such a configuration of repetitive shocks may not occur frequently, it is illustrative of the period following the start of the Covid-19 pandemic, which saw a sequence of price shocks resembling the cost-push shocks in our model.

Figure 12

Change in the percentage of backward-looking agents in response to a sequence of inflationary cost-push shocks



Sources: Own calculations.

Notes: The model economy is initialised with an equilibrium in which there is an equal number of backward-looking and forward-looking agents. The sequence of inflationary cost-push shocks considered in the simulation consists of a one-standard-deviation shock in period 1, followed by a half-standard-deviation shock in period 2 and, finally, a quarter-standard-deviation shock in period 3. After period 3, no additional shocks buffet the economy.

This simulation highlights the possibility of economic agents swiftly transitioning to backward-looking forecasting methods when faced with repeated, unexpected inflationary shocks. In fact, within approximately two years, all agents in the simulation turn their attention to the random-walk forecasting rule. This shift in dominant forecasting strategy is driven by evolving relative forecast performance. As the economy drifts further from its fundamentals, backward-looking strategies that predict more persistent dynamics gradually outperform forward-looking strategies that anticipate short-lived effects.

Thus, while inflationary pressures may initially result from temporary factors, their persistence above expectations may cause inflation to slip into a self-perpetuating spiral, with inflation and inflation expectations feeding each other. Hence, caution should be exercised when interpreting current signals of relatively well-anchored inflation expectations in light of persistently elevated inflation figures. The longer inflation remains above target, the greater the risk of a troubling change in the formation of inflation expectations and eventually a de-anchoring thereof.

Monetary policy can play a role in coordinating expectations to forward-looking beliefs

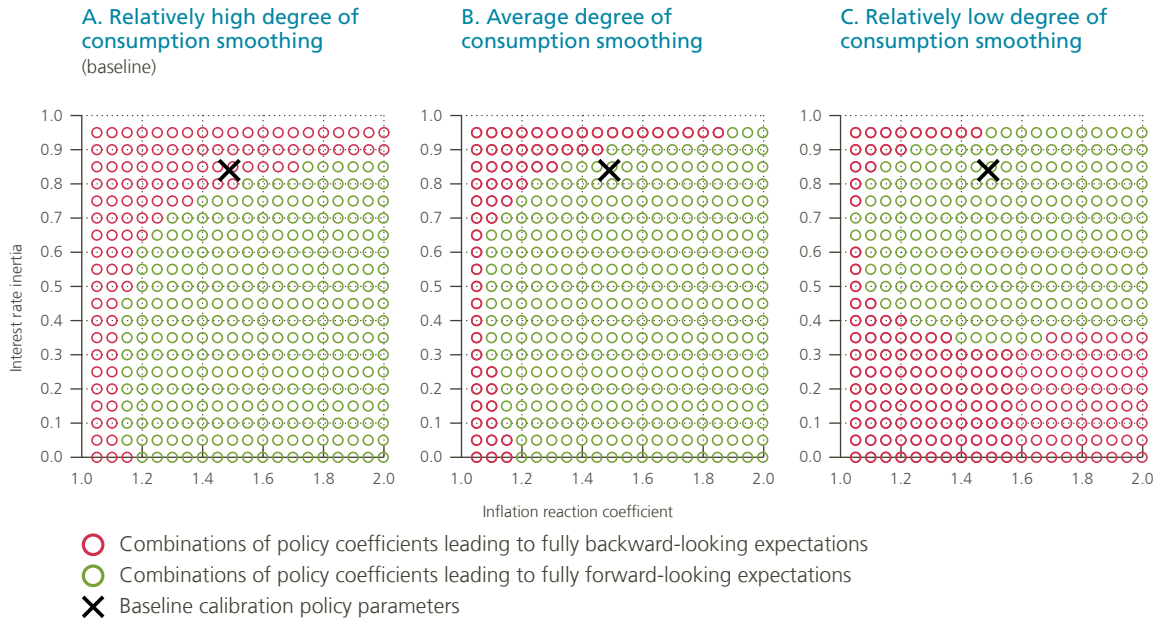
As highlighted in a recent speech by the Bank of England's Catherine Mann (2022), if forecasting strategies are endogenously shaped, this implies that monetary policy, through its anticipated effect on macroeconomic outcomes, can feed back to affect the formation of expectations and therefore current outcomes. To illustrate this point, the charts presented in Figure 13 delineate the parameter space of two crucial components in the monetary policy reaction function into two distinct regions. These regions indicate the conditions under which the sequence of inflationary shocks underlying Figure 12 causes expectations to become fully forward-looking (represented by the green area), as opposed to fully backward-looking (represented by the red area). The first parameter (on the x-axis), denoted "inflation reaction coefficient", illustrates the strength of the central bank's adjustment of the policy rate in response to deviations of inflation from the target level. The second parameter (on the y-axis), referred to as "interest rate inertia", reflects the degree of smoothing employed

