



BANCA D'ITALIA
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low rate environment

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DE-ANCHORED LONG-TERM INFLATION EXPECTATIONS IN A LOW GROWTH, LOW RATE ENVIRONMENT

by Guido Bulligan, Francesco Corsello, Stefano Neri and Alex Tagliabracci*

Abstract

This paper provides evidence of de-anchoring of long-term inflation expectations in the euro area based on both time series and panel methods and data from the ECB Survey of Professional Forecasters. Long-term inflation expectations recorded two sharp and permanent declines: the first after the 2013 disinflation, the second in early 2019. Long-term inflation expectations also started reacting to short-term developments in inflation after the 2013 disinflation. Long-term growth expectations have declined continuously since the early 2000s. Looking forward, the increased likelihood of a low growth and low inflation environment may reduce the monetary policy space. The positive correlation between long-term real GDP growth and inflation expectations suggests that forecasters view future macroeconomic developments as driven mainly by demand-side shocks. Under these circumstances, the risk of a further de-anchoring of long-term inflation expectations remains high.

JEL Classification: E31, E52, E58.

Keywords: survey data, panel data, professional forecasters, inflation expectations, monetary policy.

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1. Introduction

Long-term inflation expectations play a key role in monetary policy. The anchoring of long-term expectations is a necessary condition for central banks to maintain price stability, as it prevents temporary shocks from having persistent effects on inflation. Well-anchored long-term inflation expectations are a sign of credibility of the monetary policy strategy of a central bank.

More generally, inflation expectations influence the ability of the central bank to stabilize aggregate demand and inflation by adjusting its policy rate or adopting quantitative easing measures to influence real interest rates and, in turn, households' consumption and firms' hiring, investment, and wage and price setting behaviour. Cecchetti et al. (2021) describe the role that inflation expectations play in the transmission of aggregate shocks. They also describe how econometric tools are used at Banca d'Italia for measuring and studying inflation expectations and assessing their impact on the decisions of households and firms.

Well-anchored inflation expectations can also act as a tool to support the economy when the policy rate is constrained by the effective lower bound (ELB). In these circumstances, central banks' communication can be very effective (Coibion et al., 2020). For instance, the statement on the long-run goals of the Federal Open Market Committee (FOMC) of the Federal Reserve acknowledges the important role of anchored inflation expectations, as they “[...] *foster price stability and moderate long-term interest rates and enhance the Committee’s ability to promote maximum employment in the face of significant economic disturbances [...]*”.¹ Naggert et al. (2021) document an upward shift in the lower end (below 2 per cent) of the distribution of inflation expectations and a stronger anchoring of expectations around the 2 per cent inflation goal following the announcement of the outcome of the monetary policy review by the FOMC.

The European Central Bank (ECB) began reviewing its monetary policy strategy in January 2020, with the aim of taking stock of how it has supported the fulfilment of the price stability mandate, and also to consider whether any elements of the strategy need to be adjusted.² When the policy rates are at their ELB for an extended period of time, recording below-target inflation for too long can lead to a de-anchoring of long-term inflation expectations. Such de-anchoring can make reflating the economy even harder (Lane, 2021). To avoid de-anchoring, monetary policy must be sufficiently pre-emptive and bold to prevent inflation from staying low for too long (Lane, 2020).

Market-based indicators of inflation expectations (inflation-linked swaps) in the United States remain well above the corresponding indicators for the euro area (Figure 1). This pattern emerged in 2013 and has remained in place until today. While the different developments may reflect the distinct monetary policy strategies of the Federal Reserve and the ECB, the persistent gap may suggest a weaker anchoring of long-term inflation expectations in the euro area. Figure 1 shows that the yield

The views expressed in this article are those of the authors alone and do not necessarily represent the positions of Banca d'Italia or of the Eurosystem. The authors would like to thank Fabio Busetti, Michele Caivano, Marianna Riggi, Marco Taboga, Andrea Tiseno, Giordano Zevi and Roberta Zizza for their comments and suggestions.

¹ See the “*Statement on Longer-Run Goals and Monetary Policy Strategy*” of the FOMC released on 26 January 2021. The statement is available at https://www.federalreserve.gov/monetarypolicy/files/FOMC_LongerRunGoals.pdf. The statement was revised after the completion of the review of the strategy, which was announced at the Jackson Hole Symposium on 27 August 2020.

² See the press release “*ECB launches review of its monetary policy strategy*” published on 23 January 2020 and available at <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200123~3b8d9fc08d.en.html>.

on the 5y-5y inflation-linked swap in the United States has been above the corresponding yield for the euro area since 2010.³ Since early 2019, however, the difference between the two yields has widened, as the euro-area inflation swap declined substantially.

Motivated by the review of the monetary policy strategies by both the Federal Reserve, which underlined the importance of anchored inflation expectations, and the ECB, as well as by the persistent gap between market-based indicators of long-term inflation expectations, in this paper we update the analyses presented in Corsello, Neri and Tagliabracchi (2021; CNT, henceforth) regarding the anchoring of long-term inflation expectations in the euro area and provide complementary evidence based on a panel estimation approach. We also present evidence on the correlation between long-term inflation and growth expectations, which helps us to shed light on the probability of a low interest rate environment and on the implications for monetary policy going forward.

The paper poses the following closely related questions. Are long-term inflation expectations in the euro area well-anchored? Can individual survey replies provide additional information in assessing the degree of anchoring? How do professional forecasters view the joint long-term evolution of inflation and growth and do these expected developments pose challenges to the ECB? In answering these questions, the paper briefly discusses developments in long-term growth and inflation expectations since the outbreak of Covid-19.

We use data from the ECB Survey of Professional Forecasters (SPF), which provides information on expected inflation, real GDP growth, and unemployment rates over horizons ranging from the current year up to five years ahead.⁴ We do not consider households' and firms' expectations, as to the best of our knowledge, no measures of long-term inflation expectations are available for a sufficiently long period.

Our contribution to the literature on inflation expectations and their anchoring is twofold. First, we update the time series analyses presented in CNT to mid-2021, thus including data covering the Covid-19 pandemic and exploit the panel dimension of the SPF to assess the degree of anchoring of long-term inflation expectations. Second, we study the joint distribution of long-term real GDP growth and inflation expectations. Both issues are highly relevant from a policy perspective. In a low growth and low inflation environment, the effective lower bound constraint is likely to be more frequently binding, affecting the capability of the central bank to maintain inflation on target and therefore to preserve the anchoring of long-term inflation expectations.

Our empirical analyses offer the following answers to our questions. Both time series and panel data methods confirm the findings presented in CNT of de-anchored long-term inflation expectations in the euro area. The high likelihood of low growth and low inflation expectations extending into the medium term poses significant challenges to the ECB's monetary policy and strengthens the case for its strategy to focus on re-anchoring long-term inflation expectations.

The remainder of the paper is organized as follows. Section 2 describes developments in long-term inflation expectations and in their probability distribution. Sections 3 and 4, respectively, assess

³ Part of the difference is due to the inflation risk premiums, which may differ between the United States and the euro area. The FOMC clarified only in January 2012 that the long-run inflation goal was 2 per cent. The inflation target of the ECB is implicitly defined as "below, but close to, 2 per cent in the medium term".

⁴ See Garcia (2003) for a description of the SPF.

the degree of level anchoring and shock anchoring. Section 5 studies the joint distribution of long-term growth and inflation expectations, drawing the implications for the anchoring of long-term inflation expectations. Section 6 offers some concluding remarks.

2. Developments in survey-based long-term inflation expectations since 2013

The persistently low inflation experienced around the world since the global financial crisis has spurred a lively debate into the anchoring of inflation expectations. An extensive literature focused on the developments in the euro area around 2013, when long-term inflation expectations showed signs of de-anchoring. Among others, CNT uses the ECB SPF to document that long-term inflation expectations have de-anchored from the ECB's inflation aim since 2013. Łyziak and Paloviita (2017) also find that SPF-based long-term inflation expectations have shown signs of de-anchoring since 2013.

The decline in the level of inflation expectations, which began with the 2013 disinflation, plateaued in early 2015 after the ECB launched its Asset Purchase Programme (APP). Bulligan (2018) finds that the APP announcement coincided with the reversal of the decline of long-term inflation expectations, with an upward revision to levels that, however, remained below those prevailing before the most acute phase of the sovereign debt crisis in mid-2012. After the lows reached in 2016, long-term inflation expectations gradually recovered in 2017 and 2018. By the end of 2018, expectations had returned to levels close to the ones that prevailed before the beginning of the 2013 disinflation (Figure 2, panel a). The increase may have reflected the improvement in the outlook for inflation following the adoption of a package of non-standard measures by the ECB since mid-2014, among which the APP played a key role.

Long-term inflation expectations, however, inverted their positive trend in early 2019 (Figure 2, panel b); they declined in each of the four rounds of the SPF carried out in that year, and cumulatively by 0.2 percentage points. Long-term expectations reached new historical minima in 2020: the mean expectation was 1.65 in July 2020, the median point expectation was 1.6 in October 2020 and the mean of the aggregate probability distribution was 1.55 in April 2020. All these measures stood at 2 per cent in mid-2012. Since the outbreak of the Covid-19 pandemic in early 2020, long-term inflation expectations have remained close to their historical lows.

