BANCA D'ITALIA

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ANCHORED OR DE-ANCHORED? THAT IS THE QUESTION

by Francesco Corsello[*], Stefano Neri[*] e Alex Tagliabracci[*]

Abstract

This paper shows that long-term inflation expectations have become de-anchored from the ECB Governing Council's inflation aim. The long-term expectations in the ECB's Survey of Professional Forecasters have not returned to the levels that prevailed before the 2013-14 period of disinflation, and their distribution is still skewed towards lower inflation levels. Moreover, long-term expectations have become sensitive to short-term ones and to negative inflation surprises. Forecasters who participated in most of the surveys are the most responsive to short-term developments in inflation.

JEL Classification: E31, E52, E58.
Keywords: inflation expectations, anchoring, monetary policy, survey data.

Contents

[*] Bank of Italy, Economic Outlook and Monetary Policy Directorate.

1. Introduction and motivation

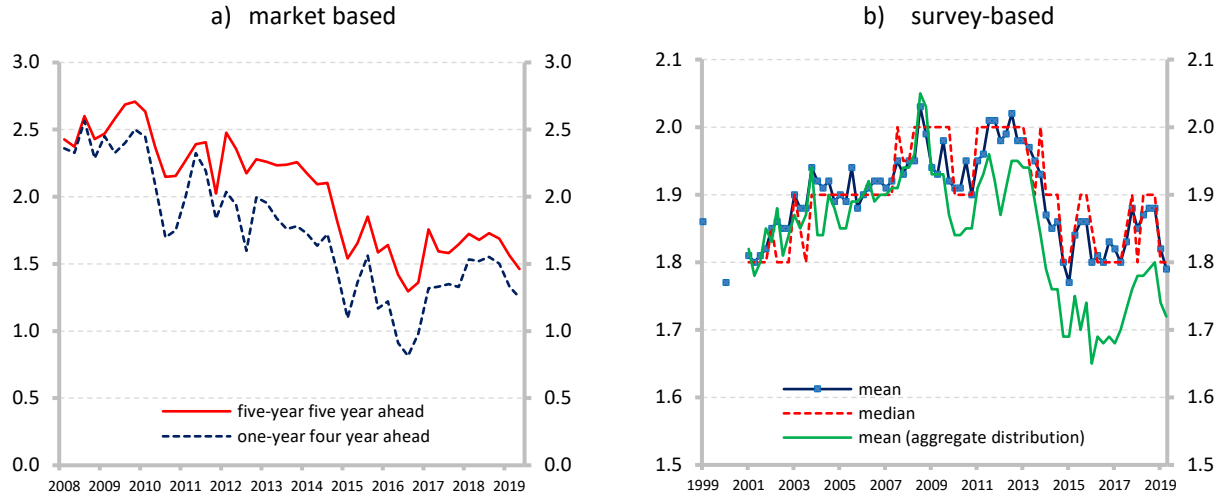
The anchoring of inflation expectations is a necessary condition for central banks to maintain price stability, as it prevents temporary shocks to inflation from feeding into the wage and price formation mechanisms (Bernanke, 2007 and Draghi, 2014).

Concerns among commentators, analysts and investors about the anchoring of long-term inflation expectations to the ECB Governing Council's aim have re-emerged forcefully since the beginning of 2019, as market-based indicators reached new historical lows.[1] The five-year five-year ahead expectation based on inflation-linked swap (ILS) reached 1.10 per cent after the June 2019 policy meeting of the Governing Council, 15 basis points below the previous minimum reached in June 2016 (Figure 1, panel a). The five-year ahead expectation in the April 2019 ECB's Survey of Professional Forecasters (SPF) was between 1.7 and 1.8 per cent (Figure 1, panel b).[2] A comparable measure (one-year four-year ahead) based on ILS was much lower, at 1.1 per cent in June 2019 (Figure 1, panel a) due to the negative inflation risk premium. The results of the July survey, which we have not used in this paper, showed a further and significant decline of long-term expectations (to 1.6 according to the mean of the aggregate probability distribution, from 1.7 in April).

The distribution of long-term expectations has shifted to the left since the outbreak of the global financial crisis, and even more after the beginning of the disinflation in 2013 (Figure A1 in the appendix). The probability of the five-year ahead expectations being below 1.4 stood at 36 per cent in the April SPF, up from 13.8 in the corresponding survey in 2008, signalling increasing concerns about the possibility of inflation remaining low for long. The same probability computed on the basis of zero-coupon inflation options was much higher, around 80 per cent (Cœuré, 2019a).