by the central bank in adjusting the interest rate to current output and inflation developments, with a higher degree of inertia indicating a slower reaction to current macroeconomic developments. The "X" coordinate indicates the value of the policy parameters used in the baseline calibration.

The charts in Figure 13 aim to assess the robustness of the results to varying degrees of intrinsic persistence in the model economy, i.e. sources of persistence in dynamic responses that do not derive from backward-looking behaviour. The calibration of the model's coefficients is informed by an estimation under rational expectations. However, as shown above, the rational expectations framework fails to account for the persistent propagation mechanisms arising from backward-looking forecasting behaviour. Consequently, the calibration is prone to excessive reliance on the model's intrinsic frictions to capture the persistence observed in the data, thereby potentially exaggerating the degree of intrinsic persistence. One such intrinsic friction results from the inclination to smooth consumption over time (so-called "consumption smoothing"). The degree of consumption smoothing considered in the model economy implies that households attach approximately equal weight to past consumption patterns and expected future consumption levels in their current spending decisions. Hence, as a robustness test, chart A assumes the baseline calibration, while the degree of consumption smoothing is gradually reduced in charts B and C.

Figure 13

Outcome of the endogenous shift in forecasting behaviour for alternative specifications of the monetary policy rule



Sources: Own calculations.

Notes: The model economy is initialised with an equilibrium in which there is an equal presence of both backward-looking and forward-looking agents. The sequence of inflationary cost-push shocks considered is the same as in Figure 12. The "X" coordinate denotes the baseline calibration of the policy parameters,1.49 for the reaction coefficient on inflation and 0.84 for the degree of interest rate smoothing. The parameter governing consumption smoothing in the IS curve is assigned a baseline value of 0.82 for the "relatively high" consumption smoothing scenario, 0.5 for the "average" scenario and 0.1 for the "relatively low" scenario.

In all scenarios, increasing the central bank's responsiveness to inflation helps redirect agents' attention from backward-looking to forward-looking approaches to shaping their expectations. This shift occurs because a stronger increase in policy rates effectively reduces the persistence of the dynamic effects caused by cost-push shocks. These faster dynamics align more closely with the expectations implied by the forward-looking rule, thereby improving its relative forecasting performance compared to the backward-looking rule, which predicts more protracted dynamics.

The effect of smoothing the interest rate response over time is less clear cut. In situations with high intrinsic persistence (such as a high degree of consumption smoothing), deterring agents from adopting backward-looking forecasting strategies necessitates a rather rapid tightening of monetary policy. Conversely, when intrinsic persistence is low, the economy seems to benefit more from a gradual tightening cycle. Interest rate inertia induces an additional source of intrinsic persistence in the dynamic effects of cost-push shocks. When other sources of intrinsic persistence are low, this tends to improve the forecasting performance of forward-looking rules in predicting sustained price increases. In fact, without intrinsic persistence, these rules would predict very short-lived effects with dynamics quickly returning to long-term equilibrium values. However, if the level of intrinsic persistence is already high, overall persistence may reach such a level that forward-looking agents expect the peak effects of the exogenous price shocks to manifest with a significant delay. In such cases, a simple backward-looking forecasting strategy that extrapolates the past is more likely to yield a superior track record when it comes to predicting sudden and prolonged price hikes.