In parallel with the decline in point expectations, the aggregate probability distribution of long-term inflation also experienced marked changes over time (Figure 3, panels a and b). The probability of long-term inflation lying below 1 per cent increased from around 4 per cent in 2007 to about 13 per cent in 2014 and then to almost 20 per cent in 2020. At the same time, the probability of inflation above 2 per cent declined from around 45 per cent in 2007 to about 37 in mid-2014 and 28 in 2020. The probability of inflation between 1.5 and 1.9 per cent, the interval that is likely to include the Governing Council's inflation aim, was at around 40 per cent in 2006.⁵ This probability started declining in 2008 and hovered around 30 per cent until 2018. After having somewhat increased between 2016 and 2018, the probability of inflation between 1.5 and 1.9 per cent has been declining

⁵ According to the answers to a special question on the interpretation of the ECB's "below, but close to, 2 per cent", SPF participants view the inflation aim as laying in the 1.7-2.0 range. The special question was the following: "What is the level or range of inflation that, according to your view, is in line with the ECB's price stability objective?". For the results, see https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/ecb.spf2020q4~dab5d8085d.en.html.

since the end of 2018. Similarly, the probability of long-term inflation falling in the 1.0-1.4 per cent bin, which stood at around 15 per cent in 2007, reached 40 per cent by the end of 2019. Since then, the probability has hovered around this level.

Until 2013, the distribution of long-term expectations was skewed to the right. The probability of inflation outcomes below or equal to 1.4 was smaller than the probability of inflation at or above 2 per cent. With the beginning of the disinflation, the probability mass started moving to the left and the distribution became skewed to the left.

3 Level anchoring

In this section, we evaluate how long-term inflation expectations have changed their degree of level-anchoring, as defined in Ball and Mazumder (2011).⁶ Expectations are “level-anchored” when they remain close to the central bank’s inflation target regardless of current inflation developments. To this purpose, we model the level of long-term inflation expectations and use break-point tests exploiting both aggregate (time series) and disaggregate (panel) data from the SPF.

3.1 Level anchoring: a time series approach

This section provides an update on one of the analyses in CNT. Among the various approaches considered, the authors applied the methodology developed by Bai and Perron (2003; BP2003 henceforth) to make inference about persistent shifts in the level of inflation expectations. Compared with CNT, who use data up to 2019:Q2, we extend the sample to 2021:Q2, which includes a few survey rounds conducted during the Covid-19 pandemic.

The BP2003 procedure is calibrated to allow for a maximum number of $m = 5$ structural regime breaks. The equation is:

$$\pi_t^e = \beta_j + \varepsilon_t \quad , \quad t = T_{j-1} + 1, \dots, T_j \quad (1)$$

for $j = 1, \dots, m$, where m is the number of potential breaks, π_t^e is the inflation expectation, β_j is a regime-specific intercept and ε_t an i.i.d. error term. Evidence of a break in the intercept implies that forecasters have switched to a new regime and have persistently revised their long-term inflation expectations. The methodology of BP2003 is calibrated to have a minimum length of 8 quarters for each regime j , compared with 11 quarters in CNT. The smaller length allows us to capture more easily downshifts in long-term expectations over the most recent period in which they kept falling. Figure 4 shows the results of the estimation of equation (1) using the three measures of long-term inflation expectations reported in Figure 2.

Compared with CNT, our approach confirms the breaks detected in mid-2000s and at the end of 2013, and identifies a further downward shift in the level of expectations in early 2019 for the mean point expectations and for the mean of the aggregate probability distribution. In the case of the median point expectations, the BP2003 methodology only detects one break in mid-2019. The magnitude of the downward shifts in 2019 ranges between 15 and 23 basis points depending on the

⁶ Kumar et al. (2015) provide a finer taxonomy of inflation expectations anchoring, describing five conditions that ideally anchored long-term inflation expectations should satisfy.

considered measure. Taking into account also the downward shift occurred in the fourth quarter of 2013, the total decline in the level of the expectations ranges between 23 and 33 basis points.

The occurrence of a further downward shift in long-term inflation expectations since 2019 reinforces the concerns of their de-anchoring, in line with the findings in CNT. The break occurred before the outbreak of the Covid-19 pandemic may be driven by the slowdown in global and euro-area economic activity, which started in early 2019 and that may have been reinforced by perceptions of a too early termination of the active phase of the APP by the ECB in December 2018.

3.2 Level anchoring: a panel approach

In this section, we further explore the behaviour of long-term inflation expectations and assess their anchoring by exploiting the panel dimension of the SPF. In a panel context, the variation across forecasters can be exploited to draw more accurate inference on the parameters of interest by controlling for both individual unobserved heterogeneity and common aggregate source of variations.

We assume that the breaks are common to all forecasters in the sample and adopt the sequential approach developed by Bai (2010) for common breaks in the mean. Theoretically, a common break is a more restrictive assumption than that of heterogeneous breaks. Nevertheless, when break points are the result of common shocks or policy shifts affecting every individual, imposing the constraint of a common break improves the precision of the estimation, without loss of realism. Furthermore, even if each individual had its own break point, the assumption of common breaks would deliver an estimate of the mean of the individual break points. Consistently with the model (1), we estimate the following (individual) fixed effect model:

$$\pi_{it}^e = \alpha_i + \beta_{ij} + \varepsilon_{it} \quad , \quad i = 1, \dots, N \quad t = T_{j-1} + 1, \dots, T_j \quad , \quad (2)$$

where the individual fixed effect (α_i) allows to control for unobserved, time invariant, forecaster specific characteristics and β_{it} captures time variation in the forecaster specific nominal anchor around which her long-term inflation expectations hover. As in the previous section, the index j refers to the specific regime reflecting the assumption that changes in the anchor occur occasionally. Unlike the time series aggregate analysis, no maximum is imposed on the number of breaks. The error term $\varepsilon_{i,t}$ is i.i.d. with constant (over time) variance.⁷

The Bai (2010) methodology identifies three break dates: 2008:Q4, 2014:Q1 and 2019:Q3. Breaks identified in those periods occur in correspondence of the large changes in the aggregate mean point forecast (Figure 5). At the first break date, mean expectations shifted upward by 6 basis points.⁸ In 2014:Q1, instead, the downward shift amounts to, on average, 12 basis points. At the second break point, long-term inflation expectations shifted downward by 16 basis points, bringing the overall decline since 2014 to nearly 30 basis points, in line with the results based on the time series approach.

⁷ The assumption of cross-sectional independence can be relaxed, without affecting the consistency of the estimator.

⁸ This first break is only detected with the panel approach (and not with the time series one) since it relies on a more efficient inference which allows to capture also these modest changes in the regime.

4 Shock-anchoring

Borrowing from Ball and Mazumder (2011), we define long-term inflation expectations as “shock-anchored” when they do not respond to shocks. Against this background, in this section, we focus on the degree of sensitivity of long-term inflation expectations to inflation surprises. Our analyses consider both aggregate and granular approaches.

4.1 Shock-anchoring: a time series approach

In this section, we measure the sensitivity of long-term inflation expectations to inflation surprises, as indicator of shock-anchoring. The inflation surprises are measured by the difference between the monthly flash releases of the euro area year-on-year inflation rates (based on the Harmonized Index of Consumer Prices) and the median forecasts of the analysts surveyed by Bloomberg.⁹

Our approach is based on a rolling-window estimation, which allows assessing changes of this sensitivity without imposing a precise sample split and is consistent with smooth modifications in the inflation expectation formation mechanism. We estimate the following equation:

$$\Delta\pi_t^e = \beta z_{\pi,t} + \varepsilon_t \quad (3)$$

where $z_{\pi,t}$ is the negative inflation surprises and ε_t is an i.i.d. error term. We estimate equation (3) using a moving window of 24 quarters. The results are robust to different window sizes (20 and 28 quarters). Based on the results presented by CNT, we only consider the negative surprises (i.e. inflation is over-predicted).¹⁰ Figure 6 shows the results. As documented in CNT, the sensitivity to inflation surprises becomes statistically significant when the rolling sample includes the observations of the 2013-2014 disinflation. This sensitivity remains significant afterwards and peaks in early 2020 for all measures, at between 0.2 and 0.35. Since mid-2020, the sensitivity to the negative inflation surprises becomes statistically not significant, with the exception of the median point expectations.

Overall, the results suggest that long-term inflation expectations have become shock de-anchored after the 2013 disinflation, in line with the results in CNT, which are based on data up to 2019:Q2.

4.2 Shock-anchoring: a panel approach

In this section, we assess the degree of anchoring of long-term inflation expectations on the basis of their sensitivity to short-term news on inflation, exploiting the panel dimension of the SPF survey.

To this end, equation (3) is modified with the subscript i to account for the panel dimension:

$$\Delta\pi_{it}^e = \beta z_{i,t} + \varepsilon_{it} \quad , \quad (4)$$

where $z_{i,t}$ is the inflation “news” indicator.¹¹ In this section the latter is either defined as short-term inflation surprise in exactly the same way as in the previous section (i.e. as the difference between

⁹ See CNT for details.

