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Euro area longer-term inflation expectations revisited

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This *Letter* examines recent dynamics in inflation expectations, which are an important determinant of actual inflation, as they impact economic decisions, such as households' spending decisions and firms' pricing plans. It is therefore important that expectations are well-anchored and that longer-term expectations are at levels consistent with the Eurosystem's inflation objective and insensitive to shocks to the economy or prices. We show some evidence for weaker anchoring since 2013 through increased sensitivity to shocks. As both the inflation risk premium and the expected level of inflation have declined more recently, monetary policymakers should continue monitoring developments in inflation expectations closely.

Introduction

Euro area headline inflation, calculated as annual percentage growth in the Harmonised Index of Consumer Prices (HICP), stayed below 1% and turned negative occasionally between 2013 and 2016. Inflation excluding food and energy components, which measures underlying inflationary pressures, was also subdued and fluctuated around only 1%. In combination with weak price dynamics, significant declines in expected inflation and rising fears of deflation over this period posed risks to the anchoring of inflation expectations and prompted the implemention of various policy measures by the European Central Bank (ECB).[1] Both headline inflation and inflation expectations recovered to some extent between 2016 and 2018, before starting to decline again in 2019. Meanwhile, measures of underlying inflation have seen little improvement. These developments bring the anchoring of inflation expectations back to the spotlight.

Subdued price pressures for a prolonged period of time, which is the case in the euro area, may eventually lead to some degree of de-anchoring of inflation expectations (Busetti et al., 2014; Ehrmann, 2015). Well-anchored expectations are essential for effective monetary policy transmission as they feed into actual inflation via price- and wage-setting mechanisms. Longer-term inflation expectations are anchored if they stay close to the level consistent with the price stability and are not sensitive to economic news or to transitory or cyclical shocks. Following a shock, inflation is expected to return to the objective level over

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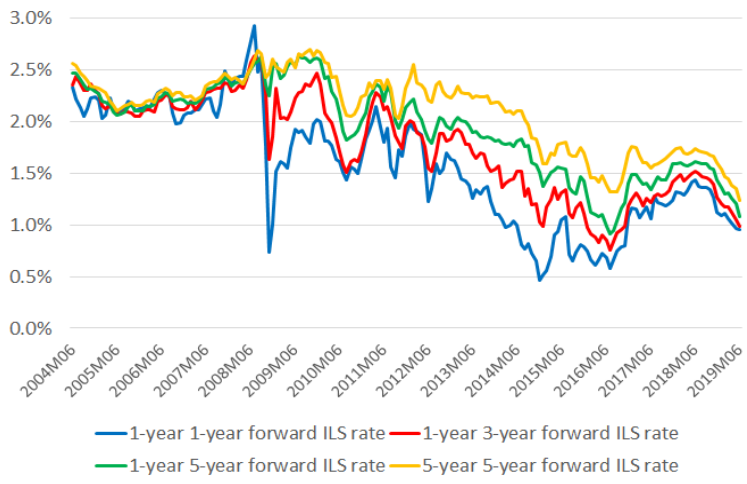
[1] For a review, see Hartmann and Smets (2018).

the medium-to-long run. Thus, longer-term inflation expectations primarily reflect views about the monetary policy framework and the central bank's ability to manage inflation.[2]

One way to measure euro area inflation expectations is to use the pricing information of inflation-linked financial instruments, such as bonds and swaps.[3] It is important to note, however, that market-based indicators do not provide a *pure* measure of expected inflation as they also incorporate various *risk premia* (Garcia and Werner, 2018), of which inflation risk is the primary example. Investors demand inflation risk premia to compensate for risks surrounding their central estimates of future inflation, signalling which outcomes of future inflation are considered more important.[4] Therefore, the expected level of inflation and inflation risk premium together should be interpreted as a broader measure of the overall inflation expectations and both are relevant from a monetary policy perspective.

