Euro area inflation expectations during the COVID-19 pandemic

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October 2021

Abstract
The COVID-19 pandemic was an unprecedented shock whose effects on inflation are uncertain because of both up and downward pressures on consumer prices interacting to different degrees throughout the pandemic crisis period. In addition, the massive economic policy stimulus as a response to the pandemic raises concerns of a possible surge in inflation with a more persistent nature. Against this background, monitoring inflation expectations is of utmost importance. This article seeks to analyse the behaviour of measures of inflation expectations for the euro area since the outbreak of the pandemic crisis by covering both market-based and survey indicators at different horizons. (JEL: E31, E52, G10)

1. Introduction

Measures of inflation expectations are regularly tracked by central banks to gain an insight into the private sector's assessment of the outlook for inflation and to assess the credibility of monetary policy. When shocks hit the economy, it is important to understand if their impact on inflation will be temporary and eventually short-lived or if they will be long-lasting, namely via their impact on the price and wage setting mechanisms, as this may require different monetary policy responses.

As described in ECB (2011) and Böninghausen *et al.* (2018), inflation expectations indicators play an important role in the large information set analysed by the European Central Bank (ECB) when determining the appropriate monetary policy stance.[1] Inflation expectations are important because they influence private agents' economic decisions and consequently inflation. In addition, financial market participants' inflation expectations are relevant in the pricing of financial instruments and can thus affect

Acknowledgements: The authors thank ECB colleagues for providing the breakdown of ILS rates into inflation expectations and risk premium components analysed in Section 3.2. The authors thank Bruno Freitas, António Antunes, João Amador, Pedro Duarte Neves, Benjamin Böninghausen, Andreea Vladu, and Matjaž Maletič for their comments. The analyses, opinions and conclusions expressed herein are the sole responsibility of the authors and do not necessarily reflect the opinions of Banco de Portugal or the Eurosystem.

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1. This is common to several central banks, namely those having an inflation target such as the US (Bernanke 2007), the UK (Tenreyro 2019) or Canada (Côté 2015).

the transmission of monetary policy. The ECB also monitors indicators of inflation expectations as a way to cross-check the ECB/Eurosystem's projections. Finally, the ECB analyses developments in inflation expectation indicators for longer horizons to assess the confidence of the public in its ability to deliver on its price stability mandate.

Monitoring inflation expectations in the pandemic crisis period entails large challenges. The pandemic is an unprecedented global shock with unusual characteristics and heterogeneous effects across sectors. Understanding its impact on inflation developments is challenging given that there are implications that pressure inflation both up and downwards. On the one hand, downward pressures are associated with the fall in consumption opportunities, though with a reallocation of consumer spending across categories. On the other hand, upward pressures have resulted from supply disruptions both at a national level and in global supply chains, from higher energy and other commodity prices but also from some statistical effects. As the recovery firms up, the release of pent-up demand may also pressure inflation upwards. In addition, the massive economic policy stimulus as a response to the pandemic, in particular the fiscal stimulus, has raised concerns that inflation may surge as a result (Goodhart and Pradhan 2020). Even though these concerns have been more pressing in the US than in the euro area, the significant policy stimulus in the euro area, both monetary and fiscal, makes following closely developments in inflation expectations of the essence.

We document the developments in measures of euro area inflation expectations during the pandemic. We proceed in two steps. First, we examine the behaviour of market-based measures of inflation expectations, which are available at high frequency, and therefore provide timely information about how market participants interpret price developments during the pandemic crisis and its implications for future inflation. Then, we consider survey-based measures of inflation expectations from the ECB Survey of Professional Forecasters (SPF). This survey provides information about expected inflation at different horizons as well as about the expected real GDP growth rate and the unemployment rate and therefore provides a more complete picture of the professional forecasters' perceptions about future economic developments in general, and the COVID-19 shock in particular.

The information analysed, which covers the pandemic period up to mid-2021, suggests that initially the disinflationary shock caused by a depressive aggregate demand surpassed supply constraints, thereby leading to a drop in inflation expectations at different horizons. As the recovery took hold, and inflationary pressures associated with supply constraints dominated, the debate about the inflation outlook shifted to the nature of the observed surge in inflation outcomes, against the background of a markedly accommodative policy, both monetary and fiscal.

The rest of the article is organised in three sections. Section 2 provides an overview of available measures of inflation expectations in the euro area. Section 3 describes the evolution of market and survey-based inflation expectations after the pandemic outbreak in the euro area. The last section offers some concluding remarks.

2. Available measures of inflation expectations

Inflation expectations are not directly observed. Therefore, one needs to find measures that approximate their behaviour. There are two main types of indicators: one based on financial markets data, and another based on surveys generally conducted with professional forecasters, firms or consumers. This section characterises both types of measures of inflation expectations.

An approach to derive inflation expectations builds on the price of financial market instruments indexed to future inflation outcomes, including inflation-linked swaps (ILS), inflation-linked bonds (ILB) and inflation-linked options (ILO).[2] These market-based measures of inflation expectations have the advantage of being available for a wide range of maturities and at a high frequency.

The market for inflation-linked products has grown substantially in past years. At present, zero-coupon inflation swap rates (ZCISR) and break-even inflation rates (BEIR) provide an important source of information regarding market participants' inflation perceptions. Under the risk-neutral measure, the ZCISR must correspond to the average expected inflation rate over the term of the contract in order to make a zero-coupon inflation swap fairly priced. Based on spot rates, it is easy to compute forward inflation swap rates, which provide a view about investors' prospects for inflation for a period starting in the future. For example, the 1Yx2Y ILS rate is the annual (1 year) inflation rate expected 2 years ahead and the 5Yx5Y ILS rate is the average inflation rate over a 5-year period starting in 5 years' time. The latter is a widely used measure of long-term market-based inflation expectations as it is less influenced by cyclical factors.

Market-based indicators of inflation expectations include risk premia. To properly interpret the developments in inflation-linked instruments one has to decompose the inflation compensation demanded in the ILS contract into an expectation component and a risk premium component. The last component may comprise, among others, a liquidity premium and an inflation risk premium (demanded by investors as compensation for the risks surrounding inflation developments over the tenor of the security). This risk premium component may vary across time, but also across the maturity structure, which makes its characterisation challenging.

Decomposing the content of inflation-linked securities into a "true" inflation expectation component and a risk premium component has attracted a lot of attention in the literature (García and Werner 2010; Kajuth and Watzka 2011; Andreasen 2012; Haubrich *et al.* 2012; Hördahl and Tristani 2014; Pericoli 2012; Camba-Méndez and Werner 2017). There are different ways to estimate the risk premium component in market-based measures of inflation expectations. One approach is to use survey-based measures as a direct gauge of the expectations component (because they are not affected

2. An ILS is a contract that involves an exchange of a fixed payment for a payment indexed to realised inflation over a predetermined horizon. ILB are bonds where principal and interest payments fluctuate with the rate of inflation. The difference between the yields of nominal and inflation-linked sovereign bonds of the same maturity is called the break-even inflation rate. ILO can be either a cap or a floor. An inflation cap (floor) is a security that offers investors protection against inflation being higher (lower) than a certain threshold level.

by premia) and obtain the premium component as a difference between inflation compensation in market-based instruments and the survey-based measure of inflation expectations. Another procedure is to estimate both the expectations and the premium component by modelling the inflation swap curve with affine term structure models (ATSM). The identification of the expectations term is conditional on the setup and the modelling assumptions taken, so the estimates of risk premia may differ in terms of the sign, magnitude and dynamics.