¹⁰ The sensitivity to positive surprises appears not significant also in the last part of the sample.

¹¹ As the model is specified in terms of revisions (i.e. changes in forecasters’ long-term inflation expectations), individual fixed effects are dropped.

the inflation release and the Bloomberg median forecast; S_t) or as the revision in the short-term (1-year ahead) forecaster-specific inflation expectation from the SPF (R_{it}^{1y}).

The “news” indicator S_t has the advantage of precisely defining short-term inflation surprises but, on the other hand, in a panel context imposes the assumption that all forecasters are subject to the same surprise.¹² Under such assumption, exploiting the panel dimension of the SPF improves the efficiency of the estimation as the number of observations is mechanically multiplied by a factor N (where N is the number of forecasters in the SPF survey) compared to the time series exercise.

The “news” indicator R_{it}^{1y} has the advantage of providing us with a forecaster-specific proxy of inflation news; the disadvantage is that it measures inflation news only indirectly and with some degree of imprecision. To understand this point, consider the quarterly frequency of the SPF: when new information about inflation is released between one survey round and the next, forecasters update their short-term (1-year ahead) expectations to account for the component of the releases that was truly unexpected. In this sense, the revisions of their expectations incorporate the “surprises” to inflation. To the extent that each forecaster embeds the inflation surprise in a different way (for example because of different forecasting models), the forecaster-specific revision of her short-term expectations allows to neatly test the relationship between long-term expectations and short-term inflation surprises using individual-specific information sets. In both cases, under the null hypothesis that long-term expectations are well-anchored, they should not react to short-term surprises.

For both definitions of the inflation “news” indicator, there is evidence of shock de-anchoring of long term expectations (Table 1, row 1), as the estimated coefficient β is positive and significantly different from zero.¹³ Furthermore, we find that the co-movement between negative short-term revisions (R_{it}^{1y}) and revisions of long-term expectations is slightly stronger than that between the latter and positive revisions (Table 1, rows 2 and 3), and significantly stronger when short-term inflation news are measured with the Bloomberg surprise (S_t).

In order to assess the robustness of the general result, we estimate the model for the groups of experienced and inexperienced forecasters, following CNT. The former are defined as those forecasters who have participated to at least 60 rounds of the SPF survey. In principle, these forecasters have committed resources to the survey and are therefore interested in the accuracy of the information it can provide. Arguably, these forecasters should revise more quickly their forecasts in response to changes in their information set, due to policy announcements, short-term inflation surprises and other data releases deemed relevant for assessing the degree of inflationary pressures in the economy. In line with this intuition, we find that the correlation between (revisions of) long-term inflation expectations and revisions of short-term forecasts (R_{it}^{1y}) is primarily driven by the behaviour of less experienced forecasters (Table 1, row 4). When using the Bloomberg inflation surprise (S_t), we find evidence of shock de-anchoring for both inexperienced and experienced forecasters.

¹² This assumption is in fact less stringent than it might appear. The Bloomberg survey is conducted few days before the official inflation release and most information is by then common knowledge across survey participants.

¹³ The result does not vary when we introduce additional regressors such as changes in expected short-term interest rates, in the bilateral €/\$ exchange rate and in oil prices as controls.

We also estimate the sensitivity of long-term inflation expectations to short-term news over time by re-estimating the model over a rolling window of 24 quarters. In line with the time-series evidence, we find that such sensitivity has increased significantly since 2015 (Figure 7 panels a and b). Interestingly, while such increase is due to inexperienced forecasters, since 2019 also experienced forecasters' long-term expectations have become shock-de-anchored. As highlighted in CNT, evidence of inflation de-anchoring among the more experienced forecasters raises serious concerns regarding the credibility of the ECB in maintaining inflation at the Governing Council's inflation aim.

5 De-anchoring in a low growth environment

The ECB SPF provides not only expectations on long-term inflation, but also on real GDP growth. In this section, we use this information to study the joint behaviour of long-term expectations of growth and inflation since the inception of the euro. This analysis offers important insights for monetary policy, since the expected evolution of the growth in the long-term may influence the policy space, through the impact on the natural rate of interest.

5.1 Long-run developments in expectations

Long-term inflation expectations (Figure 8, left panel) increased to levels close to 2 per cent in the first decade of the monetary union and then, with the beginning of the disinflation in 2013, reached historically low levels in late 2019. Long-term real GDP growth (Figure 8, right panel) has persistently declined since the early 2000s, with the only exception of the period immediately before the outbreak of the global financial crisis. Between 2002 and 2008, long-term expected growth declined by 0.5 percentage points, on average. The global financial crisis caused a downward revision of long-term expected growth by around 0.4 percentage points. The downward trend continued until late 2019, when expected growth reached 1.4 per cent, followed by a stabilization thereafter. For both growth and inflation expectations, the end-2020 levels were historically lows.

The slow but persistent decline suggests that structural factors, such as lower total factor productivity growth, lower business investments and adverse demographic developments, may be responsible for the decline in long-term expected growth. The consequences of the global financial and sovereign debt crises may have exerted further downward pressure on long-term growth.

The joint time evolution of inflation and growth expectations is represented in Figure 9 by means of an inflation-growth "clock". Their developments between 2001 and 2009, with increasing inflation expectations and declining growth expectations, suggest that SPF participants viewed long-term prospects as driven primarily by supply-side factors. After a period of stabilisation, the downward trend in both expectations, which began after the sovereign debt crisis, suggests that participants switched to a view of long-term developments based on (negative) demand-side factors. This interpretation is consistent with the evidence in Rostagno et al. (2019), who argue that the ECB's definition of price stability worked as a cap to long-term inflation expectations in the case of supply-side shocks before the global financial crisis, while it offered no protection against demand-driven disinflationary shocks after the sovereign debt crisis.

The above evidence suggests the following policy considerations. An expected lower long-term growth can lead to a lower natural rate of interest (Holston et al., 2017).¹⁴ A low natural rate raises the probability and duration of periods in which the policy rate is at its effective lower bound (Brandt et al., 2018). If the central bank follows a symmetric monetary policy rule, inflation in equilibrium will hover at levels below the target, unless the central bank adopts non-standard measures (Coenen et al., 2020), which are also subject to constraints. The below-target inflation is commonly referred to as disinflationary bias. In this context, fiscal policy can support monetary policy in counteracting the effects of recessionary shocks, and, together with structural reforms, raise potential output growth.

5.2 The risk of a low-growth low-inflation environment

In parallel with the decline in the level of expectations, the aggregate probability distributions of long-term inflation and growth expectations have also undergone marked changes over time.¹⁵ Figure 10 shows their time evolution (panels a and b, respectively).

In the case of inflation expectations (left panel), the distribution changed considerably after three main episodes: the global financial crisis, the sovereign debt crisis and the missing inflation period (see Section 2). In 2021, about 40 per cent of the distribution lies below 1.5 per cent; the probability of inflation below 2 is as high as 70 per cent. The pattern partially differs for the growth distribution (Figure 10, right panel). The probabilities of the different bins have gradually declined since the early 2000s. In the early stages of the survey, the probability of growth above 2.5 per cent was almost 60 per cent. Then, a downward shift prevailed until the outbreak of the global financial crisis, when the distribution changed considerably: the major change involved the probability of the 1.5-2 per cent interval, which increased at the expenses of outcomes above 2 per cent. The process of converging to lower expected growth regained traction until the end of 2019, when the probability of GDP growth below 2 per cent reached its maximum at 80 per cent. After the outbreak of the Covid-19 pandemic, the probabilities of low growth outcomes (in particular of the 1-1.5 per cent bin) marginally declined, although the overall picture still points towards an expected low-growth environment in the long-term.

To sum up, the probability distributions of long-term inflation and GDP growth have undergone major changes since the early 2000s, with their mean values settling at historically low levels. A scenario of low-inflation and low-growth represents a key challenge for the ECB's monetary policy in the future, as it may imply a limited policy space for both conventional and unconventional tools.

5.3 A joint assessment of the probability distribution

This section focuses on the co-movement between long-term expectations on inflation and real GDP growth. For every round of the survey, we compute the correlation between the point forecasts of inflation and output growth across participants.

¹⁴ In the 2013 special survey, 68 per cent of the forecasters replied that they interpret long-term forecast of real GDP growth as an estimate of potential output growth. In the 2018 special survey, the same percentage was 93 per cent (44 per cent always, 49 sometimes).

¹⁵ In the analysis, we consider a fixed support ranging from 0 to 3%, with intervals of width equal to 0.5 p.p. and open intervals at the two extremes. The description of the intervals can be found at the ECB webpage:

https://www.ecb.europa.eu/stats/prices/indic/forecast/shared/files/SPF_dataset_description.pdf (Annex 3).