Figure 1. *Long-term inflation expectations*

(*per cent*)



Source: Bloomberg and ECB. *Note*: market-based inflation expectations (panel a) are computed as averages over the period in which forecasters were responding to the SPF.

[1] Concerns about a possible de-anchoring were raised, for example, in an on-line article by Reuters published on the day of the release of the results of the SPF for the third quarter of 2019: "*In the longer term, defined as five years into the future, inflation was projected at 1.7%, below a previous forecast of 1.8%, indicating that longer-term inflation expectations may be de-anchoring.*"

[2] De Guindos, Vice-President of the ECB, said in an interview that "*What we need to see is a de-anchoring of inflation expectations. This has not yet happened, despite the fact that there has been a drop in market-based inflation expectations. If you look at the survey of professional forecasters, the situation is a little bit different – expectations have remained stable.*" (De Guindos, 2019).

Three methods can be used to assess the degree of anchoring of long-term inflation expectations: (*i*) their level; (*ii*) their sensitivity to macroeconomic surprises;[3] (*iii*) their sensitivity to movements in short-term inflation expectations. Long-term inflation expectations are anchored if they are in line with the inflation objective of the central bank and they do not respond to both macroeconomic surprises and developments in short-term inflation expectations. In these cases, investors are confident that the central bank can and will react to shocks in order to ensure that inflation returns to the target over the policy-relevant horizon.

The literature has mainly focused on methods (*ii*) and (*iii*). For instance, Łyziaka and Paloviita (2017) use data from the ECB's SPF and find that inflation expectations in the euro area have shown signs of de-anchoring after 2014, featuring an excess sensitivity to changes in the short-term inflation expectations and in current inflation rates. Grishchenko, Mouabbi and Renne (2019), using survey data, find that after the Great Recession inflation anchoring improved in the United States while a mild de-anchoring occurred in the euro area. At the end of the sample, in mid-2016, inflation expectations were broadly anchored in both economies. Buono and Formai (2018) investigate the degree of anchoring of inflation expectations in different advanced economies using data from Consensus Economics and time-varying parameter regressions. Inflation expectations in the euro area have become de-anchored shortly after the global financial crisis. Cœuré (2019a) shows that between 2010 and 2015 low realizations of inflation have contributed to the downward revisions in medium to long-term inflation expectations. The launch of the Asset Purchase Programme (APP) by the ECB in January 2015 succeeded in removing the sensitivity of expectations to current inflation. Bulligan (2018) finds that the announcement of the APP in January 2015 caused a statistically significant upward revision of long-term inflation expectations and lowered the forecasters' assessment of the probability of a low inflation regime. Interestingly, SPF participants, who had been relatively more accurate prior to the announcement, were also those who revised their inflation forecasts more markedly. Using ILS, Natoli and Sigalotti (2017) have proposed an indicator of anchoring based on the odds that strong negative shocks to short-term expectations are associated with large declines in long-term expectations. The indicator highlights an increased risk of de-anchoring in the last quarter of 2014 in the euro area, which diminished after the launch and the subsequent recalibrations of the APP. Since the beginning of 2019, however, the indicator has increased again in the euro area (Figure A2 in the appendix). Miccoli and Neri (2019) find that inflation surprises have significant effects on ILS-based inflation expectations. The sensitivity of long-term expectations to the surprises disappeared after the introduction of the APP.

Regarding the level of long-term inflation expectations as indicator of their anchoring, Dovern and Kenny (2017) exploit the panel dimension of the SPF to study the whole distribution of long-term inflation expectations and test for breaks in its moments. The authors document a small downward shift in mean long-run expectations, an increase in forecasters' uncertainty and an increase in the asymmetry of the distribution after 2013.

The literature briefly described suggests that the concerns recently raised about the anchoring of long-term inflation expectations in the euro area are indeed justified.[4] A threat to the credibility of monetary policy should be the main contingency to which the ECB should react by adjusting all

[3] Bernanke (2007) defines anchored expectations those who are "*relatively insensitive to incoming data*".
[4] For a more detailed survey of the existing research based on the SPF, see ECB (2019).

its instruments. However, preserving the anchoring when inflation is persistently above target may be less costly than when inflation runs persistently below target, for example because the policy rate is at its effective lower bound or because there are limits to the implementation of quantitative measures. Ehrmann (2015), using data from Consensus Economics, finds that under persistently low inflation, expectations are not as well anchored as when inflation is around the target: expectations are more dependent on lagged inflation and they are revised downward in response to negative surprises to inflation, but do not respond to higher-than-expected inflation. Armenter (2018) shows that when the policy rate is at its lower bound, low-inflation expectations can become self-fulfilling. Busetti et al. (2014) show that a series of deflationary shocks can de-anchor long-term inflation expectations from the central bank's target.