ILO are a source of market data about inflation expectations that allows for the assessment of the probability of different inflation outcomes. The probability distributions of inflation extracted from options prices are the so-called risk-neutral probability densities for future inflation outcomes obtained through standard no-arbitrage considerations without making assumptions about investors' risk preferences. Option-implied risk-neutral probability densities are not equivalent to the underlying "physical" probabilities of inflation events, that is, actual probabilities of inflation perceived by market players. This happens because when agents buy or sell options, they consider not only the probability that the option will pay out, but also how much they would value the payout in each state of the world. Even though typically investors are not risk-neutral and thus actual probabilities of inflation tend to incorporate a risk premium component, the analysis of developments in ILO implied-probabilities is still informative, as changes in risk-neutral probabilities and the physical probabilities should be related, especially in periods of reduced financial market turmoil.

Surveys generally provide direct measures of inflation expectations as participants respond to specific questions for this purpose. However, they are available at a lower frequency than market data (usually at a monthly or quarterly frequency). There are several survey-based measures of inflation expectations in the euro area at different horizons. Among the widely used surveys are the ECB SPF, specifically for the euro area, the Consensus Economics and the Eurozone Barometer, both covering a broader set of countries. The type of information available in different surveys differs, namely in terms of the horizons available, the characteristics of the point forecasts' distributions (e.g. mean, median, standard deviation) and the individual forecasters' quantitative assessment of uncertainty surrounding the point forecasts. The ECB SPF is a quarterly survey carried out by the ECB since 1999. The survey rounds take place in the first month of each quarter, i.e. January, April, July and October. The SPF has an important role in the ECB's monetary policymaking information set, as described in ECB (2011) and Böninghausen *et al.* (2018). For information about the SPF see García (2003).

The aforementioned surveys are inquiries of professional forecasters and therefore may be an inaccurate representation of the private sector's expectations. Even though there are also questions on the inflation outlook in surveys of firms and households, usually these have only a short-term focus.[3] Some results in the literature show that there is disagreement among surveys of different types of agents (Mankiw *et al.* 2003; Driver

3. For instance, the European Commission's Business and Consumers Surveys collect consumers' expectations of prices developments in the euro area over the next 12 months.

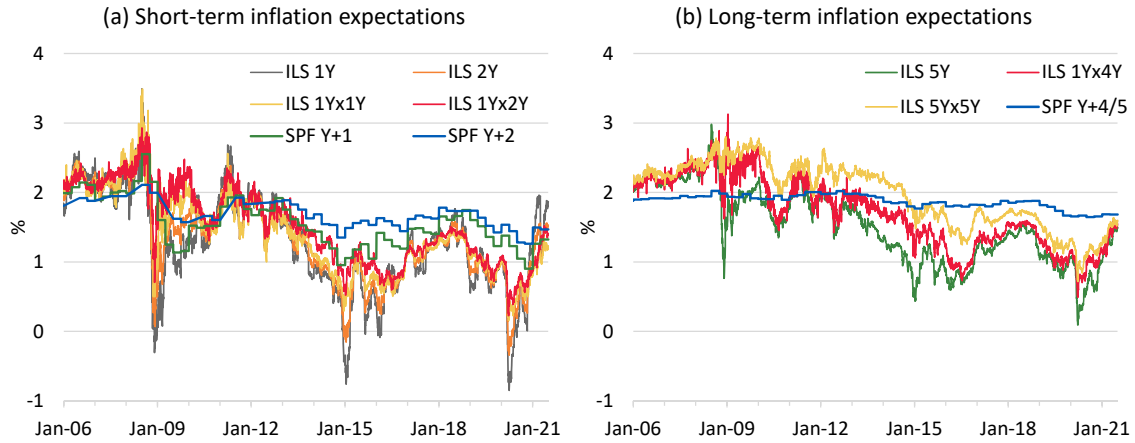

FIGURE 1: Measures of euro area inflation expectations

Sources: Bloomberg, ECB, Refinitiv and authors' calculations. Notes: ILS - inflation linked swaps; SPF Y+4/5 – Survey of Professional Forecasters inflation expectations 4 or 5 calendar years ahead (fixed forecast target), depending on the survey; Last observation: 30 June 2021 for the ILS and July 2021 for the ECB SPF.

et al. 2013; Mokinski *et al.* 2015). Finally, the results of the surveys may be imprecise due to insufficient information among respondents and low sample size. The conclusions may also depend on the wording of the questions, as pointed out by Bruine de Bruin *et al.* (2008).

Given that all existing measures have shortcomings and are imperfect gauges of the (unobserved) "true" inflation expectations, it seems useful to look at several measures of inflation expectations. In the remainder of this article, we concentrate the analysis on ILS and ILO as well as on the ECB SFP. We focus on the ILS as in the euro area the market for ILS is more developed than that for ILB.[4] Among the surveys, we explore the SPF as it provides a wider range of information than other surveys for the euro area.

Figure 1 depicts the evolution of measures of euro area inflation expectations at different horizons based on ILS rates and on the ECB SPF. In the period prior to the pandemic crisis, actual inflation and inflation expectations in the euro area were persistently below 2%. Among the factors potentially explaining this low inflation environment are structural forces such as globalisation, digitalisation and population ageing. Long-run forces may also play a relevant role given that the permanence of interest rates at low levels over a prolonged period and of the expectations that they will persistently remain at low levels may also lead to low inflation outcomes.

4. Currently, various euro area countries, such as Germany, France, Italy and Spain, have sovereign ILB indexed to the euro area HICP (excluding tobacco) that allow for the computation of BEIR. However, in contrast with ILS rates, BEIR can be influenced by non-negligible time-varying liquidity effects and country specific risk premia.

3. The behaviour of euro area inflation expectations during the COVID-19 pandemic crisis

3.1. Inflation-linked financial instruments

When the pandemic shock hit the euro area economy in early-2020, the ILS inflation compensation for several horizons exhibited a marked decrease in the euro area, hitting all-time lows towards the end of March. For various horizons, the magnitude of the monthly drop is only comparable with the falls observed during the global financial crisis. The decline in inflation compensation measures was more marked for shorter horizons, in particular in the case of the 1-year ILS rate, illustrating that, at the onset of the crisis the impact on inflation was mostly seen as concentrated in the shorter term. This steep decline of inflation compensation measures coincided both with the period when severe containment measures were introduced and uncertainty increased considerably, but also with a period when oil prices dropped significantly. It has been argued that movements in the oil price have party driven the co-movement between short- and long-term inflation compensation measures. The strength of this relationship, which has been statistically significant since 2015 in the euro area, recorded an increase after the outbreak of the pandemic crisis, particularly noticeable at shorter horizons.[5] For an analysis of the drivers of inflation expectations, including the role of oil prices see Baumann *et al.* (2021).