The correlation between long-term growth and inflation expectations remained negative until the global financial crisis and turned positive (between 0.2 and 0.4) after the 2013 disinflation (Figure 11). Over time, forecasters gradually revised their long-term expectations in a way that suggests a change in their views about the drivers of real GDP growth and inflation (Section 5.1). The change in the correlation between inflation and growth expectations is corroborated by the change in the sign, from positive to negative, of the inflation risk premium at a comparable horizon, estimated using a decomposition of inflation-linked swaps. A negative risk premium indicates that investors are more willing to pay an insurance against low inflation especially when associated to adverse economic conditions, which is more likely in a context characterized by positive correlation between inflation and growth in the future. The correlation between the (negative of the) inflation risk premium and the co-movement between inflation and growth expectations is 0.8, on average.

The low-inflation and low-growth environment arising from the SPF signals that forecasters expect a predominance of adverse demand factors. This evidence is also in line with the findings in Coibion et al. (2020) for Italian firms. The authors show that in a sub-sample during which the ECB's policy rates were constrained by the effective lower bound, Italian firms associated higher inflation expectations with a stronger economic outlook in the short-term. On the other hand, the authors show that households' expectations on inflation and output growth correlate negatively, consistently with the view that the economy is affected primarily by supply-side shocks.¹⁶

The evidence provided above motivates an exercise to characterize the joint aggregate density of inflation and growth expectations, based on the time evolution of the aggregate distributions (Figure 10) and of the correlation between the expectations, which is estimated using the cross-section of individual point forecasts (Figure 11). Higher-order moments do not provide strong evidence against the normality of the inflation and real GDP growth marginal distributions. These distributions are only slightly left-skewed and displayed a modestly negative excess kurtosis that has vanished since 2020. Hence, the assumption of a normal joint distribution does not appear too strong given the properties of the aggregate marginal distributions, also considering the absence of information about the joint distribution in the SPF.

To characterize the joint density, we carry out the following simulation:

- i)* for each period t (from 2001:Q1 to 2021:Q2) draw numbers from a bivariate normal distribution with mean zero and unitary standard deviations, and correlation ρ_t , estimated from the cross-section;
- ii)* compute the cumulative density function for each draw using the normal cdf $\Phi(\cdot)$;
- iii)* use the inverse of the cumulative density function of the marginal distributions (obtained using kernel estimation) to obtain correlated draws.¹⁷

¹⁶ See Cecchetti et al. (2021) for a discussion of the evidence regarding households' expectations.

¹⁷ For each t , we repeat the following steps:

- a) draw from $\begin{bmatrix} Z_1 \\ Z_2 \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_t \\ \rho_t & 1 \end{bmatrix}\right)$;
- b) calculate the standard normal cdf: $\begin{bmatrix} U_1 \\ U_2 \end{bmatrix} = \begin{bmatrix} \Phi(Z_1) \\ \Phi(Z_2) \end{bmatrix}$;

Figure 12 shows the resulting bivariate density in six selected periods: the early years of the ECB (2002), before and after the global financial crisis (2007 and 2010, respectively), the 2013 disinflation, late 2018, when the ECB began normalizing its monetary policy, and the Covid-19 pandemic (2020:Q2).

The simulations allow us nicely summarising in one single chart the evidence presented in the previous sections. Long-term inflation and growth expectations have gradually moved from the north-west area of high growth and close to 2 per cent inflation to the south-west quadrant, with much lower growth and well-below 2 per cent inflation.

The evidence presented in this section bears important policy implications. The lower expected long-term growth may be partly responsible for the decline in the natural rate in the euro area documented in Brandt et al (2018). Indeed, considering also the effective lower bound to the ECB's policy rates and limits to asset purchases (either objective or self-imposed), these constraints limit the conventional and unconventional monetary policy space. In this context, agents may question the ability of the ECB to fulfil its mandate and gradually revise downward their inflation expectations, further reducing the policy space for the central bank and contributing to keeping actual inflation below the target. Fiscal policy can provide support to monetary policy in the aftermath of a deep recession, as the one caused by the Covid-19 pandemic. At the same time, structural reforms and fiscal measures supporting investment in R&D and infrastructure can contribute to raising potential output growth, and thus the natural rate, eventually increasing the policy space for the central bank.

5.4 Inflation and growth expectations during the Covid-19 pandemic

In that first phase of the Covid-19 pandemic, the severe restrictions put in place by governments to contain the diffusion of the novel coronavirus induced a halt in the supply of goods and services and led to an unprecedented contraction in aggregate demand.

The SPF allows us to study how forecasters assessed the implications of the pandemic for real GDP growth and inflation expectations. Such an assessment has important implications for monetary policy both in the short-term and in the longer-term. In the short-term, the relative importance of demand- and supply-side effects of the pandemic may influence the effectiveness of fiscal and monetary policies in stabilizing economic activity and inflation. In the longer-term, the relative importance of these effects may determine the fiscal and monetary policy space, through the impact of the Covid-19 pandemic on the natural rate of interest and potential output growth.

Guerrieri et al. (2021) develop a theory of Keynesian supply shocks that trigger changes in aggregate demand, rationalizing the transmission of the Covid-19 pandemic shock. Baqaee and Farhi (2020) study how in a multi-sector new Keynesian model, inflationary supply shocks and deflationary demand shocks emerge and propagate via input-output linkages.

Between the January 2020 round of the SPF, when news of the virus were still scarce and focused on China, and the April 2020 round, when several European countries locked-down their economies, SPF forecasters revised down their point forecasts for GDP growth and inflation in 2020

- c) obtain the final draws using the inverse of the cdf of the marginal distributions: $\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} F_1^{-1}(U_1) \\ F_2^{-1}(U_2) \end{bmatrix}$.

significantly (-6.6 p.p. and -0.8 p.p., respectively, on average), indicating a recessionary shock of unprecedented magnitude. Expectations at medium-to-long horizons were also revised but to a much lesser extent, suggesting that forecasters interpreted the shock as having only a temporary impact on inflation and growth, also taking into account the policy response put in place by national and European policymakers.¹⁸ Indeed, in terms of mean point forecasts, long-term expectations were only marginally revised: long-term growth expectations have been hovering around 1.4 per cent since 2019 and long-term inflation expectations declined by 0.1 p.p. per cent only in the July round of the SPF.

The correlation between long-term inflation and real GDP growth expectations discussed in Section 5.3 reached its maximum value in 2020:Q2, consistently with forecasters' interpretation of the Covid-19 shock as exerting its initial impact on the economy more through the demand side than through the supply side (Figure 11). In the first half of 2021, the progress in the vaccination campaigns and the gradual removal of the containment measures, bolstered aggregate demand and improved the forecasts for both economic activity and inflation in the medium-term. At the same time, persisting disruptions in supply-chains and the shortage of raw materials continued restraining aggregate supply.¹⁹ A rebalancing of the relative importance between supply- and demand-side factors towards the former may have led to a decrease in the correlation between long-term inflation and GDP real growth expectations, which fell to the levels that prevailed in late-2013.

6 Conclusions and policy implications

Long-term inflation expectations play a key role, as they provide a measure of the credibility of the central bank. Moreover, well-anchored expectations preserve the effectiveness of monetary policy.

Both time series and panel methods confirm the previous findings (e.g. Corsello, Neri and Tagliabracchi, 2021) that long-term inflation expectations have become de-anchored since the 2013 disinflation. In a low-growth environment (where the natural rate of interest is structurally low; see Brand et al., 2018) de-anchored inflation expectations increase the risk that the policy rates may hit their effective lower bound more frequently, causing the economy to remain stuck in a low inflation-low inflation expectations-low growth environment. So far, the preliminary evidence conveyed by the SPF about the impact of the Covid-19 pandemic on inflation expectations seems to suggest that the response of monetary, fiscal and micro- and macro-prudential authorities in the euro area has helped to prevent a further de-anchoring of long-term inflation expectations.

The ongoing review of the ECB's monetary policy strategy is an opportunity to acknowledge the risks posed by an environment characterized by a low natural rate and the presence of the ELB, in which it would be beneficial to improve the anchoring of long-term inflation expectations by adopting a clear and precisely defined symmetric inflation target.

¹⁸ Expectations for GDP growth were revised downward by 3.9 pp 1-year ahead and by 1.6 pp upward 2-year ahead; for HICP inflation they were revised by 0.3 downward 1- year ahead and were not revised at 2 years' horizon.

¹⁹ For instance, the Financial Times titled on 24 February 2021 "*Europe's factories raise goods prices as supply bottlenecks bite*" to document that shortages of materials and soaring shipping costs have disrupted supply chains and manufacturers are passing higher input cost to their customers, raising concerns for potential inflation pressures. See: <https://www.ft.com/content/7aef28eb-ce0c-49a4-b7cc-06d89478c44c>.