This paper presents an assessment of the degree of anchoring of long-term inflation expectations in the euro area using survey-based (SPF) expectations to study possible shifts in their long-run levels (Section 2) and their sensitivity to inflation surprises (Section 3). The paper also exploits the panel dimension of the survey (Section 4) and discusses the policy implications of the main findings (Section 5). We do not consider households' inflation expectations for three reasons. First, several studies have documented that households' expectations are very different from actual inflation (see the references in Cœuré, 2019b). Second, households' expectations display a strong and stable correlation with the more volatile components (energy and food) of inflation. Third, to the best of our knowledge there are no measures of long-term expectations derived from households' and firm's surveys in the euro area. There is evidence that firms' and households' expectations may be biased. Coibion, Gorodnichenko and Kumar (2018) show that one-year ahead firms' and households' inflation expectations in New Zealand exhibit a significant upward bias compared with professional forecasters, notwithstanding more than three decades of inflation targeting by the Reserve Bank of New Zealand.

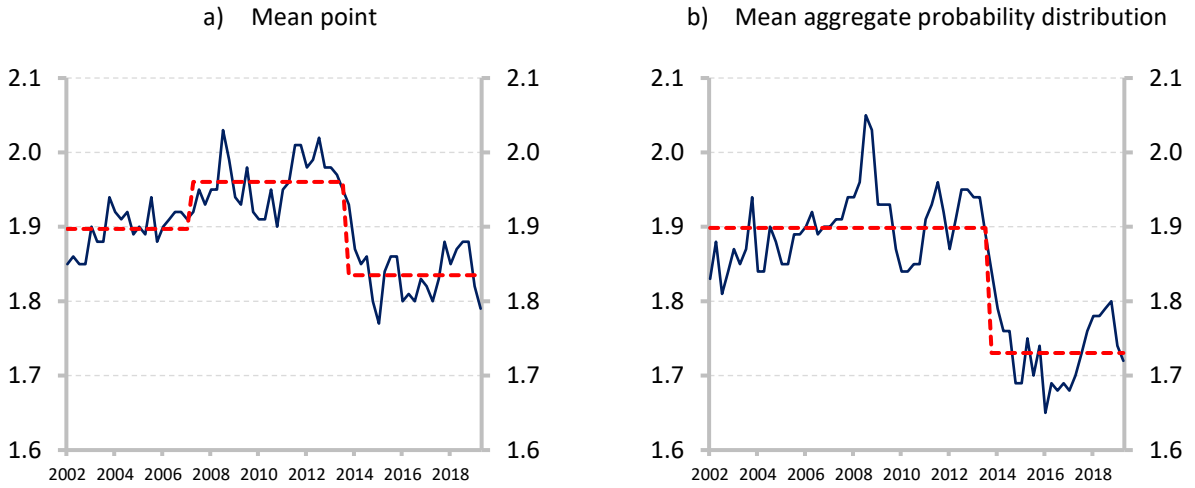
Our contribution to the literature is to offer an in-depth assessment of the anchoring of survey-based long-term inflation expectations in the euro area using a variety of approaches. The paper extends the analysis in Miccoli and Neri (2019) to survey-based inflation expectations, refines the analysis in Łyziaka and Paloviita (2017) and updates Dovern and Kenny (2017). The SPF can provide additional insights on the anchoring of long-term inflation expectations which is particularly valuable given that participants are experts affiliated with financial or non-financial institutions (research institutes, employers' associations and trade unions).[5] The survey is anonymous, which encourages participants to submit the forecasts without any concern about forecasting errors. The quarterly frequency is a limitation of the SPF.

2. Level anchoring

Following the approach employed in Dovern and Kenny (2017), we use the ECB's SPF to test for level shifts of long-term inflation expectations. For a description of the data, see the appendix. To this end, we apply the sequential procedure developed in Bai and Perron (2003) to test for possible structural changes in the mean within a univariate setting. Figure 2 shows the results.

[5] The list of the institutions that have contributed to the SPF can be found on the ECB webpage in the Statistics section.

Figure 2. *Testing for level shifts of long-term inflation expectations*
(*per cent*)



Source: authors' calculations based on SPF data.