After the sharp drop in March 2020, inflation compensation measures have broadly shown an upward trajectory. This is likely partly linked to the recovery in oil prices (though to a lesser extent than the drop in March 2020). In addition, at the end of March 2020, there was the announcement of significant policy measures to respond to the pandemic. In particular, the ECB deployed several measures, including the PEPP (Pandemic Emergency Purchase Programme), that likely contributed to stopping the steep decline in inflation compensation measures. Also, a number discretionary measures with a significant fiscal impact were introduced over time to lend support to the economy, both with a short-term focus to preserve installed productive capacity (e.g. measures aimed at supporting firms' liquidity and the financial situation of households) and with a medium to long-run focus, such as the Next Generation EU recovery package. This increasing trajectory was interrupted after the summer of 2020, especially for expectations regarding inflation over the next year, which likely reflects the worse developments of the pandemic over that period.

Throughout 2021, despite their usual volatility, measures of inflation compensation at different horizons have shown a broadly increasing trajectory along with positive surprises in the releases of euro area economic indicators and rises in the prices of

5. Analysis performed by means of the statistical significance of the rank correlation coefficient between the daily changes of long-term inflation swap rates (5Yx5Y) and changes of short-term rates (1Yx1Y) through a rolling window with 90 days. To analyse the relationship with oil prices, weekly changes of long-term inflation swap rates were regressed on changes of oil prices and the empirical results show that coefficient picked up temporarily in March 2020, amid an already stronger positive relationship registered since mid-2019. These results are available from the authors upon request.

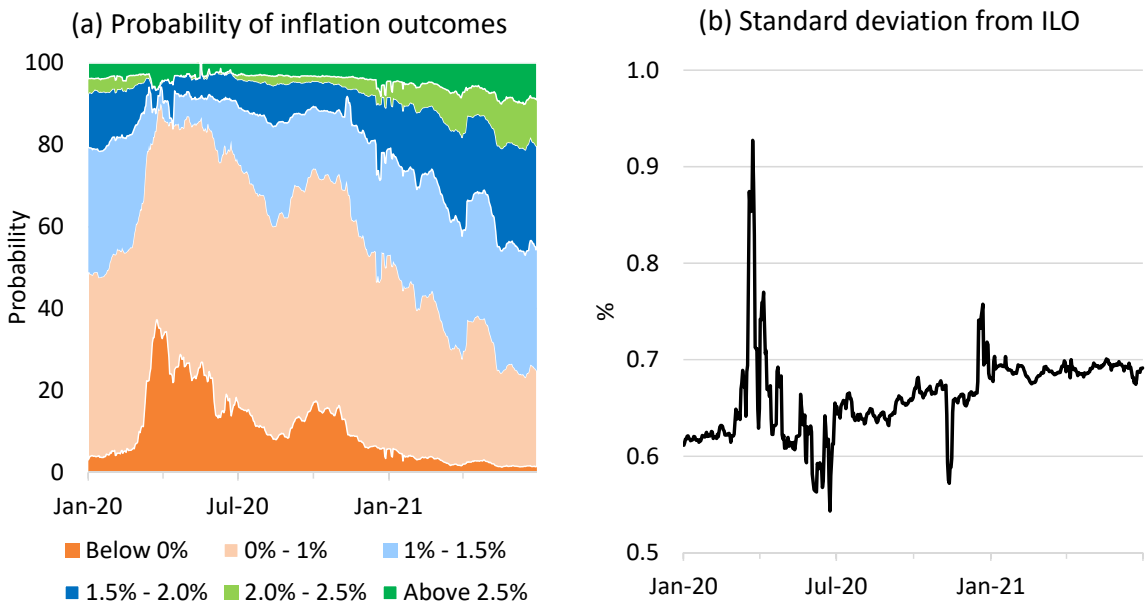

FIGURE 2: Option-implied risk-neutral distribution of average inflation over the next 5 years

Sources: Bloomberg and authors' calculations. Notes: Probabilities implied by 5-year zero-coupon inflation-linked options, smoothed over 5 business days. Latest observation: 30 June 2021.

commodities, including oil. Expectations for inflation over the next year stood for much of the first half of 2021 above expectations for annual inflation 1 and 2-years ahead, as agents saw this increase as mostly temporary. Still, there has been an upward movement of inflation expectations at several horizons, including longer-term expectations (ILS 5Yx5Y). By the end of June 2021, 1 and 2 years ahead annual inflation compensation were hovering around 1.2% and 1.3% respectively, while longer-term inflation compensation measures (5Yx5Y) were at around 1.6%, a level not seen since end-2018/early-2019.

A salient feature of the pandemic period has been an upsurge in uncertainty. This can also be illustrated by exploring ILO that allow us to obtain information about the distribution of expected inflation outcomes. The probability distributions, extracted from ILO under the assumption of risk-neutrality (see Section 2), convey relevant information on changes in investors' evaluation regarding inflation prospects. Figure 2 displays the implied risk-neutral probabilities of expected inflation over the next 5 years for different buckets since 2020 in chart (a), while chart (b) presents the standard deviation of the respective implied distribution.

The standard deviation of ILO-implied distribution of inflation expectations over the next 5 years showed a pronounced increase at the onset of the pandemic crisis, denoting a heightened incertitude surrounding the inflation outlook. Next, from the end of March 2020 to the end of June 2020, the standard deviation registered a significant fall, possibly benefiting from the launch of important policy measures to tackle the crisis. Since then, it has increased somewhat and by mid-2021 it stood at levels somewhat above those seen before the outbreak of the pandemic.

During the pandemic period, there were significant changes in the risk-neutral distribution of inflation expectations over the next 5 years. At the beginning of the pandemic period in the euro area, there was a large increase in the risk-neutral probability that agents attached to low inflation outcomes, in particular below 1%. The probability of deflation (inflation outcomes below 0%) peaked considerably in March/April 2020, reaching levels above those recorded in 2015. The probability of low inflation outcomes gradually fell over the summer of 2020, but increased again in the last quarter of that year, given worse pandemic developments with an intensification of containment measures in response to a strong resurgence in infections. Since the start of 2021, the probability attached to low inflation outcomes over the next 5 years has decreased markedly. In mid-2021, the probability of below zero inflation was negligible, while the probability of having inflation between 1.5 and 2.0% increased noticeably.[6]

3.2. "True" expectations and risk premium

As explained in Section 2, inflation compensation measures are widely viewed by central banks and analists as shedding light on inflation expectations, but they may include non-negligible time-varying risk premia. The "true" inflation expectation and the risk premium components are not directly observable and need to be estimated. This breakdown of the ILS inflation compensation conveys interesting information, not only for the analysis of the estimated ("true") expectation component, but also for the analysis of the risk premium. This component reflects to a large extent a premium requested by investors as compensation for the uncertainty surrounding inflation developments over the horizon of the contract. Given that, in general, agents are not risk-neutral, they require a compensation for the uncertainty regarding the pay-off of any security, in particular developments in inflation.[7]

In this section, we explore this decomposition based on a methodology that follows Joslin *et al.* (2011) applied to ILS rates adjusted for the indexation lag as in Camba-Méndez and Werner (2017) and that is used in Böninghausen *et al.* (2018). This type of methodology is widely used in the literature (Haubrich *et al.* 2012; Vicente and Kubudi 2018) and consists of applying an ATSM to the term structure of ILS rates in order

6. The mass of risk-neutral probability associated with tail events may show considerable differences compared to survey-based distributions, such as SPF probabilities. This can in part reflect the fact that risk-neutral probabilities tend to overstate physical probabilities for adverse outcomes and vice versa for non-tail events. Investors tend to be risk-averse so risk-neutral probabilities reflect both preferences towards risk and the physical probability of different inflation outcomes. Risk-averse investors are willing to pay a premium to protect themselves against the disutility associated with particularly adverse outcomes. Note also that the ILO-based distribution refers to inflation over the next 5 years whereas the SPF refers to inflation expectations 4/5 years ahead and that the agents responding to the SPF and those that participate in the ILO market are not necessarily the same.