Forward rates on inflation-linked swap (ILS) contracts of various horizons have recently declined towards the historic lows registered in 2016, as shown in Figure 1. Based on recent inflation risk premium developments, investors expect inflation to be lower than previously anticipated over the medium-to-long term (Cœuré, 2019). These developments call into question the degree of anchoring of euro area inflation expectations.

Figure 1: Forward inflation-linked swap rates



Notes: this figure plots forward rates on inflation-linked swap contracts of various horizons over the period 2004M6-2019M6. They provide information on the expected inflation rate over a number of years, starting at a future date, e.g., inflation over five years starting five years from now.

Prior to the global financial crisis, it was generally accepted that euro area inflation expectations were well-anchored, implying that the ECB had a high degree of credibility with respect

[2] In contrast, short-term inflation expectations may be influenced by temporary and cyclical shocks hitting the economy.

[3] An alternative way to measure inflation expectations is to rely on surveys, such as the Survey of Professional Forecasters (SPF) by the ECB or those by Consensus Economics. However, surveys are produced at a lower frequency. Meanwhile, the prices of financial contracts are available at higher frequency and without a reporting lag (ECB, 2012; Bundesbank, 2015).

[4] For instance, a falling inflation risk premium implies a lower probability of inflation being greater than expected. A negative premium signals that deflation, rather than excessive inflation, is the key concern. Bönginghausen et al. (2018) show that falling inflation risk premia in the euro area can be linked to downward shifts in the balance of risks to the inflation outlook from survey data.

to achieving its price stability mandate (Demertzis et al., 2009; Beechey et al., 2011). Following the crisis, several studies report significant responses of longer-term inflation expectations to macroeconomic news (ECB, 2012; Nautz et al., 2017; Garcia and Werner, 2018) and provide evidence of increased sensitivity of longer-term expectations to past inflation and to short-term inflation expectations (Łyziak and Paloviita, 2016). In addition, the mean of euro area longer-term inflation expectations appears to have fallen slightly since the second half of 2013 (Kenny and Dovern, 2017) and the probability of long-run expected inflation being between 1.5% and 2.5% has also declined (Grishchenko et al., 2017; Cœuré, 2019).

This *Letter* hence examines how the degree of anchoring changed during the period of low inflation by analysing the responsiveness of inflation expectations to economic shocks. We also aim to shed some light on developments since the second half of 2018, a point at which the euro area economy began to slow down (Goodhead and Parle, 2019).

Our results provide evidence of somewhat weaker anchoring of longer-term inflation expectations in the euro area since 2013, reflected by higher sensitivity of longer-term inflation expectations to short-term expectations, economic activity and oil prices. This coincides with a period in which the euro area was hit by several large and persistent shocks. Over the past year, we show that the sharp decline in the 5y5y ILS rate is explained by economic activity, recent inflation outcomes and short-term inflation expectations. Looking more closely at the 5y5y ILS rate, its movements are mostly driven by inflation risk premia, likely reflecting increased risks of inflation being lower than expected. However, the expected level of future inflation has also declined somewhat, as indicated by survey measures.

Data

The empirical analysis is based on monthly data from June 2004 to June 2019. Table A1 provides a summary of the data and sources.

This *Letter* measures euro area inflation expectations using forward inflation-linked swap rates. In ILS contracts, net cash flows are exchanged between one party (the "inflation buyer"), paying a fixed interest rate on a principal amount, and a counterparty (the "inflation seller"), who pays a variable rate linked to realised inflation. The fixed interest rate thus reflects the expected inflation over the contract maturity. Forward ILS rates are preferred to break-even inflation rates (BEIRs) derived from the bond market as they provide a cleaner measure of expectations.[5] Forward ILS rates are widely used by researchers (del Giudice Rodriguez and Yoldas, 2016; Speck, 2017; Kose et al., 2019) and monetary policymakers (Draghi, 2014) to measure longer-term inflation expectations.