Using the mean long-term expectation[6] from the SPF we found two level breaks: the first, from 1.9 to 1.96 per cent, occurred in 2007:Q2 (Figure 2, panel a), the second in 2013:Q3, when long-term expectations shifted downward to 1.84. The latter shift has not been reverted. The approach applied to the mean of the aggregate probability distribution yields a single regime break in 2013:Q4, when the level shifted downward by 17 basis points, from 1.9 to 1.73 per cent. This downward shift is slightly larger than the one found by Dovern and Kenny (2017). The authors also find that forecasters from the financial industry have revised downward their long-term expectations after 2013 more than forecasters from other sectors. No significant break is detected using the median expectation (Figure A3 in the appendix).

The above results show that the degree of anchoring measured by the level of long-term inflation expectations has weakened with the beginning of the disinflation in 2013. Even though the new levels around which expectations have been fluctuating since then may be viewed as consistent with the ECB Governing Council's inflation aim, the lack of a recovery to the levels that prevailed before the disinflation, notwithstanding the very accommodative monetary policy stance, suggests that long-term expectations may have become de-anchored.[7]

[6] Participants are asked to provide their long-term forecasts for a horizon that corresponds roughly to five years ahead.

[7] Otmar Issing provided some clues about the quantitative definition of price stability during the presentation of the review of the ECB monetary policy strategy in May 2003. When asked whether the aim of "*below but close to 2%*" is a change, Issing replied: "*This "close to 2 percent" is not a change, it is a clarification of what we have done so far, what we have achieved – namely inflation expectations remaining in a narrow range of between roughly 1.7 and 1.9% - and what we intend to do in our forward-looking monetary policy*." (ECB, 2003). Draghi (2019), during the press conference of the July policy meeting, hinted at a value of 1.9 per cent as a quantification of the Governing Council's inflation aim ("[…] *In the meantime, however, the main thing in this introductory statement is that the Governing Council* […] *reaffirmed its commitment to symmetry around the inflation aim, which in a sense is 1.9 – it's close to, but below, 2%.*" Demertzis and Viegi (2009) show that the provision of an explicit numerical inflation target provides a focal point for agents' expectations when information is imperfect. Neri and Ropele (2019) study the implications of the imperfect observability of the inflation target for the transmission of transitory (cost-push) shocks to inflation.

3. Sensitivity to inflation surprises

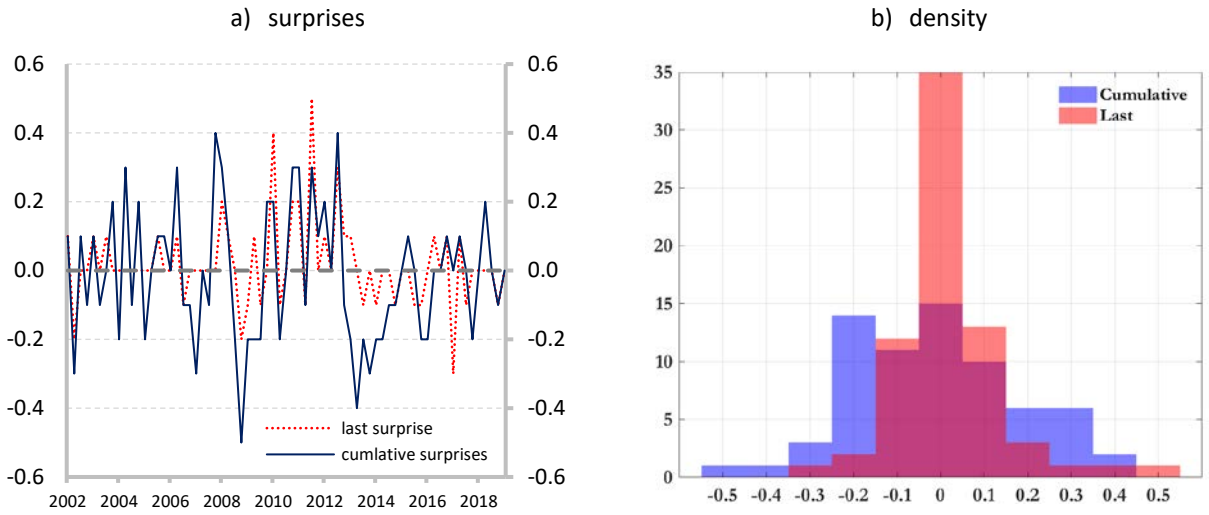
This Section describes the inflation surprises used to assess the degree of anchoring of long-term inflation expectations by quantifying their sensitivity to these surprises.