7. The risk premium component implicit in ILS to a great extent should correspond to an inflation risk premium, as other types of premia (e.g. a liquidity premium) are likely to be of little importance, in particular in periods without significant stress in financial markets.

to disentangle the inflation compensation into the expectation and the inflation risk premium components.[8]

Figure 3 reports the breakdown of inflation compensation extracted from ILS into expectations and inflation risk premium components for short-term (1Yx1Y) and long-term (5Yx5Y) contracts.

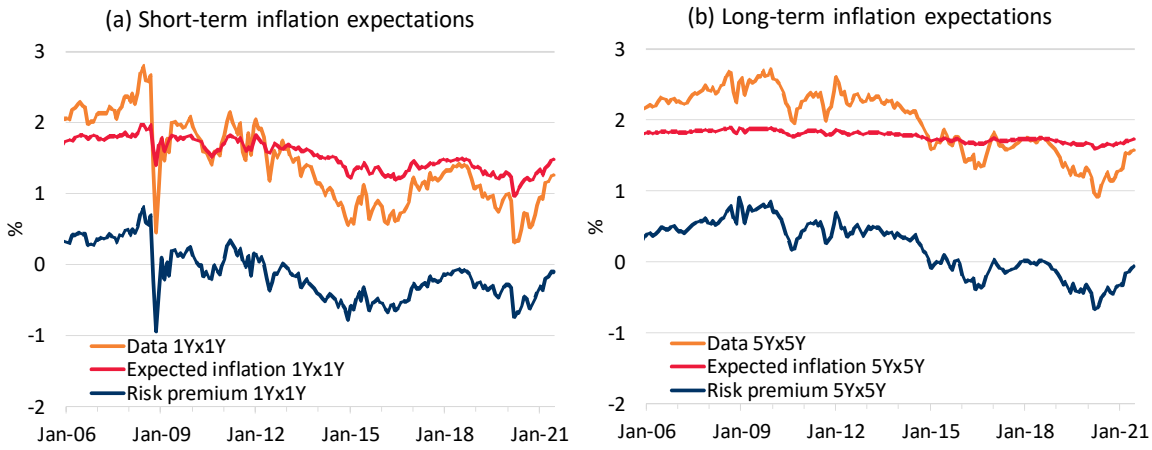

FIGURE 3: Estimates of the expectations and inflation risk premium components of ILS rates

Source: ECB staff calculations. Notes: Estimates based on two affine term structure models following Joslin *et al.* (2011) applied to ILS rates adjusted for the indexation lag as in Camba-Méndez and Werner (2017). Last observation: June 2021.

At shorter maturities, the dynamics in inflation compensation throughout the pandemic period has reflected developments in both the inflation compensation and the premium components, though the changes in the premium are larger. After the drop of both inflation expectations and inflation risk premium in March 2020, one can observe a broadly upward trajectory in both components, to levels above the pre-pandemic ones. At longer horizons, developments in inflation compensation measures were mostly due to changes in the premium component. Even though the long-term inflation expectation component has shown limited variation over the whole sample, it is noteworthy that after a very gradual downward trajectory over the last decade, since April 2020 it has shown a consistent increase, reaching levels above pre-pandemic ones.[9]

8. Despite being widely used, one should bear in mind the caveats of this approach when interpreting results. In particular, the model used — based on principal components of ILS rates and estimated following the method of Joslin *et al.* (2011) — assumes that the unconditional level of inflation expectations is aligned with the average across all long-run inflation survey forecasts collected since the onset of the euro area, i.e. 1.9%. In addition, forward rates, such as the 5Yx5Y expected inflation, also depend on the speed of convergence to the long-run mean, which is determined by the estimated degree of persistence. Given that unit root tests soundly reject the stationarity of the ILS data over the sample period, the degree of persistence is likely to be underestimated, and therefore the estimated ATSM-based expectations converge to the long-run mean too quickly.

9. The limited variation of the expectation component is in line with the survey based long-run inflation expectations, even though this survey data is not used in the estimation.

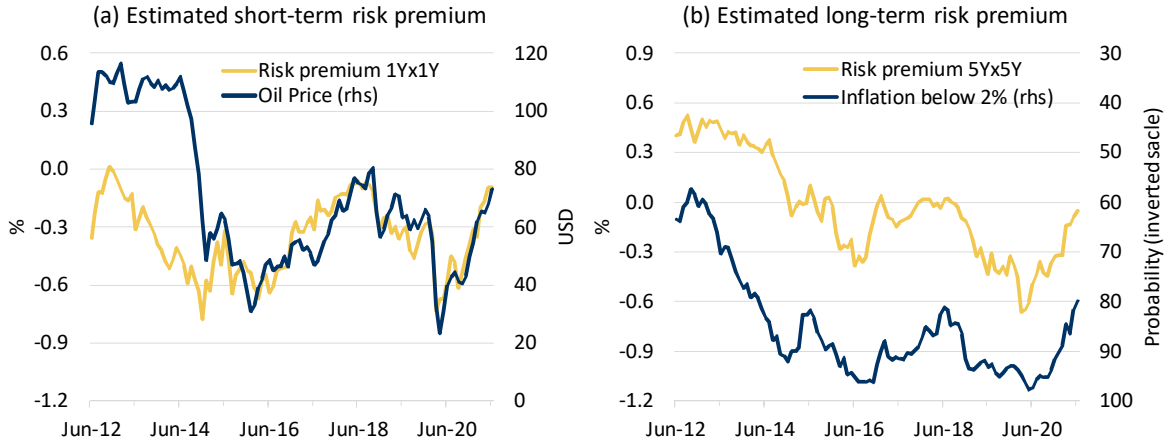

FIGURE 4: recent developments in the inflation risk premium

Sources: Bloomberg, ECB staff calculations and authors' calculations. Notes: Estimates of risk premia based on two ATSM following Joslin *et al.* (2011) applied to ILS rates adjusted for indexation lag as in Camba-Méndez and Werner (2017). Oil price and probability of inflation below 2% shown as monthly averages. Probability of inflation outcomes over 5 years extracted from ILO. Last observation: June 2021.

The fact that the estimated inflation risk premia (at both short and long maturities) are negative suggests that agents are more worried about low inflation outcomes than high outcomes. This has been seen in the euro area for several years. After an initial drop with the outbreak of the pandemic, the premia have become less negative, which suggests that investors have become less worried with low/negative inflation. This is in line with the presumable temporary nature of the COVID-19 shock. But, if the inflation risk premium is mainly driven by the perceived uncertainty surrounding the behaviour of inflation over the life of the contract, the impact of the pandemic crisis seems to be more reasonably reflected in shorter-term contracts. The estimated risk premium in inflation compensation embedded in ILS 1Yx1Y also seems to evolve in tandem with oil prices (chart (a) of Figure 4). Regarding longer-term horizons, in the years prior to the pandemic crisis, there was a decline in the 5Yx5Y inflation premium because agents were worried about a scenario of persistently low inflation (signalling risks in terms of the ability of the central bank to fulfil its price stability mandate), as suggested by the fact that the drop in the inflation risk premium occurred in parallel to an increase in the probability that (risk-neutral) agents attach to low inflation rates over the next 5 years (chart (b) of Figure 4). Since March 2020, this probability has also decreased concurrently with the premium becoming less negative. The consistent increase in the premium for longer-term horizons is more challenging to relate to the pandemic developments *per se*, as the effects of the pandemic crisis should be mostly transitory even if persistent (and long-run effects may exist but are harder to anticipate), but should be seen in light of the policy response to the pandemic crisis.