More specifically, we use the five-year five-year forward inflation-linked swap rate (the "5y5y ILS rate"). This rate denotes the average expected inflation rate over a five-year period starting five years from now. Short-term expectations are measured using the one-year one-year forward rate (the "1y1y ILS rate"). To gain some insight into the inflation risk premium

[5] For instance, BEIRs carry time-varying liquidity and country-specific risk premia (Bundesbank, 2015; Böninghausen et al., 2018) that is less of an issue in the case of swap contracts.

developments, we use the mean of the aggregate probability distribution of longer-term inflation expectations from the SPF by the ECB to proxy for expected inflation. We are then able to calculate the inflation risk premium as the difference between the 5y5y ILS rate and the expected level of inflation.

Economic activity is represented by the IHS Markit Composite Purchasing Managers' Index for the euro area. Inflation is calculated as the annual percentage change in the HICP. Euro-denominated nominal oil prices are used to calculate annual oil price inflation. Interest rates are important for economic activity and price dynamics. Since the implementation of unconventional monetary policy, policy actions affect longer-term interest rates in addition to short-term rates (Cœuré, 2017). To capture interest rate dynamics, the term spread between the euro area 10-year government bond benchmark yield and the three-month EURIBOR rate is included in the model.[6]

Methodology

The empirical analysis is based on a structural vector autoregressive (SVAR) model.[7] The baseline model in a reduced form can be expressed as follows:

$$\mathbf{Y}_t = \alpha + \beta_1 \mathbf{Y}_{t-1} + ... + \beta_p \mathbf{Y}_{t-p} + \mathbf{u}_t \tag{1}$$

where α is a vector of constant terms, $\mathbf{Y}_t$ denotes a vector of endogenous variables, $\mathbf{u}_t$ represents a vector of reduced-form errors and p is a number of lags. We include six endogenous variables in $\mathbf{Y}_t$ in the following order: annual oil price inflation, euro area composite PMI, annual HICP inflation, the term spread, 1y1y ILS rate, and 5y5y ILS rate.

To provide some economic interpretation of the relationships described by the model, structural shocks must be recovered from their reduced form. The structural identification is achieved by Cholesky (recursive) decomposition of variance-covariance matrix of reduced-form residuals. The ordering of the endogenous variables implies a number of timing restrictions.

Oil price inflation is assumed to be the most exogenous, i.e., not to be affected contemporaneously by any other variable in the model (Kilian and Vega, 2011). The composite PMI follows the oil price variable and precedes HICP inflation. For any given month, the PMI data is collected and released before the final estimate of the HICP inflation rate for that month. As a result, it is unlikely that the composite PMI is affected contemporaneously by inflation. Economic variables are then followed by the financial variables: the term spread

[6] While the term spread could proxy for the monetary policy stance (Baumeister and Benati, 2013; Bobeica et al., 2019), note that other factors may also affect its dynamics, including perceptions of macroeconomic conditions and the expected monetary policy path.

[7] Several other studies also estimate a SVAR model to analyse inflation expectations (Ciccarelli and García, 2009; Davis, 2014; Böninghausen et al., 2018).

and inflation-linked swap rates. This way, financial variables are allowed to respond to other variables within the same month in line with the fact that any new information is priced in by financial markets immediately. Consequently, they only have a lagged effect on the economic variables and oil price inflation. Interest rate and expectations dynamics typically take time to have an impact on the economy. This approach is broadly in line with Ciccarelli and García (2009) and Böninghausen et al. (2018).

The model is estimated by OLS using 2 lags as recommened by the Akaike Information Criterion. In addition to the full-sample SVAR analysis, we also estimate the model over a shorter sample period spanning 2004M6-2012M12. The choice of the end point of the shorter sample is motivated by evidence reported in the relevant literature (Łyziak and Paloviita, 2016; Nautz et al., 2017; Garcia and Werner, 2018) as well as by our own bivariate regression analysis.[8]

The first part of the SVAR analysis examines structural impulse response functions (IRFs) for the 5y5y ILS rate over the two sample periods. If inflation expectations are well-anchored, there should not be significant responses to shocks in oil prices, inflation, economic activity and short-term inflation expectations. Secondly, for each sample we examine what proportion of the 5y5y ILS rate forecast error variance can be explained by each structural shock. Finally, we do a historical structural shock decomposition over the full sample. This shows the contributions of each variable to developments in the 5y5y ILS rate over time. This allows us to gain some knowledge of the relative roles of the different variables in causing the 5y5y ILS rate to move away from its model-implied steady state during the post-crisis period.