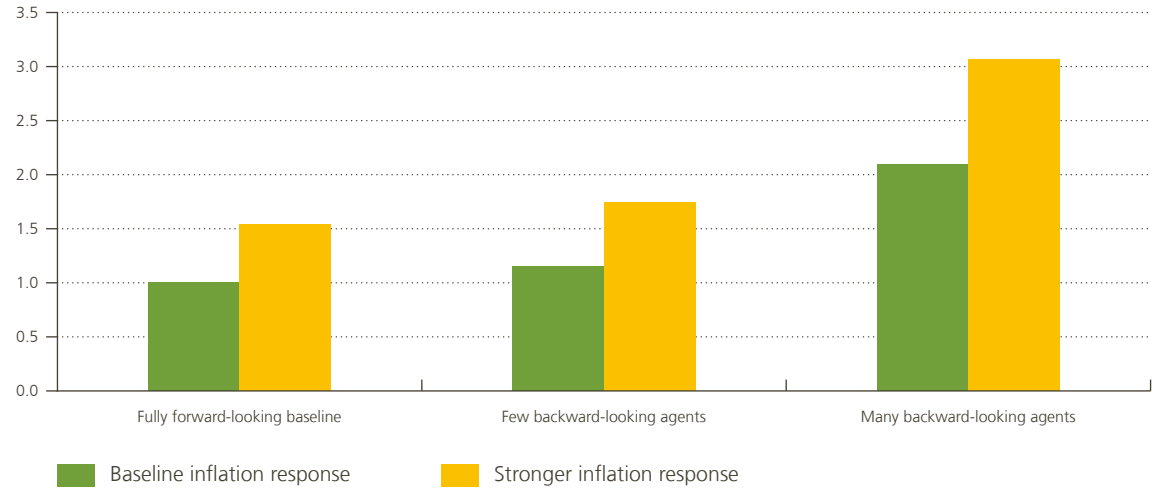
Guiding households and firms away from backward-looking expectations is optimal from a welfare perspective

The preceding exercise suggests that given the prevailing uncertainty as to the degree of intrinsic persistence in the economy, monetary policy should be sufficiently restrictive in the face of persistent, unexpectedly high inflation, albeit with some lag, in order to prevent the development of backward-looking expectations. However, it remains to be seen whether such a tight yet gradual approach is also optimal from a welfare perspective, in that it leads to shorter deviations of inflation and output from their long-run equilibrium values. After all, while tighter monetary policy effectively mitigates the persistence resulting from backward-looking forecasting tendencies, it can exacerbate the recessionary impact of cost-push shocks. These two effects need to be balanced against each other.

Figure 14

Welfare losses under alternative inflation response weights in the policy rule and varying degrees of backward-looking expectations

(relative to the baseline)



Sources: Own calculations.

Notes: Welfare losses are expressed relative to outcomes in the baseline model specification. Losses are calculated employing a stylised but standard discounted squared-error loss function which counts all deviations from output and inflation targets as losses but assigns relatively greater importance to inflation deviations. Results are robust to increasing the weight of output variability to at most half that of inflation and to including interest rate variability as an additional source of loss. See Annex A.1 for a more detailed description of the loss function. In the baseline calibration of the interest rate rule, the reaction coefficient on inflation is set at 1.49 (i.e. abstracting from inertia in policy setting, a one percentage point increase in inflation leads the central bank to raise its policy rate by 1.49 percentage points). In the "stronger inflation response" scenario, the response weight is increased to two. The "fully forward-looking baseline", "few backward-looking agents" and "many backward-looking agents" groupings refer to different model variants in which the share of backward-looking agents is calibrated at zero, 40% and 80%, respectively (see the notes to Figure 11 for more information).

While a comprehensive analysis of optimal monetary policy is beyond the scope of this article, Figure 14 sheds some light on this issue by assessing the welfare implications associated with increasing the central bank's responsiveness to inflation in the context of the three model economies considered in Figure 11, which differ in their share of backward-looking forecasters, using a standard loss function.