3.3. Survey based expectations

In this section, we evaluate the impact of the COVID-19 crisis on inflation expectations of professional forecasters. The data come from the ECB SPF. The survey data from the 2020 rounds of the SPF are particularly useful to study how the pandemic affected expectations of professional forecasters at the early stages of the pandemic crisis period since it provides multiple forecasts for the same set of forecast targets, made before and after the beginning of the pandemic. Specifically, the COVID-19 pandemic outbreak in the euro area occurred between the first (January) and second (April) rounds of the survey. One of the features of SPF is that, during a given year, survey participants are asked for forecasts of the same set of fixed targets, for example, average inflation in the current calendar year or the next one. Hence, using SPF results from 2020, we can see how professional forecasters' beliefs responded to the pandemic outbreak and then evolved over the course of 2020. In addition, we present results from the available 2021 editions of the survey in order to illustrate some notable changes in the evolution of inflation expectations that have occurred recently, following the upward surprises in observed inflation in the first half of 2021.

3.3.1. Aggregate forecasts

We plot in chart (a) of Panel (I) of Figure 5 the average point forecasts for inflation in 2020, 2021, 2022, and in the longer term (2024 or 2025, depending on the survey) for the surveys published in 2020.[10] Overall, the COVID-19 pandemic outbreak had a significant impact on the slope of the profile of inflation expectations published throughout 2020, with shorter-term expectations being revised downwards significantly more than the longer-term ones. Expected inflation for 2020 was revised down by 0.8 percentage points between the first and second 2020 rounds, and by almost an additional 0.15 percentage points in the next two survey rounds (July and October). Forecasts for 2021 and 2022 were also revised down in the 2020 survey rounds after the outbreak of the pandemic, by about 0.5 and 0.25 percentage points over the same period, cumulatively, but these revisions were more evenly spread out over the course of the year. The average longer-term expectations for inflation in 2024/25 remained essentially unchanged throughout 2020, signalling the expected temporary nature of the impact of the pandemic shock on inflation developments.[11]

Chart (b) of the same figure shows aggregate point forecasts for core inflation (i.e. inflation excluding energy, food, alcohol and tobacco) in the surveys released in 2020, which displayed similar dynamics to that of headline inflation, except for the significantly smaller revisions in the forecasts for 2020. The comparison of charts (a) and (b) suggests that a significant part of the revision in the inflation outlook for 2020 had to

10. SPF participants are asked to provide forecasts for a longer-term horizon which is set as 4 calendar years ahead in the first and second survey rounds, and 5 calendar years ahead in the third and fourth rounds.

11. In the January and April surveys, the average expected inflation for 2024 was 1.657% and 1.669%, respectively, and the figures for 2025 in July and October 2020 surveys were 1.648% and 1.656%.

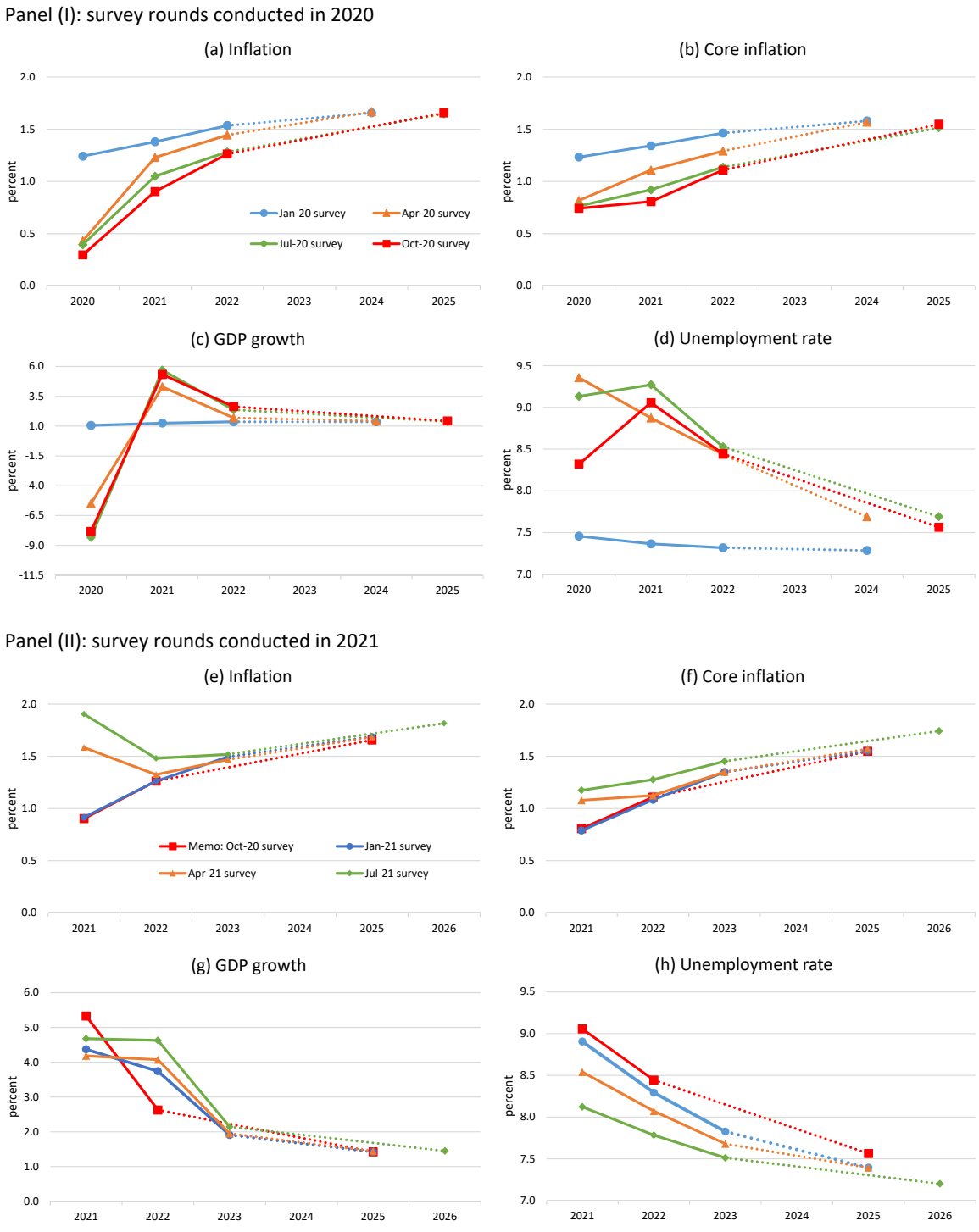

FIGURE 5: Average point forecasts
Sources: ECB and authors' calculations.

do with the expected effect of the pandemic on the prices of energy, food, alcohol and tobacco. The revisions in core inflation expectations can be related to survey participants' expectations about the effect of the pandemic on the real economy. This is confirmed by

charts (c) and (d), which show aggregate forecasts for real GDP growth and the rate of unemployment for the 2020 survey rounds. Expectations for both variables were revised in a direction consistent with a perceived large negative economic shock, with the real GDP growth rate for 2020 being revised between the January and the April of 2020 surveys by more than 6 percentage points, and the rate of unemployment being revised upwards by close to 2 percentage points. The profile of forecasts for both variables indicated expectations for an economic rebound to take place, with growth expectations for 2021/22 being revised upward relative to those in the January 2020 round, while longer-term expectations remained virtually unchanged. For the unemployment rate, a decrease was expected to take place after the significant increase following the outbreak of the pandemic, although to an average longer-term level somewhat above the one expected in the January 2020 survey. In the July and October 2020 surveys, expectations for real GDP growth in 2020 were revised down further, while the expected rebound in 2021/22 was raised. In the case of the unemployment rate, the expected increase in 2020 was revised downwards significantly.