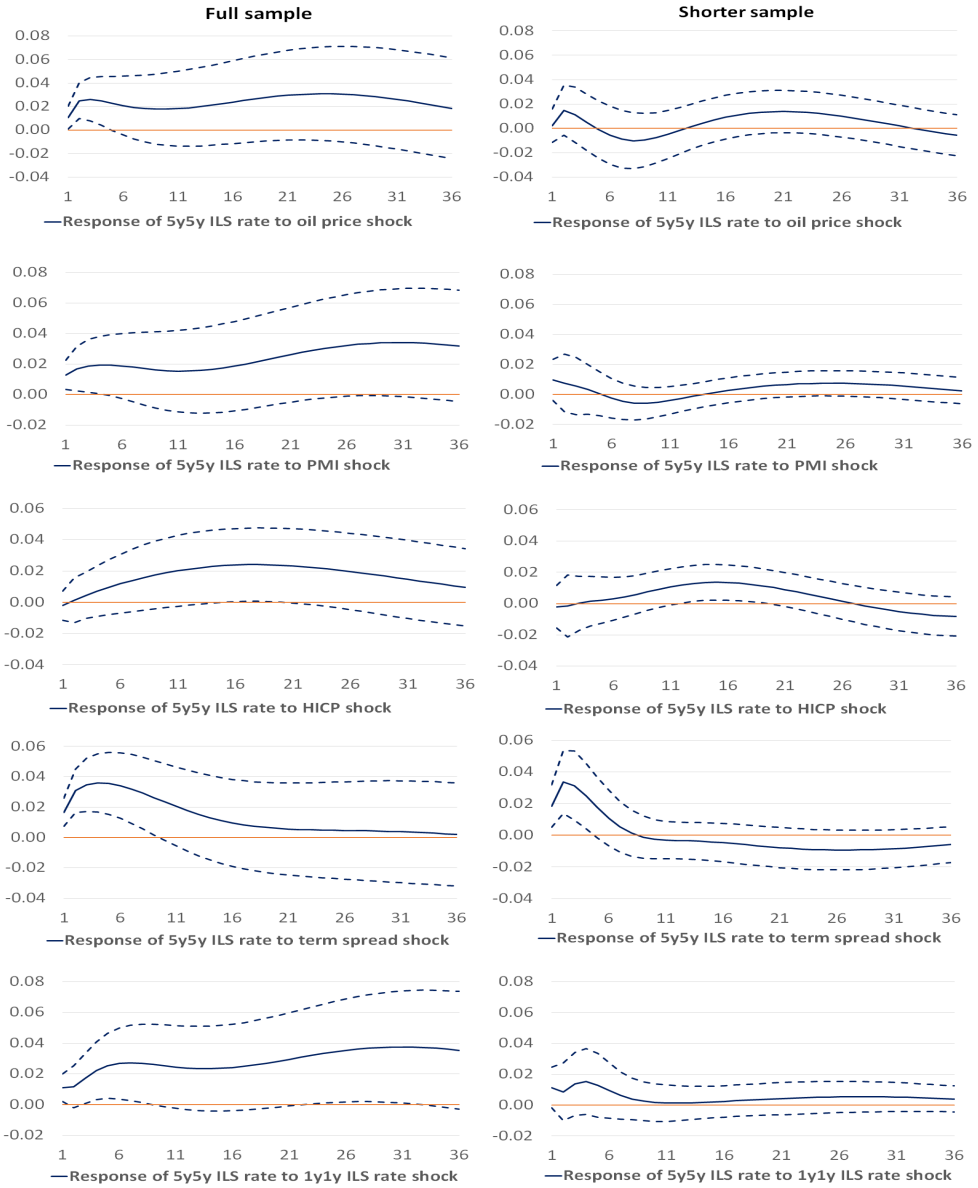
Results

Impulse response functions

We first look at the response of longer-term inflation expectations to structural shocks based on the model estimated over the two sample periods. Figure 2 depicts the IRFs of the 5y5y ILS rate to one standard deviation shocks to the other variables in the system. The results indicate some changes in what causes longer-term inflation expectations to move over the period of persistently low inflationary pressures.

[8] We estimate (3-year) rolling bivariate equations where monthly changes in the 5y5y ILS rate are regressed, in turn, on monthly changes in oil prices, short-term inflation expectations, and inflation. The results suggest a somewhat weaker degree of anchoring following the sovereign debt crisis.

Figure 2: Response of longer-term inflation expectations to estimated structural shocks



Notes: the figure plots the full-sample (LHS) and shorter-sample (RHS) impulse response functions of the 5y5y ILS rate to a positive 1 standard deviation shock to oil price inflation, euro area composite PMI, actual inflation, term spread and 1y1y ILS rate. The full (shorter) sample spans 2004M6-2019M6 (2004M6-2012M12).