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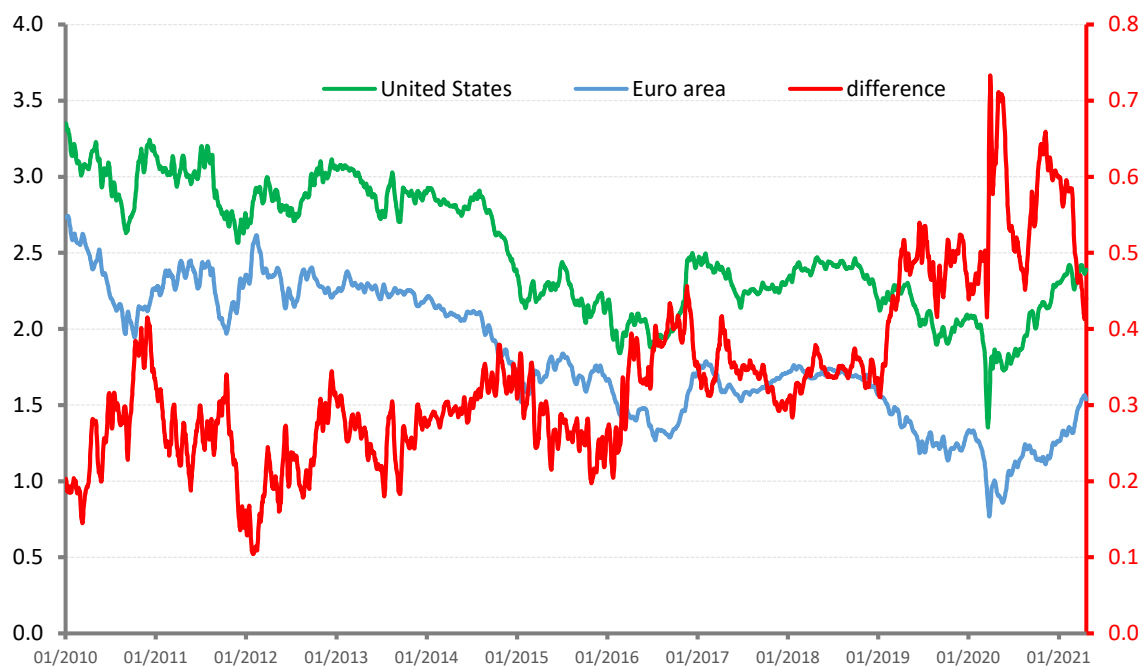
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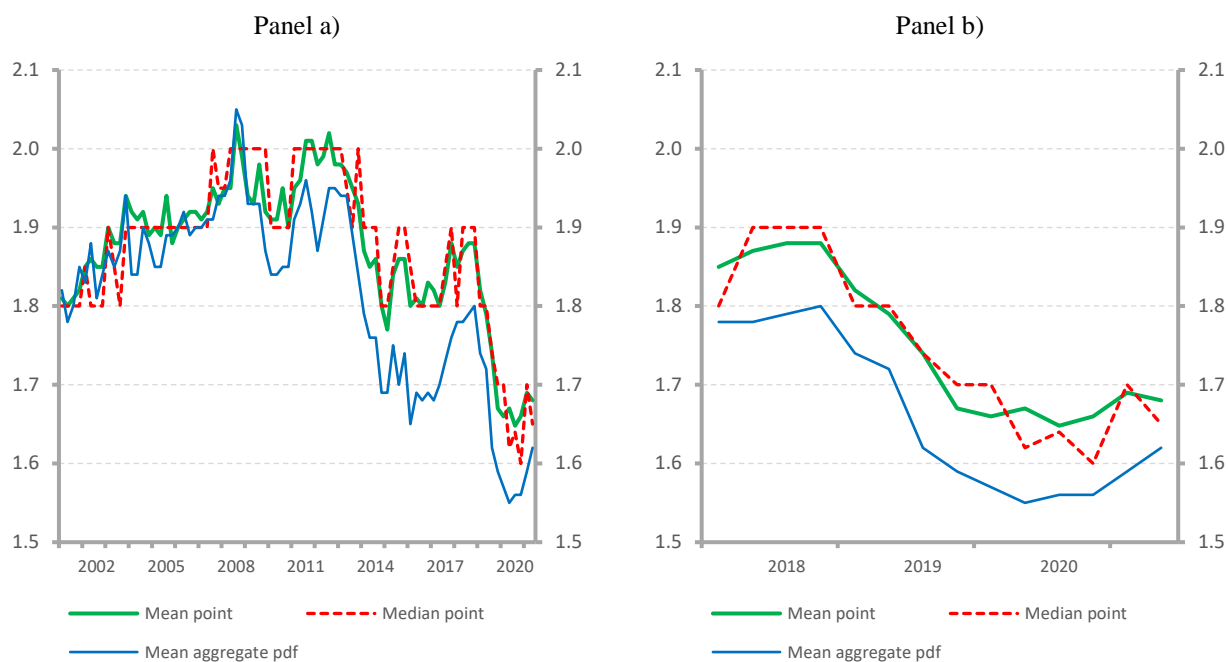
Figures and tables

Figure 1. Market-based indicators of inflation expectations: United States and euro area



Source: Reuters.

Figure 2. Long-term survey-based inflation expectations



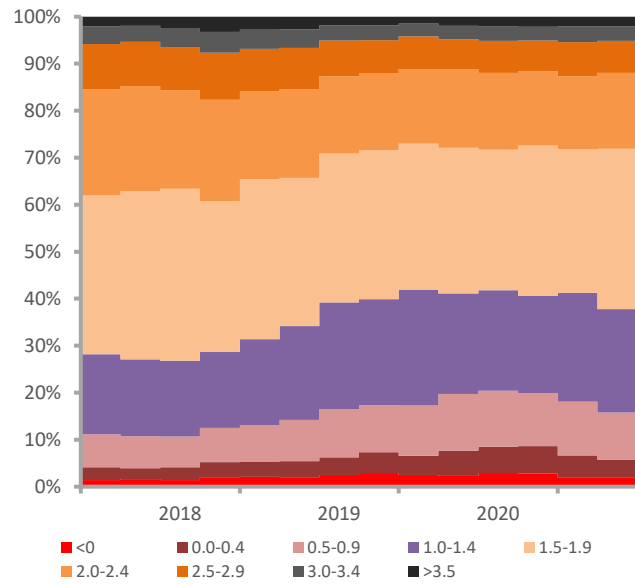
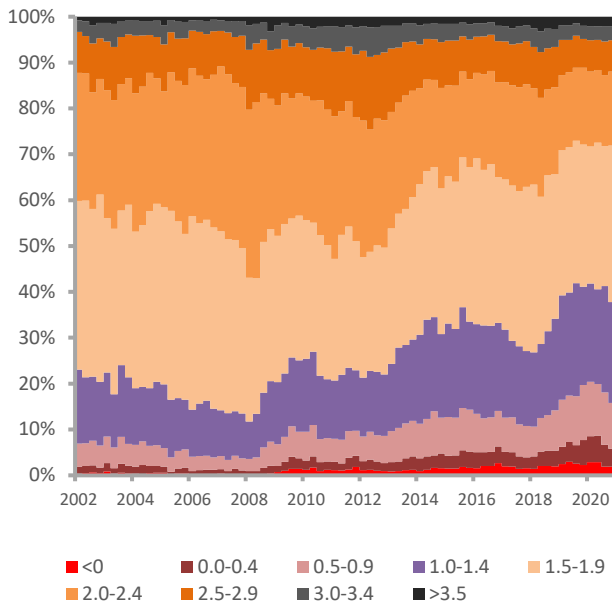
Source: ECB's Survey of Professional Forecasters.

Note: the long-term corresponds to roughly five years; thus, expectations refer to one-year four-year ahead inflation.

Figure 3. Probability distribution of long-term inflation expectations

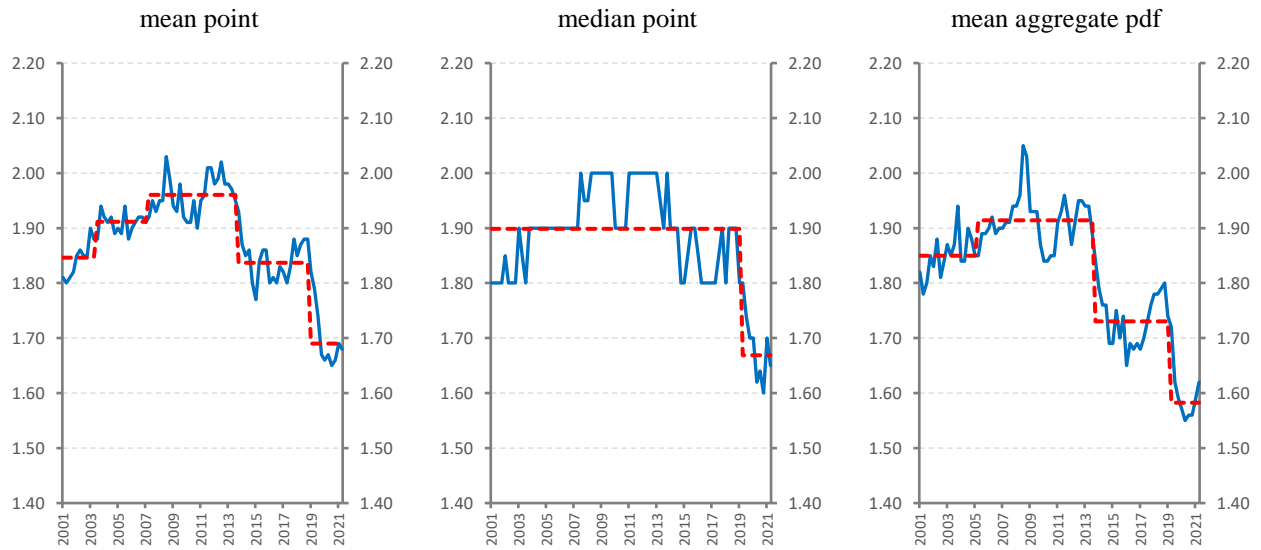
Panel a)

Panel b)



Source: ECB's Survey of Professional Forecasters.