As of the time of writing, three surveys rounds of the SPF have been published in 2021. The additional information they provide allows us to examine the more recent developments in expectations, and to compare them to the forecasts made in the initial wake of the pandemic. Panel (II) of Figure 5 shows the average point forecasts for 2021, 2022, 2023, and in the longer term (2025 or 2026, depending on the survey) for the three survey rounds published in 2021 (for comparison the last survey round of 2020 is also included). As seen in chart (e), significant upward revisions of the expected inflation rate in 2021 occurred in the April and July rounds of the survey, initially by almost 0.7 percentage points, and then by an additional 0.3 percentage points. As a result, the expected 2021 inflation rate stands above the forecast for this year made before the outbreak. The forecasts of core inflation were also revised upward, but to a lesser extent, and remain below the rate expected before the outbreak. Headline and core inflation expectations for 2022 were also revised in the July survey round but remain close to and below the rates expected before the outbreak. Among the main factors behind the expected increase in inflation, the survey participants pointed at the higher than expected realized inflation in the first months of 2021, related to supply chain bottlenecks and shortages, as well as the stronger than anticipated rebound in oil prices and improved economic outlook.[12] The expected improvement in the real GDP growth rate in 2022 can be seen in chart (g). Also notable is the increase in longer-term expectations for both headline and core inflation at the July survey in 2021. In particular,

12. This information is from a part of the survey results which is not publicly available and is summarized in the ECB's report about the survey results, available in the ECB's website.

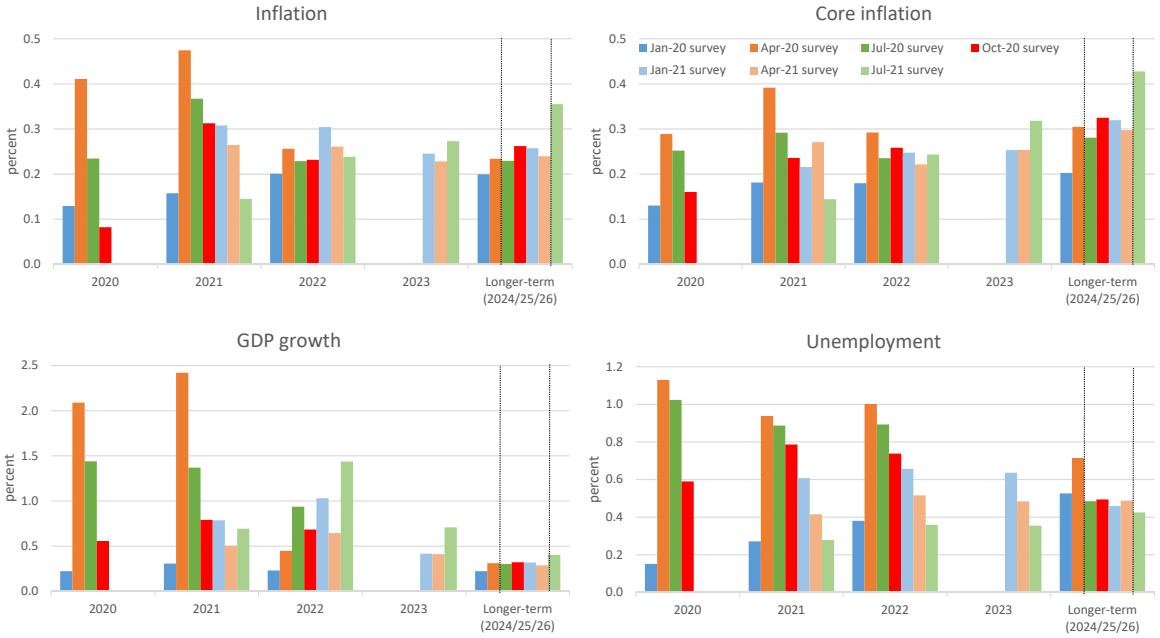

FIGURE 6: SPF forecast disagreement

Sources: ECB and authors' calculations. Note: Standard deviation of individual point forecats across SPF participants for each variable in each year.

the value above 1.8% for headline inflation is the highest level for that horizon since the beginning of 2019.[13,14]

The pandemic has been associated with a significant increase in economic uncertainty. There are two common ways to measure the uncertainty in survey forecasts – using the disagreement across survey participants and using the aggregate forecast probability distributions. Figure 6 shows measures of forecast disagreement given by the standard deviation of individual point forecasts. Disagreement for all forecasted variables increased significantly after the outbreak of the pandemic, especially for the 2020 and 2021 forecast horizons. Over time, disagreement about shorter-term forecasts decreased, as more data became available. In the 2020 survey rounds, the level of disagreement remained above the one observed in the pre-pandemic forecasts for most variables and horizons. In the 2021 rounds included in the analysis (up to July), disagreement continued to edge down. For medium to longer-term horizons, disagreement recorded smaller variations, except for expected headline and core inflation in the July round, reflecting the existence of two outliers.

Figure 7 reports measures of aggregate uncertainty, given by the standard deviation of the aggregated probability distribution of expectations. The aggregated probability

13. The reported figures are for average point forecasts which are sensitive to outliers, and in the July survey there were two point forecasts that deviated significantly from the rest of the participants. Using the median instead, which is more robust to outliers, results in a value of 1.8%

14. The July survey was conducted before the announcement of the press conference reporting the outcome of the ECB's strategy review.