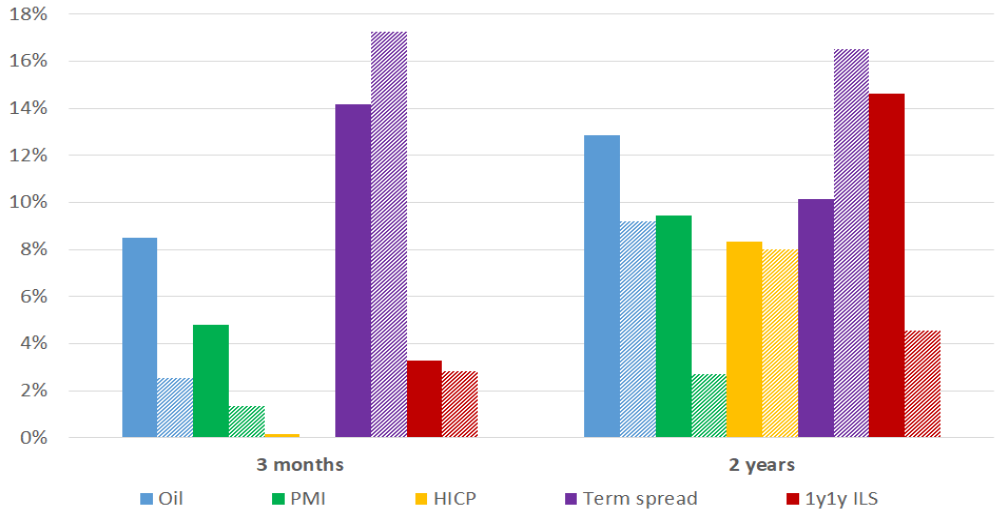
The impact of oil price inflation, economic activity and short-term inflation expectations on longer-term inflation expectations in the full sample is positive and statistically significant, although the magnitudes are quite small. Prior to 2013, however, the response of the 5y5y ILS rate to these variables is never significantly different from zero. With respect to actual inflation, there is some evidence of a delayed (small) positive and significant effect on the 5y5y ILS rate prior to 2013. The full-sample response function shows that this effect has become slightly larger since 2013. Meanwhile, the effect of the term spread has remained positive and significant but it has become somewhat more persistent.

Based on the IRF analysis, longer-term inflation expectations have become more sensitive to oil prices, economic activity and short-term inflation expectations since 2013. This result implies a somewhat weaker degree of anchoring.