For given degrees of backward-looking behaviour, increasing the inflation response in the policy rule leads to larger welfare losses (the orange bars are higher than the green ones). This result can be attributed to the empirical observation of a relatively flat Phillips curve, which implies that reducing inflation requires significant sacrifices in terms of output losses. As a result, strengthening monetary policy tightening exacerbates the recessionary impact of cost-push shocks, with only a marginal reduction in inflation. On balance, this worsens overall stability. In isolation, this conclusion supports a more moderate policy response.

However, as illustrated above, stronger monetary tightening also serves to prevent the economy from shifting towards configurations with a greater presence of backward-looking agents (i.e. it prevents the economy from shifting to the right in Figure 14). When accounting for this effect, the analysis favours a more forceful monetary policy response. The welfare losses incurred in environments characterised by a higher percentage of backward-looking agents and a moderate inflation response clearly outweigh those observed in environments featuring more forward-looking agents but stronger monetary policy tightening. Consequently, when looking at the overall picture, while tighter monetary policy worsens the output-inflation trade-off in the short run, opting for a less proactive approach and allowing backward-looking expectations to prevail would eventually require even more economic pain to bring inflation back to desired levels.

Conclusion

The anchoring of inflation expectations at low levels is widely seen as one of the great accomplishments of central banks. This was made possible due to their recognition of the inflation expectations issue in the 1970s-1980s, increased independence in the 1980s and 1990s, explicit and clear inflation-targeting objectives, and repeated credible policy actions. Anchored inflation expectations promote macroeconomic stability by allowing economic agents to look through temporary economic fluctuations when taking decisions (in relation to consumption and wage negotiations, for instance) and by giving central banks greater influence over real interest rates (nominal interest rates less inflation expectations), which determine real financing conditions.

The reflex of most economists and virtually all central bankers to the post-pandemic surge of inflation to levels not seen since the 1970s has been to look at the different measures of inflation expectations, in the hope that they remain well anchored at the monetary policy objective. In that respect, the situation today seems very different from the 1970s; the "inflation psychology" referred to by Burns (1979) does not appear to have returned. In the euro area, in particular, short-term inflation expectations rose after repeated inflation surprises, but measures of medium- and long-term expectations – many of which are touched on in this article – send quite reassuring signals as they remain close to the ECB's objective of 2 %. As a result, monetary policy can afford to be less tight than would be the case had longer-term expectations become de-anchored, and a soft (meaning not too costly) economic landing is possible (Sargent, 1981, 1982; Bullard, 2022).

There is no room for complacency, however. While long-term inflation expectations appear to have remained broadly anchored, several points for attention have emerged over the past year. Long-term market-based measures seem to be on an upward trend. At the end of August 2023, the 5y5y ILS rate reached values close to 2.6 %. Similarly troubling is the distribution of long-term expectations derived from surveys of professionals which indicate that a growing number of respondents expect inflation to be above 2.5 % at a horizon of around five years. The expectations of both consumers and firms have also risen, although these survey measures remain harder to interpret in terms of de-anchoring, notably due to a lack of questions related to longer-term expectations. Moreover, changes in short-term inflation expectations seem to be passing through to longer-term expectations, although the degree of pass-through depends on the type of inflation expectations measure.

Eventually, if longer-term inflation expectations become unmoored, this will undermine the credibility of the monetary policy objective. The longer inflation remains above this objective, the greater the chances of a loss of faith. The risk is that economic agents will stop anticipating low, stable inflation based on a stated objective and start relying more on observed current inflation to form inflation expectations. This would signal a return to the 1970s and the need for monetary policy to regain credibility by stepping in forcefully, which would likely lead to a severe economic recession. This scenario is clearly inferior to one in which central banks ensure that inflation expectations remain anchored at their objective by tightening monetary policy sufficiently early, be it at the cost of moderately weighing on economic activity.