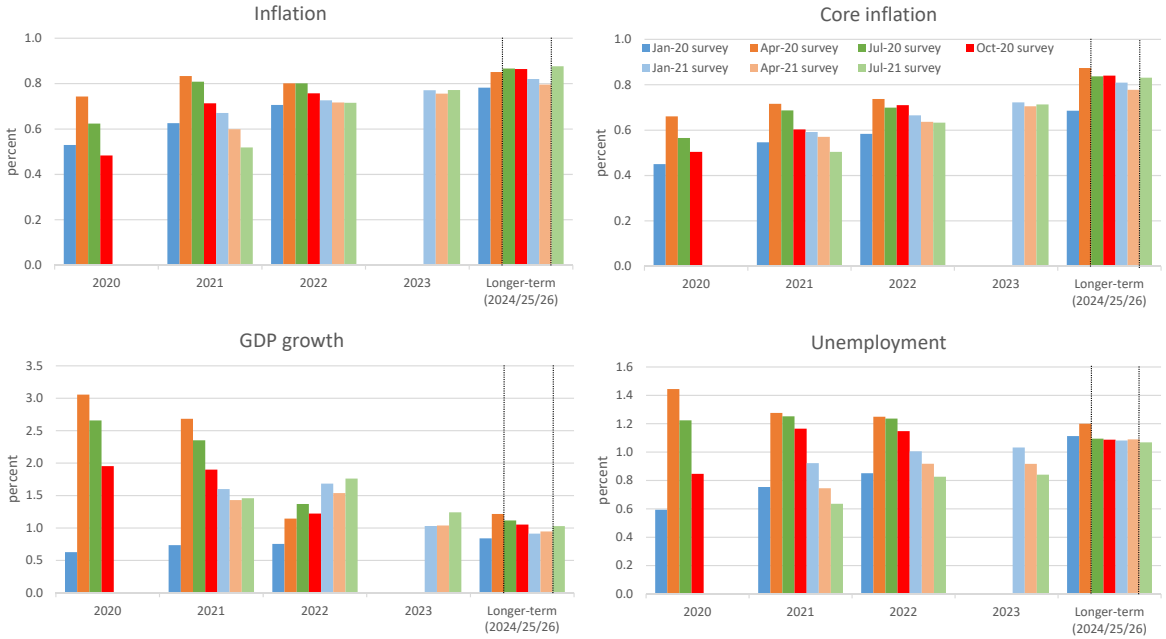

FIGURE 7: SPF aggregate forecast uncertainty

Sources: ECB and authors' calculations. Notes: Standard deviation of the aggregated probability distribution for each variable in each year. Each aggregated probability distribution is obtained by averaging the individual distributions of the survey participants.

distribution is obtained by averaging the individual distributions of the survey participants. These distributions are expressed in terms of the probabilities assigned to the future values of the forecasted variables being within specific intervals. Therefore, the probability distributions provide information about the uncertainty surrounding the point forecasts (as opposed to the disagreement across point forecasts). The standard deviation of the aggregated probability distribution (aggregate uncertainty) depends on the standard deviations of the individual probability distributions (individual uncertainty) and also on the standard deviation of the individual point forecasts (disagreement). So, it conveys additional information compared to the disagreement measure described in the previous paragraph. Still, it shows qualitatively the same patterns as the disagreement measures in Figure 6. Aggregate uncertainty increased with the outbreak of the pandemic, but then recorded a decrease throughout the survey rounds for shorter-term horizons for most variables, a notable exception being expectations for the real GDP growth rate in 2022. Uncertainty regarding longer-term horizons showed much smaller variations.

The pandemic outbreak triggered historically high levels of both forecast disagreement and uncertainty for headline and core inflation, GDP growth and unemployment. The increase was especially marked for real GDP growth and for the unemployment rate expectations. For instance, both uncertainty and disagreement about GDP growth expectations in the April 2020 round were more than 3 times larger than the previous record that occurred in the April 2009 survey round. Compared to the 2019 levels, the rise in disagreement in 2020 was more than 13-fold, while uncertainty

rose more than 5-fold. In contrast, disagreement and uncertainty surrounding headline inflation in April 2020 were between 30% and 50% larger than the previous record from 2012. The observation that the rise in uncertainty and disagreement about inflation expectations was relatively small, compared to GDP growth and unemployment expectations, does not change when we consider other forecast horizons.

3.3.2. *Individual forecasts*

As seen earlier, the COVID-19 pandemic outbreak caused a significant increase in disagreement among SPF respondents. Focusing on aggregate measures, such as the average point forecasts, may obscure existing heterogeneity in the way professional forecasters interpreted the nature and consequences of the COVID-19 shock. Therefore, in this section we consider the inflation expectations of individual forecasters.

FIGURE 8: SPF individual inflation forecasts

Sources: ECB and authors' calculations. Note: Each dot represents a forecast for a specific year by a survey participant.

Figure 8 shows the individual SPF point forecasts for inflation reported in the 2020 and 2021 (up to July) survey rounds. Focusing on the results of the rounds published in 2020, there is a clear downward shift of the distributions of the shorter-term forecasts following the COVID-19 pandemic outbreak, consistent with the patterns seen in Figures 5 and 6. The downward shift is most obvious in the case of the 2020 inflation forecasts, where 86% of the April 2020 forecasts and 100% of the July and October forecasts are strictly below the minimum of the January point forecasts. At the same time, while the aggregate forecasts for inflation in 2021 and 2022 decreased post-COVID-19, there appears to be some disagreement among forecasters, especially in the April

and July surveys, on whether the effect will be positive or negative. Note that there are forecasts in those surveys that are above the respective maximum point forecast from the pre-pandemic survey. The same observation applies to the forecasts for longer-term inflation reported throughout the 2020 rounds - there are point forecasts in the April and later 2020 surveys, which are above the pre-pandemic values. This suggests that some forecasters may have revised upward their forecasts for inflation in 2021 and the following years. However, this is not necessarily true because the panel of survey participants often changes between surveys. For instance, it is possible that the highest 2021 inflation forecasts in the April survey were provided by participants who did not participate in the January round. Therefore, next we examine the forecasts only of those forecasters who participate in both survey rounds.

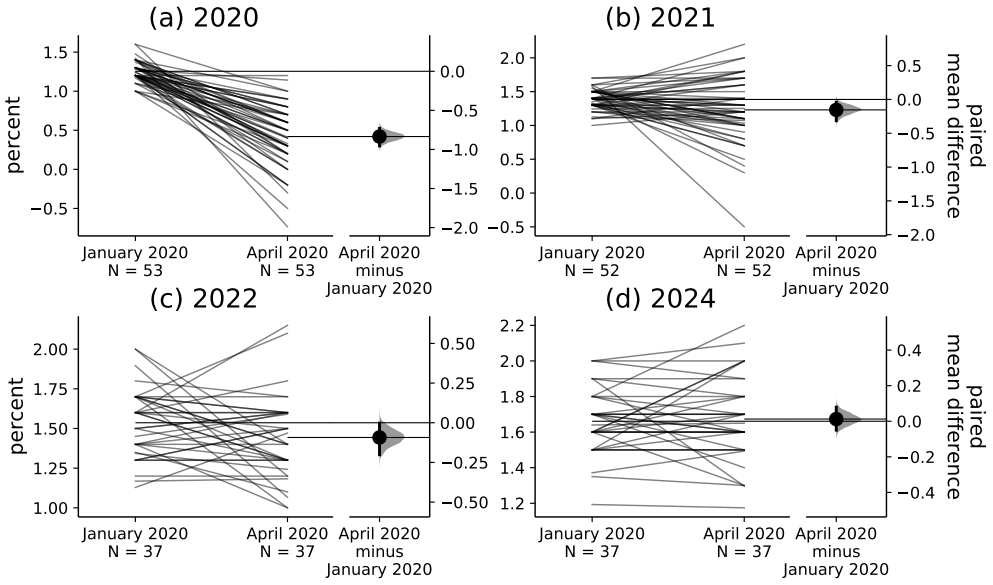

FIGURE 9: Revisions of individual inflation forecasts between the January and April 2020 SPF rounds

Sources: ECB and authors' calculations. Notes: The distributions of the paired mean revisions are obtained by bootstrap. The left-hand side of each chart presents the forecast revisions and the right-hand side displays the distribution of the estimated mean revision with a 95% confidence interval.