Forecast error variance decomposition

In the second part of the SVAR analysis, we look at the forecast error variance decomposiiton (FEVD) of the longer-term inflation expectations. The FEVD demonstrates how much each structural shock contributes to the 5y5y ILS rate forecast errors on average. Figure 3 reports such decompositions of the 5y5y ILS rate forecast errors for short term (3-month) and medium term (2-year) horizons. As with the IRFs, we compare the full-sample results (solid fill) to the results based on the estimation prior to 2013 (pattern fill).

Figure 3: Forecast error variance decomposition for 5y5y ILS rate



Notes: The figure plots the full-sample (solid fill) and shorter-sample (pattern fill) the forecast error variance decomposition for the 5y5y ILS rate over 3-month and 2-year horizons based on the estimated SVAR model. The contributions of the 5y5y ILS rate itself can be inferred by subtracting the sum of the shares from 100%. The full (shorter) sample covers the period 2004M6-2019M6 (2004M6-2012M12).

The role of oil prices and composite PMI have increased across both forecast horizons since 2013. Meanwhile, short-term inflation expectations now account for a larger share of longer-term inflation expectations forecast errors over 2-year horizon, while their role in the short-term remained broadly unchanged. With respect to the term spread, its contributions declined across both horizons in the full sample, more notably in the medium term, but still remained large. The share attributed to inflation is largely unchanged. Figure 3 also implies that structural shocks to the 5y5y ILS rate itself still explain the most of the variance in its forecast errors, but this share has declined in the full sample. Overall, the FEVD analysis also indicates that the sensitivity of longer-term inflation expectations to some economic variables and short-term expectations has increased since 2013.

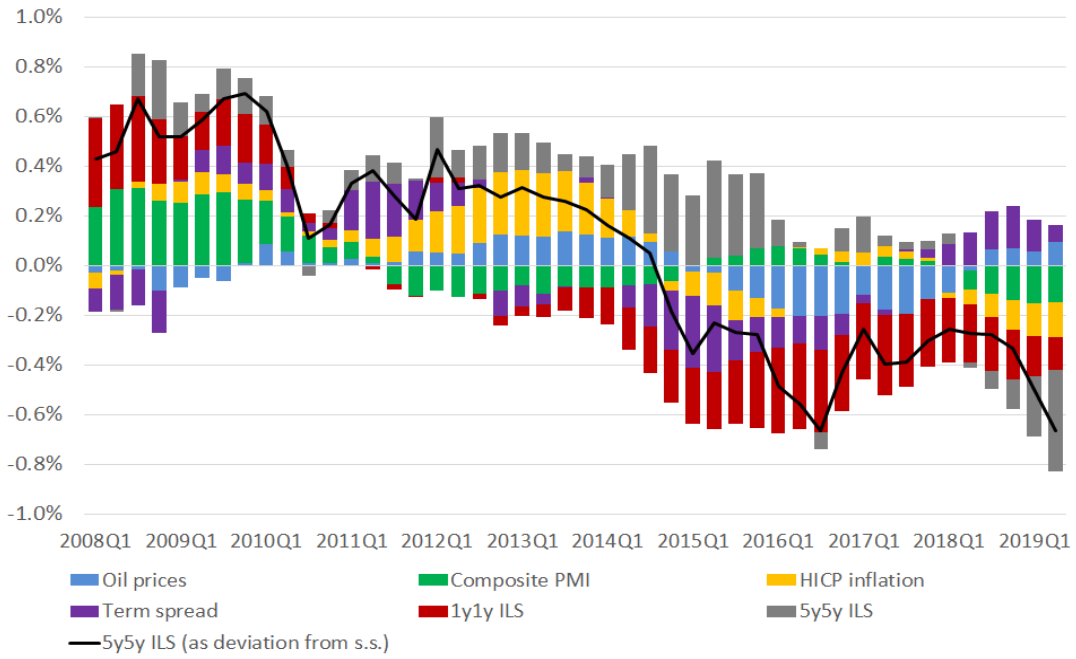
Historical shock decomposition

Next, we examine the historical shock decomposition to gain insight into which structural shocks matter more at a given point in time based on their cumulative effect on a variable of interest. Figure 4 plots the 5y5y ILS rate in terms of deviations from its model-implied steady

state (i.e., long-run mean) together with the contributions of the shocks. In the immediate aftermath of the financial crisis, the 5y5y ILS rate was well above its steady-state level but it declined to levels closer to the model-implied long-run mean after 2009. Since the middle of 2014, the 5y5y ILS rate has stayed below its steady state. After reaching a trough in the middle of 2016, longer-term inflation expectations recovered somewhat before falling again to the historic lows by the middle of 2019.[9]