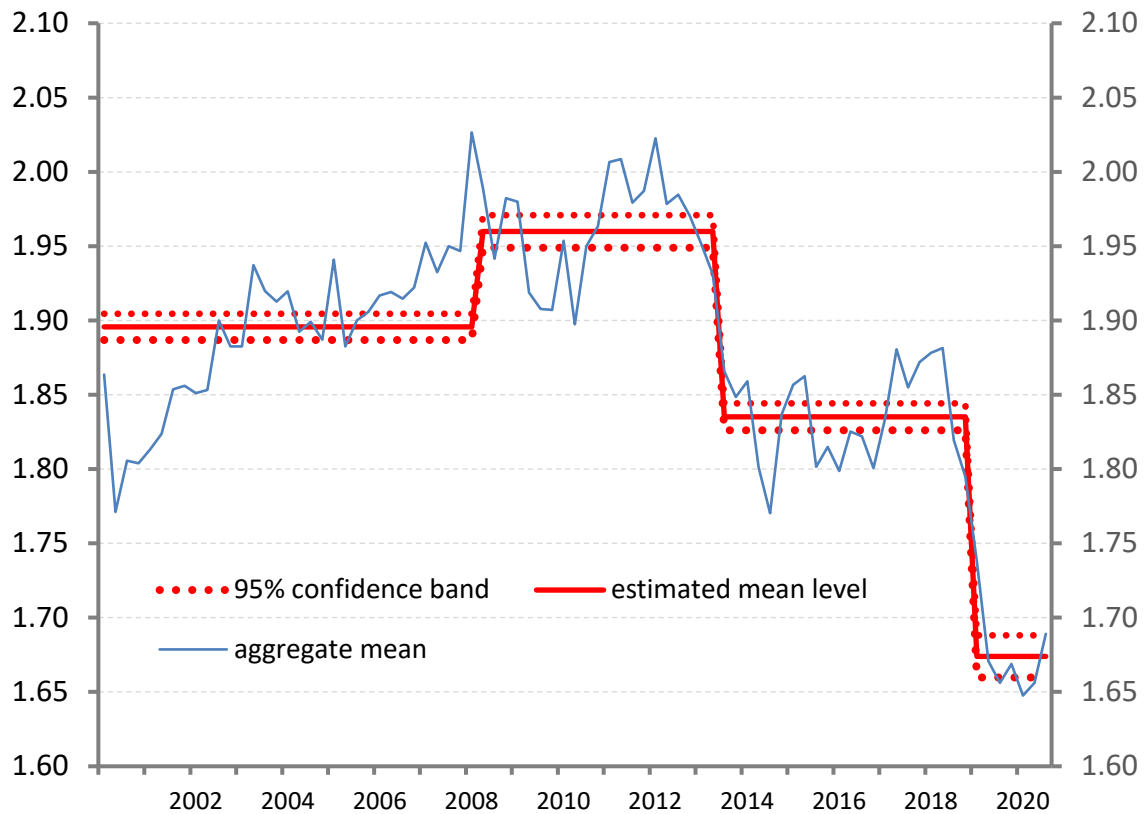
Figure 4. Level shifts of long-term inflation expectations



Source: ECB's Survey of Professional Forecasters.

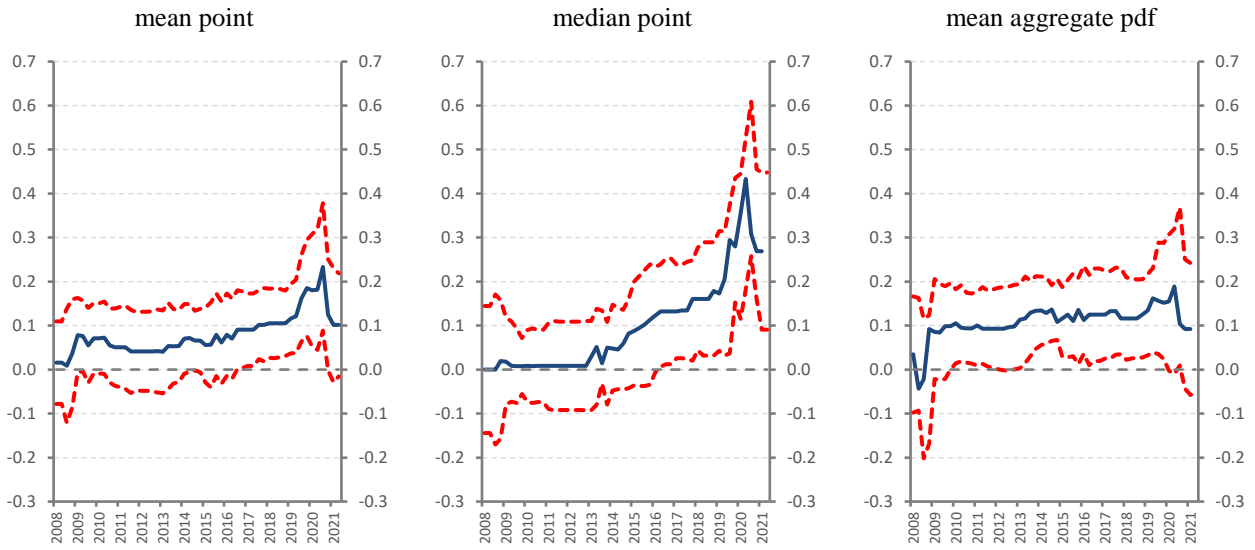
Note: the Bai and Perron (2003) procedure is calibrated to allow for a maximum of 5 structural breaks, each of a minimal length of 8 quarters. Sample period: 2002:2 – 2021:2.

Figure 5. Break in mean level: panel approach



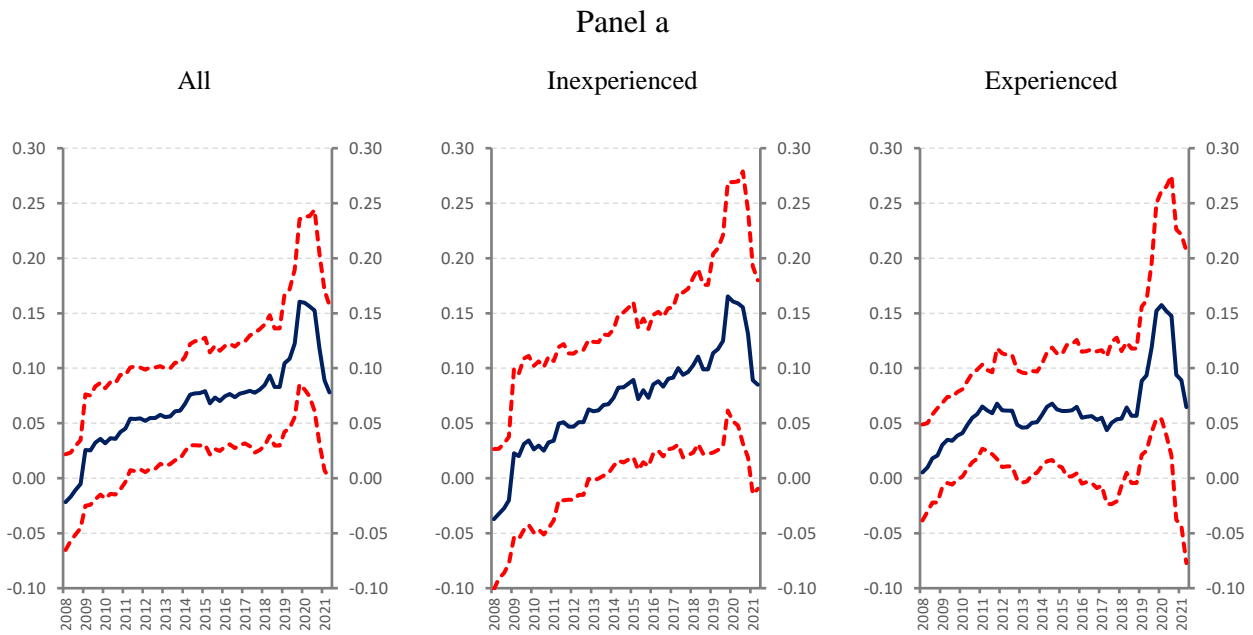
Note: blue line: mean (across forecasters) of individual 5-year ahead point forecasts. Red solid line: estimated intercept of model 1 according to estimated break dates (2008:Q4; 2014:Q1 and 2019:Q3). Red dotted line: 95% confidence bands.