The ECB's Governing Council has reiterated in its monetary policy statements that a timely return of inflation to the 2 % medium-term target is desirable (see e.g. ECB, 2023). Inflation has been declining, but it is still projected to remain too high for too long. Based on its current assessment, the Governing Council considers that the key ECB interest rates have reached levels that, maintained for a sufficiently long duration, will make a substantial contribution to the timely return of inflation to the target (the main monetary policy rate – the deposit facility rate – stands at 4% at the time of writing). The Governing Council's future decisions will ensure that the key ECB interest rates will be set at sufficiently restrictive levels for as long as necessary. The Governing Council will continue to follow a data-dependent approach to determining the appropriate level and duration of restriction.

Annex

A.1 – Simple New Keynesian model with heterogeneous expectations

The core of the model is a version of the simple New Keynesian model featuring nominal price rigidities and intrinsic inertia in inflation and output as described by *inter alia* Clarida, Gali and Gertler (1999). The model is characterised by the following three equations, presented in linearised form and with variables expressed as deviations from the steady state:

- Dynamic IS curve:

$$y_t - \varphi y_{t-1} = E_t y_{t+1} - \varphi y_t - \sigma(i_t - E_t \pi_{t+1}), \quad (1)$$

- Phillips curve:

$$\pi_t - \gamma \pi_{t-1} = \beta(E_t \pi_{t+1} - \gamma \pi_t) + \kappa y_t + u_t, \quad (2)$$

- Interest rate rule:

$$i_t = \rho i_{t-1} + (1-\rho)[\alpha_\pi \pi_t + \alpha_y y_t], \quad (3)$$

where y_t is the output gap, π_t is the inflation rate, i_t is the monetary policy interest rate, and E_t denotes expectations formed at time t.

The IS curve (1) and Phillips curve (2) describe private sector behaviour. Intrinsic inertia in output and inflation dynamics is allowed for through the persistence parameters $\varphi \in (0,1)$ and $\gamma \in (0,1)$, reflecting the degree of habit formation in consumption and price indexation, respectively. The remaining parameters in equations (1) and (2) are defined as follows: $\sigma > 0$ denotes the intertemporal elasticity of substitution in consumption, $\beta \in (0,1)$ is the pure rate of time preference, and κ represents the slope of the Phillips curve.[10] Finally, u_t is a persistent cost-push shock capturing exogenous price increases over and above what would be implied by domestic demand conditions.

The interest rate rule (3) represents monetary policy. It assumes that the central bank adjusts the interest rate i_t in response to inflation π_t and the level of the output gap y_t, with corresponding feedback coefficients α_π and α_y, respectively. However, the interest rate is adjusted only gradually, leading to interest rate smoothing of degree ρ.

In the spirit of Cornea-Madeira *et al.* (2019), we assume that agents can choose between a forward-looking and a backward-looking forecasting rule to predict future output and inflation. As a result, average expectations, $E_t X_{t+1}$, in the economy are a weighted average of backward-looking, E_t^b, and forward-looking, E_t^f, beliefs:

$$E_t X_{t+1} = (1-\theta_t) E_t^b [X_{t+1}] + \theta_t E_t^f [X_{t+1}],$$

where θ_t captures the fraction of agents choosing a forward-looking forecasting strategy. The backward-looking rule takes a random-walk specification projecting future variables to stay at their latest realisations: $E_t^b[X_{t+1}] = X_t$. The forward-looking rule corresponds to the rational expectations solution of the model when all agents are forward-looking, meaning expectations about the future are correct in the absence of future shocks: $E_t^f[X_{t+1}] = X_{t+1}$ given $u_{t+1} = 0$ and $\theta_t = 1$. It should be noted that when $\theta_t < 1$, forward-looking

10 The Phillips curve slope κ is itself a function of the subjective discount factor $\beta \in (0,1)$ and the Calvo price stickiness parameter $\xi \in (0,1)$: $\kappa = \frac{(1-\beta\xi)(1-\xi)}{\xi}$

expectations are *not* model consistent as they do not take into account the presence of backward-looking agents.