With respect to the contributions of the structural shocks, the importance of these shocks tend to vary over time. The oil price shocks do not explain much of the 5y5y ILS rate dynamics between 2008 and 2011. However, oil prices made somewhat larger positive contributions in 2012-2014, following the period of high oil price inflation. Over the period 2015-2017, negative oil price contributions are even more notable in magnitude. This is in line with oil prices falling substantially between 2014 and 2016. The past four quarters nevertheless saw positive but smaller contributions from oil prices.

Figure 4: Historical shock decomposition of the 5y5y ILS rate



Notes: The figure plots the 5y5y ILS rate (as deviations from the model-implied steady state) together with the contributions from the structural shocks. To obtain this historical shock distribution, the SVAR model is estimated over the full sample period (2004M6-2019M6). Monthly contributions are averaged over each quarter.

Large and positive contributions of composite PMI shocks in 2008-2009 could be explained by strong PMI figures in years preceding the financial crisis.[10] Since late 2010, PMI contributed only moderately to the dynamics of the 5y5y ILS rate. Nevertheless, it is important to note that the composite PMI has increasingly put downward pressure on the swap rate since 2018Q2. The role of actual inflation was particularly pronounced in 2012-2013. Nev-

[9] This recovery between 2016 and 2018 is partly due to the ECB's monetary policy measures (see, for instance, Hartmann and Smets (2018)).

[10] Note that the historical shock decomposition shows the cumulative effect of each shock on a given variable at a given point in time.

ertheless, since then inflation mostly weighed on the overall longer-term inflation expectations. It is worth noting, that its contributions have also been increasingly negative since 2018. These developments are consistent with the economic slowdown in the euro area observed since the second half of 2018.

Short-term inflation expectations contributed greatly to the increase in longer-term expectations in 2008-2009 but their share dissipated afterwards. The role of the 1y1y ILS rate in explaining the 5y5y ILS rate deviations from its steady state level increased significantly in the 2014-2018 period. Substantial negative contributions of short-term inflation expectations over this period largely coincide with the period of very low (below 1%) inflation rates (until the end of 2016). The contributions are gradually less negative since the second half of 2017 but they are still non-negligible over the past few quarters. The magnitude of term spread contribution is quite stable over time and seems to be broadly in line with the monetary policy response to the financial and sovereign crises as well as to fears of deflation in 2014 and 2015. Interestingly, structural shocks to the 5y5y ILS mostly have a positive effect. This has changed since 2018 as the contribution has been increasingly negative.[11]

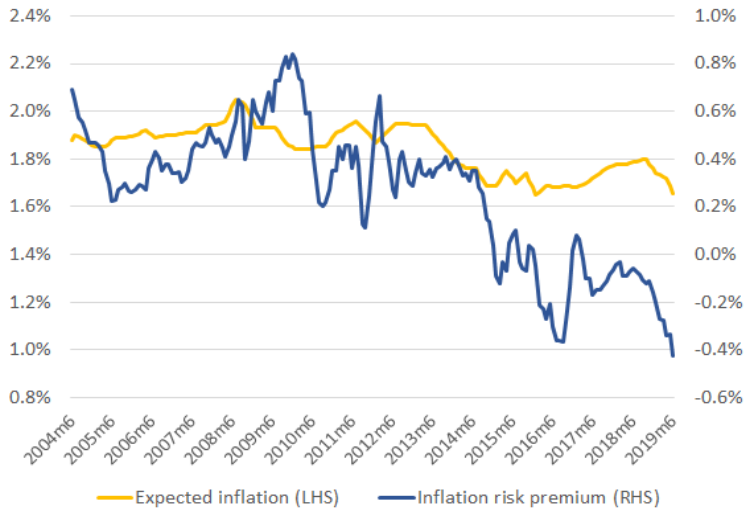
Longer-term inflation expectations were more sensitive to oil prices, inflation and short-term expectations after the sovereign debt crisis. While oil prices and short-term inflation expectations appear to have had less impact on longer-term inflation expectations more recently, the contributions of actual inflation, composite PMI and the 5y5y ILS rate itself have been increasingly negative.