Figure 6. Sensitivity of long-term inflation expectations to negative inflation surprises – time series approach

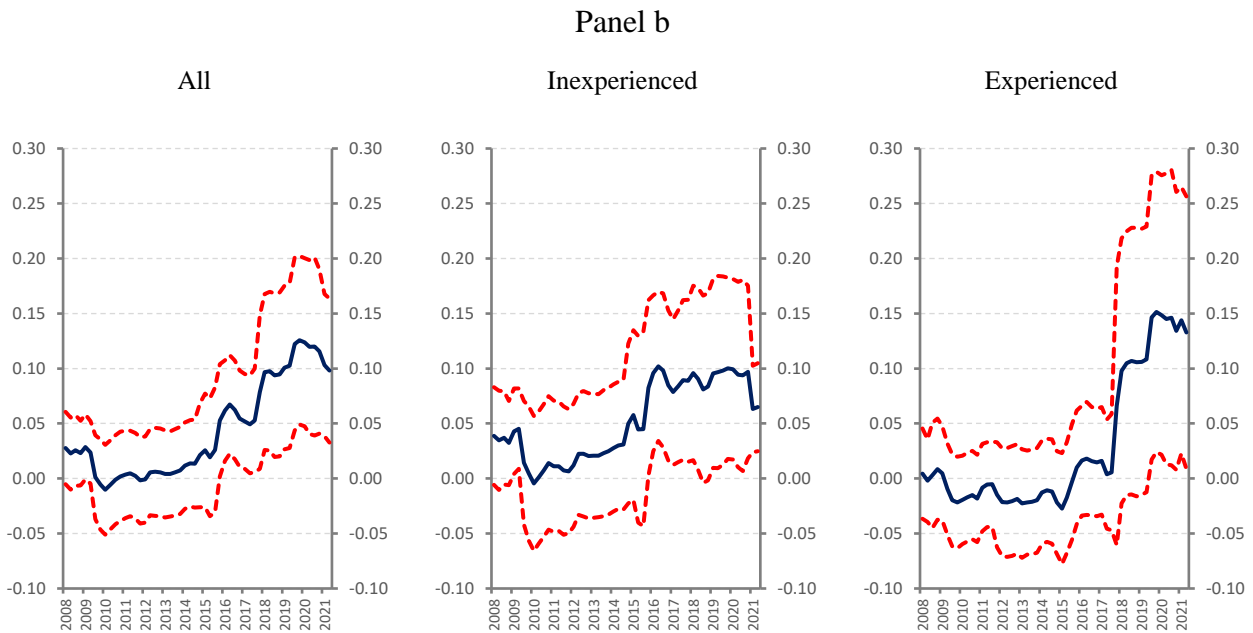


Note: blue line: estimated coefficient. Red dotted line: 95% confidence bands. The horizontal axis reports the end of each rolling sample.

Figure 7: Sensitivity of long-term expectations to inflation news – panel approach

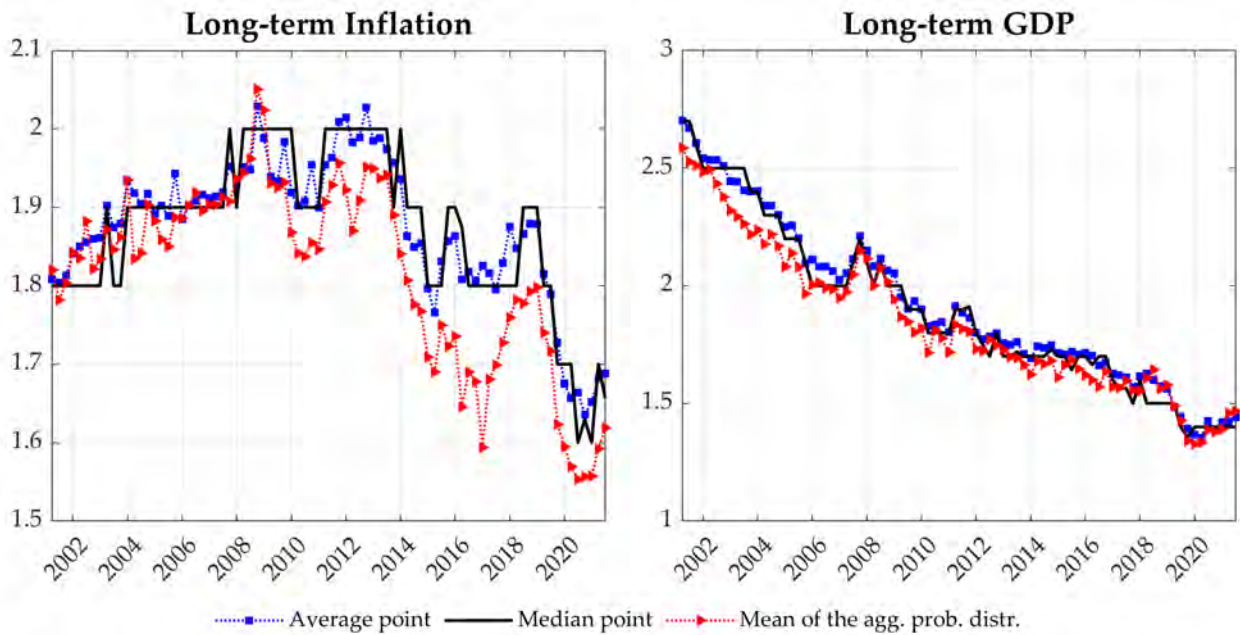


Note: short-term inflation news are defined as the Bloomberg short-term inflation surprises, S_t . Rolling window. Starting sample is 2002:Q1-2008:Q1. In all graphs, the date refers to the last observation of the sample. Red solid line: estimated coefficient on inflation news; red dashed line: 2-standard deviation confidence bands. Experienced forecasters are those who have participated in at least 60 rounds of the SPF.



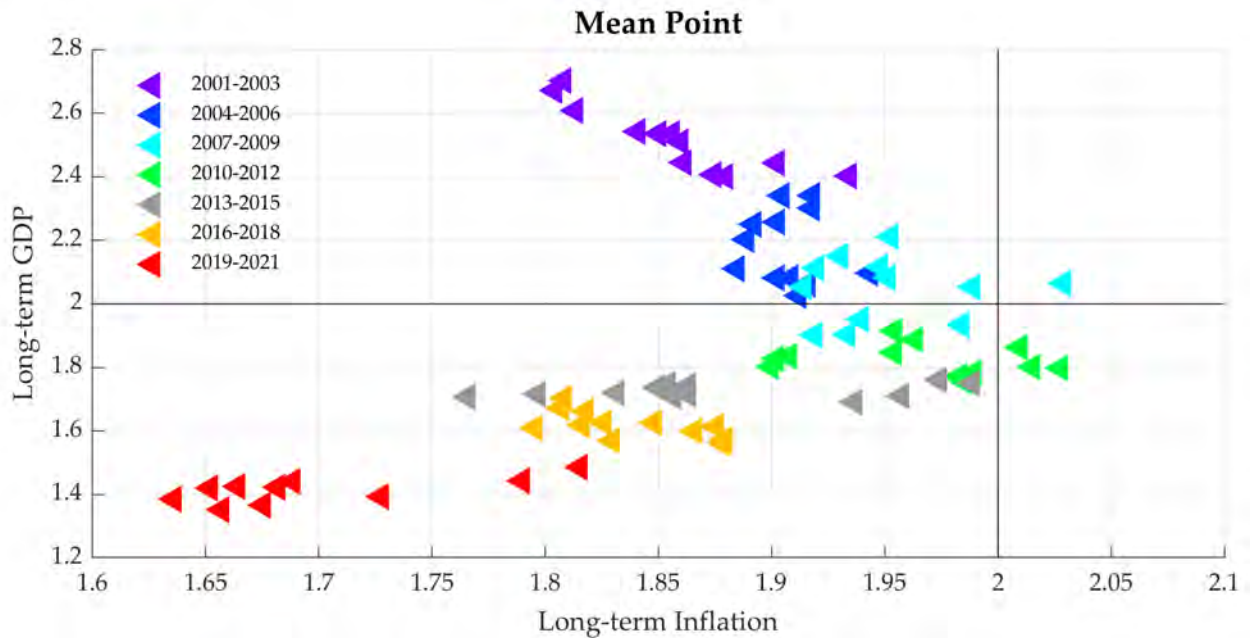
Note: short-term inflation news are defined as revisions of 1-year ahead SPF inflation forecasts, R_{it}^{1y} . Rolling window. Starting sample is 2002:Q1-2008:Q1. In all graphs, the date refers to the last observation of the sample. Red solid line: estimated coefficient on inflation news; red dashed line: 2-standard deviation confidence bands. Experienced forecasters are those who have participated in at least 60 rounds of the SPF.