Figure 9 shows how individual inflation forecasts changed between the January and April 2020 surveys. The left-hand side of each chart presents the forecast revisions and the right-hand side displays the distribution of the estimated mean revision with a 95% confidence interval.[15] It should be noted that not every survey participant provides forecasts for all horizons in a given survey, which explains why the number of paired forecasts is different for different forecast horizons. The results show that only for inflation in 2020 there was a complete agreement among professional forecasters that

15. The mean revision is estimated with the sample average of the individual revisions. It is an estimate of the "true" unobserved mean revision, and is therefore a subject of estimation uncertainty. We use the bootstrap technique to estimate the sampling distribution of the estimated mean and its 95% confidence interval.

the pandemic outbreak would cause a lower inflation rate than the one anticipated previously. About a third of the participants increased their expectations for inflation in 2021, 2022, and 2024, and between 10% and a third of them kept their forecasts unchanged. Nevertheless, as the majority of forecasters lowered their inflation forecasts for 2021 and 2022, it can be said that most forecasters expected the COVID-19 shock to have a negative impact on inflation over that time span, consistent with the aggregate results displayed in panel (I) of Figure 5. For longer-term inflation expectations, however, there is no such consensus view – the average expectation did not change because a third of the forecasters revised their expectations upwards, and another third revised them downwards. The average revision in either direction was about 0.2 percentage points, and as a result, the overall average change in forecasts was close to zero, as seen above in chart (a) of Panel (I) of Figure 5.

As may be expected, there is a significant, although not complete, overlap between the forecasters who raised their inflation expectations for 2021 and 2022 in the April 2020 round on the one hand, and for 2024, on the other hand. In particular, half of the forecasters who increased their 2021 forecasts, and more than 60% of the forecasters who increased their 2022 forecasts also raised their 2024 forecasts. Most of the remaining forecasters kept their longer-term inflation forecasts unchanged, and only a few lowered them. Therefore, a common characteristic of this group of forecasters is their belief in the persistent positive effect of the COVID-19 shock on inflation, after the initial negative impact. Another common belief is that similarly to the inflation forecasts, there is also disagreement among forecasters about the sign of the impact of the COVID-19 crisis on expected real GDP growth. In particular, 38% of the forecasters increased their 2024 growth forecast in April relative to January, and 22% lowered their forecasts. As with long-term inflation expectations, the forecast changes cancel each other, leading to the nil impact on the aggregate forecast, seen in Figure 5. Again, there is a significant overlap between forecasters who raised both their long-term expectations of inflation and GDP growth – around 60% of the forecasters who increased one of these forecasts from January to April also increased the other with most of the remaining keeping it constant and very few changing inflation and GDP growth 2024 forecasts in opposite directions.

It is important to point out that raising expectations about future real GDP growth rates after the pandemic outbreak does not mean that forecasters interpreted the shock as having a positive impact on economic activity. All forecasters predicted a strong negative effect of the crisis on real GDP in 2020. Similarly, there was a consensus that the economy will rebound in the following years. There was disagreement regarding the speed and extent of the recovery, with some forecasters expecting a more rapid and short-lived recovery, while others predicted a slower and more prolonged one. Forecasters who revised up their longer-term growth forecasts are mostly from the latter group. However, for the vast majority of forecasters, the expected level of future real GDP remains significantly below the one anticipated before the COVID-19 crisis.

Similarly to the aggregate results in Figure 5, there are some notable differences between the individual inflation point forecasts from the 2020 and 2021 editions of the survey, displayed in Figure 8. In particular, the expectations for inflation in 2021 show

a clear upward shift in the three 2021 rounds. The same pattern is also visible, although less pronounced, in the case of the forecasts for 2022, particularly in the April and July rounds. In fact, there is a reduction in the number of forecasters with expectations below 1% (from 8.5% in January to 5% in April and 0% in July). In addition, in the July survey, there is an increase in the fraction of forecasters whose expectations are above 1.5% (34.5% compared to 8% in April and 15% in January). While longer-term expectations have remained relatively stable throughout the pandemic period, there was some upward movement in the distribution of individual point forecasts in the 2021 July round. This observation remains even when we discard the two outliers, or restrict the sample of forecasters to only those who participated in all 2021 surveys.[16]

4. Final remarks

The outbreak of the COVID-19 pandemic has had a major impact on the euro area as well as the global economy. In this article we document the effect of the pandemic crisis on inflation expectations in the euro area, using data from financial markets and surveys of professional forecasters. Following developments in inflation expectations is of paramount importance for monetary policy, whose aim in the euro area is to maintain price stability.

The analysis of financial market data shows that at the onset of the pandemic crisis in March 2020 there was a significant decrease in the inflation compensation extracted from ILS rates, especially at shorter horizons. While the striking decline in these tenors resulted from both the expectation and risk premium components, in the case of longer-term inflation compensation the risk premium component played a dominant role. There was also an increase in the uncertainty surrounding future inflation outcomes, as illustrated by a rise in the standard deviation of the risk-neutral distribution of inflation over the next 5 years. After the initial drop, forward inflation compensation indicators have followed an upward trajectory. For short-term contracts, the behaviour of the inflation compensation and the risk premium seems to be partially related to the evolution of oil prices. For longer maturities, the surge in the risk premium has happened in tandem with a decrease of the risk-neutral probability attached to inflation outcomes below the ECB's inflation objective.

The information from financial market instruments linked to inflation is complemented by survey-based inflation expectations. Even though the ECB SPF is only available at a quarterly frequency, the larger array of information available from this survey presents a useful complement to the market-based measures of inflation expectations. Three main messages emerge from our analysis of the SPF data. First, professional forecasters initially viewed the COVID-19 crisis mainly as a demand rather than a supply shock. While both demand and supply-side factors were at play, on net, the expected impact of the crisis on real GDP growth and inflation was strongly negative,

16. In fact, the two outliers seen in the July 2021 distribution of longer-term inflation in Figure 8 did not participate in the previous survey round.

consistent with a perceived dominant demand shock. As the pandemic unfolded, the supply side effects started to dominate. Second, there was a significant uncertainty increase in response to the pandemic. Indeed, all measures of forecast uncertainty and disagreement among survey participants reached their highest values in the history of the survey. Third, we find that using aggregate forecast measures can be misleading. In particular, the average point forecast of long-term inflation did not change after the pandemic outbreak, suggesting that professional forecasters did not anticipate the crisis to have a persistent effect on inflation. However, examining individual-level forecasts reveals that two-thirds of survey participants revised their long-term inflation forecasts, but disagreed on the sign of the revisions. This result highlights the fact that agents' inflation expectations can be very diverse and, thus, aggregate measures typically used in monetary policy analysis need to be interpreted with caution.

Professional forecasters and financial market participants are not the only economic agents whose inflation expectations matter for the conduct of monetary policy. Expectations of households and firms are equally, if not more, important as these agents are the ones who make spending, saving and investment choices. They also set prices and wages. Thus, monetary policy transmission is strongly affected by the decisions of households and firms, which in turn are influenced by their expectations of future inflation. Data on those expectations for the euro area as a whole is not available.[17] Nevertheless, it seems safe to assume that households' and firms' expectations are generally different from those of professional forecasters and financial market participants, and may have reacted differently to the COVID-19 crisis.

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