Furthermore, the 5y5y ILS rate has fallen further below its steady state while the steady state has also declined over time. Its full-sample estimate stands at 2% in comparison to 2.35% based on the model estimation prior to 2013. The relatively high mean in the first part of the sample may be explained by a large and positive inflation risk premium, among other types of risk premia, as depicted in Figure 5.[12] The premium has become smaller, even turning negative, in the latter part of the sample, which could also provide a reason for concern, as discussed previously. While it is evident that most of the fluctuation in the 5y5y ILS rate is accounted for by the inflation risk premium, it should also be noted that the expected level of inflation has declined since the start of 2019. Thus survey-based measures of inflation expectations may also indicate some degree of weaker anchoring.

[11] Contributions of own shocks likely reflect omitted information from the model, such as a global inflation trend, etc.

[12] This risk premium closely resembles model-based estimates in Cœuré (2019).

Figure 5: Expected inflation and inflation risk premium



Notes: The figure plots expected inflation together with the inflation risk premium, i.e. the difference between the 5y5y ILS rate and the mean of the aggregate probability distribution of longer-term inflation expectations (SPF) as a proxy for expected inflation, over the full sample period (2004M6-2019M2).

Conclusion

Euro area inflationary pressures have been persistently weak since 2013, while market-based measures of inflation expectations have also seen renewed declines since late 2018. Together, these developments call for the re-examination of anchoring of euro area inflation expectations. Well-anchored expectations are important to ensure against inflationary or deflationary spirals. The empirical analysis in this *Letter* examines the anchoring of longer-term inflation expectations and sheds light on the drivers of recent developments in these expectations.

We find evidence of somewhat weaker anchoring of euro area longer-term inflation expectations since 2013. The results point to greater sensitivity of longer-term expectations to short-term expectations, oil prices and economic activity. Over the past year, we show that the sharp decline in the 5y5y ILS rate is explained by economic activity, recent inflation outcomes and short-term inflation expectations. Even though the decline in financial market measures of longer-term inflation expectations in late 2018 and early 2019 was mainly driven by a falling inflation risk premium, the expected level of future inflation has also declined recently as indicated by survey measures.

From the perspective of monetary policymakers, it is important to closely monitor and understand the drivers of inflation expectations. Lower expectations may feed back into inflation dynamics, making it harder to achieve the price stability mandate. If inflation expectations decline persistently, without remediating actions, the public and financial markets may interpret this as the willingness to tolerate rates of inflation below the objective. Therefore, timely policy actions to ensure the appropriate monetary policy stance and demonstrate central bank's committment are key. A potential option to support inflation expectations in the euro area would be to re-visit the monetary policy strategy, including the definition of

price stability.

Appendix

Table A1: Data Description

Description and source
5-year forward inflation-linked swap rate 5 years ahead for the euro area and the US (Bloomberg)
1-year forward inflation-linked swap rate 1 year ahead for the euro area (Bloomberg)
Euro area composite Purchasing Managers' Index (IHS Markit)
Year-on-year growth rate of the Harmonised consumer Price Index (Eurostat)
Nominal price of oil in terms of euro (Thomson Reuters)
Mean of the aggregate probability distribution of longer-term inflation expectations (ECB Survey of Professional Forecasters)
Term spread (euro area 10-year government benchmark yield less 1-month EURIBOR rate (ECB)

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