We consider two approaches for determination of the share of forward-looking versus backward-looking agents, θ_t. In the first approach θ_t is treated as an exogenously determined constant coefficient. Alternatively, we follow Cornea-Madeira *et al.* (2019) and assume agents endogenously switch between forecasting rules based on their recent forecast performance, with the best performing rule receiving the most attention. Implementation of this endogenous forecast switching mechanism is done using the learning algorithms developed by Slobodyan and Wouters (2012) with a few modifications to keep the coefficients for each forecasting rule constant over time.[11]

The calibration of the model is informed by Bayesian estimation on quarterly euro area data for the period 1970Q2 –2019Q4, under the assumption of fully forward-looking expectations (i.e. $\theta = 1$). All coefficients take standard values compared to the literature (see Table 1).

Table 1

Parameterization

Parameters	Value	Economic interpretation
β	0.99	Subjective discount factor
φ	0.82	Habit formation in consumption
σ	3.81	Intertemporal elasticity of substitution in consumption
γ	0.12	Price indexation
ξ	0.94	Share of firms per period keeping prices unchanged
ρ	0.84	Interest rate smoothing
α_π	1.49	Monetary policy response to inflation
α_γ	0.10	Monetary policy response to output
ρ_υ	0.90	AR coefficient cost push shock
σ_υ	0.019	Standard deviation cost push shock

Note: These parameter values imply a Phillips curve slope of $k = (1 - \beta\xi)(1 - \xi) / \xi = 0.0034$.

Figure 14 in Section 3 examines the welfare implications of enhancing the central bank's responsiveness to inflation, given varying degrees of backward-looking expectations formation. For this exercise, monetary policy is assumed to aim at minimising a standard discounted squared-error loss function considering the deviations of inflation, the output gap and interest rates from their respective long-term equilibrium values:

$$Loss^2 = \sum_{h=1}^{48} \beta^h \left[(\pi_{t+h} - 0)^2 + \lambda_y (y_{t+h} - 0)^2 + \lambda_i (i_{t+h} - 0)^2\right].$$

It should be noted that variables are already expressed in deviations from the steady state, so that long-term equilibrium values are all zero under this notation. Moreover, the loss function only considers losses observed in the first 48 quarters. This simplifying assumption is justified by the fact that the dynamic effects of the cost-push shock under consideration have largely died out after 12 years in all model specifications.

The coefficients λ_y and λ_i denote the weights assigned to stabilising the output gap and interest rates, respectively, relative to inflation stabilisation. In the baseline calibration, $\lambda_y = 0.1$ and $\lambda_i = 0$; this implies a

11 Slobodyan and Wouters' (2012) replication files are available at https://www.openicpsr.org/openicpsr/project/114246/version/V1/view.

standard loss function that prioritises inflation stabilisation while abstracting from concerns about interest rate variability. The results are robust to considering a non-zero weight on interest rate stabilisation of $\lambda_i = 0.75$ and increasing the output weight λ_y up to 0.5, which covers the range of reasonable values for a central bank engaged in inflation targeting.

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Conventional signs

%	per cent
e.g.	*exempli gratia* (for example)
et al.	et alia (and others)
etc.	*et cetera*
i.e.	*id est* (that is)
p.m.	*pro memoria*

List of abbreviations

Abbreviations

BMPE	Broad macroeconomic projection exercise
CES	Consumer Expectations Survey
COVID-19	Coronavirus disease
EA	Euro Area
EC	European Commission
ECB	European Central Bank
HICP	Harmonised index of consumer prices
ILS	Inflation-linked swap
IS curve	Investment-savings curve
SMA	Survey of Monetary Analysts
SPF	Survey of Professional Forecasters

National Bank of Belgium
Limited liability company
Brussels RLP – Company number: 0203.201.340
Registered office: boulevard de Berlaimont 14
BE-1000 Brussels
www.nbb.be

Publisher

Pierre Wunsch
Governor

National Bank of Belgium
Boulevard de Berlaimont 14 – BE-1000 Brussels

Contact for the publication

Dominique Servais
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© Illustrations: National Bank of Belgium

Cover and layout: NBB CM – Prepress & Image

Published in 2023