Figure 8. Real GDP growth and inflation expectations in the long-term



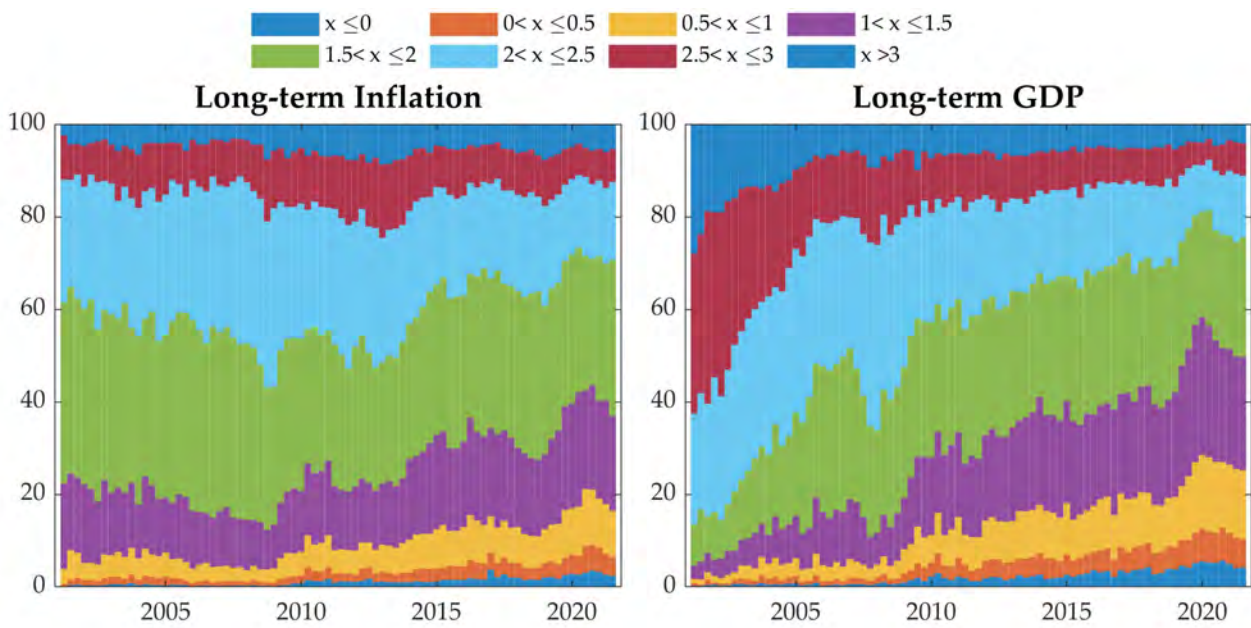
Source: our computations based on the ECB’s Survey of Professional Forecasters. Note: long-term corresponds to roughly five years. The mean of the aggregate probability distribution is obtained by aggregating forecasters’ individual distributions and computing the mean.

Figure 9. The GDP growth and inflation expectations “clock”



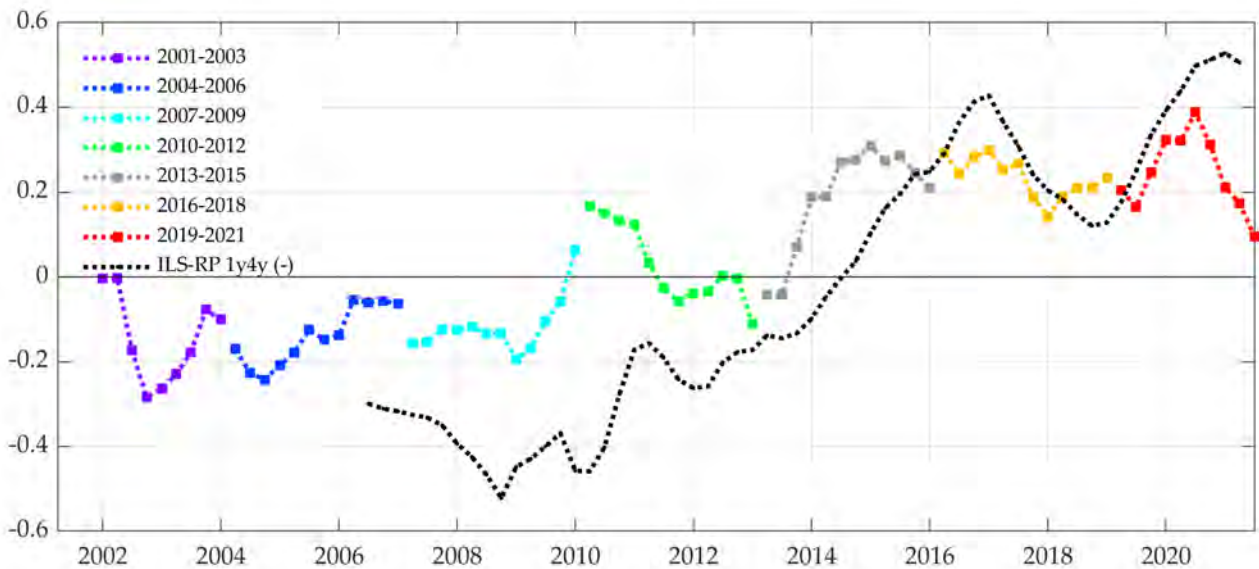
Source: ECB’s Survey of Professional Forecasters.

Figure 10. Probability distribution of long-term inflation and GDP growth expectations



Source: ECB's Survey of Professional Forecasters. Data covers the period 2001Q1-2021Q2.

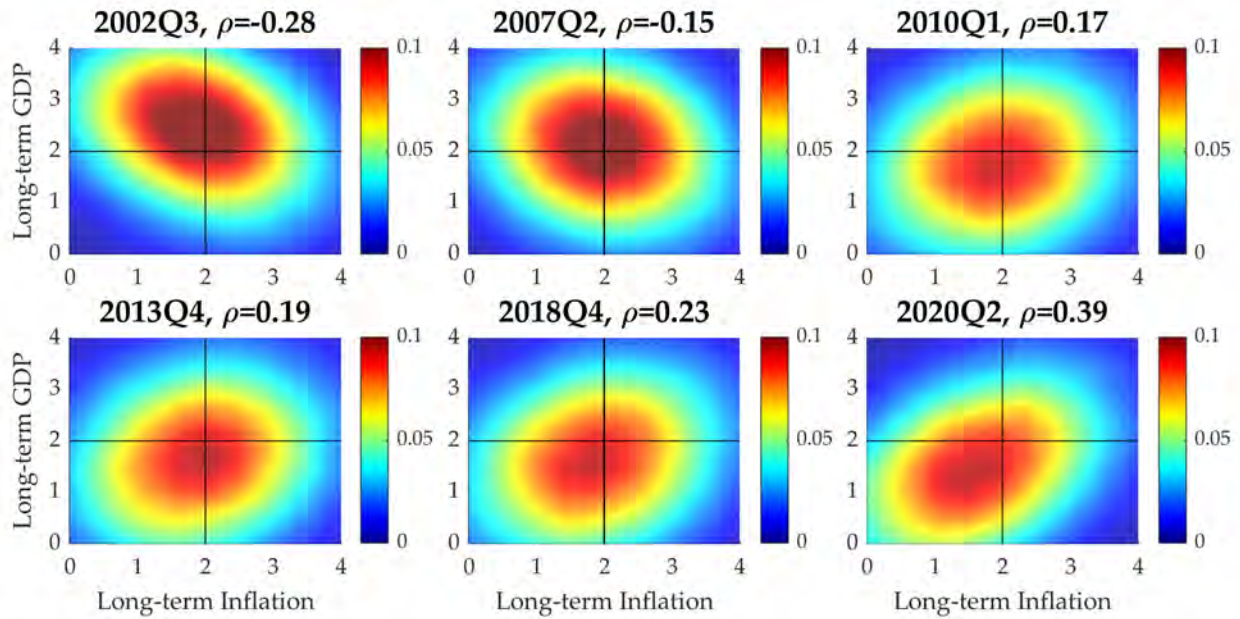
Figure 11. Correlation between long-term expectations of real GDP growth and inflation



Source: calculations based on the ECB's SPF and Refinitiv data (for ILS-RP).

Note: The coloured line represents the 4-quarters moving average of the correlations (in the cross-section) between the 5-year ahead point forecasts of inflation and GDP growth. The black line represents the 4-quarters moving average of the (negative) risk premium of the ILS forward 1 year-4 year ahead based on Camba-Méndez and Werner (2017).

Figure 12. Joint probability distribution of long-term inflation and real GDP growth expectations



Source: ECB's Survey of Professional Forecasters.

Table 1. Sensitivity of long-term inflation expectations to short-term news

		R_{it}^{1y}	S_t
1)	$\beta^{\text{full-sample}}$	0.046** (0.018)	0.05*** (0.015)
2)	β^-	0.048** (0.021)	0.069*** (0.021)
3)	β^+	0.040* (0.024)	0.028 (0.016)
4)	$\beta^{\text{experienced}}$	0.029 (0.025)	0.048** (0.015)
5)	$\beta^{\text{inexperienced}}$	0.057** (0.016)	0.050* (0.021)

Note: heteroskedasticity and autocorrelation robust (Driscoll-Kraay) standard errors in parentheses. Significance levels: *** 1%; ** 5%; * 10%.