The surprises are measured by the difference between the monthly flash release of euro area HICP (Harmonized Index of Consumer Prices) year-on-year inflation rate and the corresponding analysts' median forecast surveyed by Bloomberg few days before the release. Positive surprises indicate that analysts have under-predicted inflation and vice versa.[8] The timing of the release of the flash estimates for the largest euro area economies could affect the size of the surprises for the euro area as a whole. Indeed, the flash estimates for Germany, France, Italy and Spain may be released few days before the euro area data. The forecasters participating in the Bloomberg survey may thus revise their forecasts, leading to smaller surprises for the euro area as a whole. On the contrary, when national and euro area data are released on the same day, the euro-area surprise is a "true" one.

We construct two measures of surprises: their sum between two consecutive surveys (cumulative surprises, henceforth); the last surprise before the deadline for replying to the survey. Figure 3 plots the two surprises and their distribution and Table 1 reports selected statistics.

Figure 3 shows that during the disinflation in 2013 and 2014 the surprises were mostly negative (panel a), suggesting an increasing difficulty in forecasting inflation even in the very short-term. The distribution of the cumulative surprises is tilted to the left (panel b). Although similar in their mean and median, the two surprises differ in the higher moments of their distributions (Table 1). The cumulative surprises display a larger variance, a smaller skewness and more mass in the tails. Overall, the moments of the distributions have remained relatively stable throughout the sample. Both type of surprises display a small degree of serial correlation indicating low persistence of the errors, which is larger in the case of the cumulative surprises.

Figure 3. *Inflation surprises*



Source: Bloomberg. *Note*: panel a) shows the surprises, in percentage points; panel b) show their density.

[8] The surprises do not capture the impact of unexpected changes in oil prices (Miccoli and Neri, 2019).

Table 1. *Inflation surprises: summary statistics*

	Cumulative surprises	Last surprise
Mean	-0.01	0.02
Median	0.00	0.00
Standard deviation	0.19	0.12
Skewness	0.11	1.19
Excess kurtosis	-0.29	4.22
First order correlation	0.20	-0.12

Note: authors' calculations based on Bloomberg data.

In the next two sections we assess the sensitivity of inflation expectations to the surprises using two approaches: (*i*) a break-point analysis (section 3.1); (*ii*) a rolling estimation (section 3.2).

3.1 Break-point analysis

In order to test for significant changes in the sensitivity of long-term expectations to inflation surprises, we applied, following Dovern and Kenny (2017), the methodology of Bai and Perron (2003) in a regression of the first differences of long-term inflation expectations on the cumulative surprises. The multiple regression with *m* breaks (and *m+1* regimes) is the following:

$$\Delta\pi_t^e = \beta_j z_{\pi,t} + \varepsilon_t \qquad t = T_{j-1} + 1, \dots, T_j \tag{1}$$

for $j = 1, \dots, m+1$. In the equation, $z_{\pi,t}$ represents the cumulative surprises between t and $t-1$, while $\Delta\pi_t^e$ is the change in the average point expectations between the same periods. The Bai and Perron (2003) procedure identifies and tests sequentially for regime breaks. The model is estimated over the sample from 2002:Q2 to 2019:Q2. Table 2 shows the results.

The analysis finds a significant regime break in the second half of 2013 in the case of both the mean and the median expectations. The coefficient after the break is larger in the case of median expectations (0.256 compared with 0.142). The coefficients before the break are not statistically different from zero. Using the mean of the aggregate distribution, no break is detected. A regime break is not detected when the "last surprise" series is used as a regressor instead of the cumulative surprises. This suggests that forecasters react more to a sequence of surprises rather than just to the last one.

Table 2. *Sensitivity of long-term expectations to inflation surprises*

	Coefficient	*SE*	*robust SE*	*t-stat*	*p-value*
			mean expectation		
β_1	0.025	0.0217	0.0192	1.3024	0.1973
β_2 : from 2013:Q3	0.142	0.0482	0.0382	3.7173	4.17E-04
R^2	0.131				
			median expectation		
β_1	0.012	0.0286	0.0238	0.4873	0.6277
β_2: from 2013:Q4	0.256	0.0673	0.0639	4.0122	1.56E-04
R^2	0.182				
			mean aggregate distribution		
β_1	0.061	0.0239	0.0262	2.3380	0.0224
R^2	0.087				

Note: the regime break for each coefficient is obtained using the sequential procedure of Bai and Perron (2003). SE indicates the standard errors, and robust SE indicates the HAC (Heteroskedasticity and Autocorrelation Consistent) standard errors; *t*-stats and *p*-values are based on the HAC SE.

In order to assess the possibility of an asymmetric response to positive and negative surprises, we estimated separately the equations for positive, $z^{+}_{\pi,t}$, and negative, $z^{-}_{\pi,t}$, surprises:

$$\Delta\pi^{e}_{t} = \beta^{-}_{j} z^{-}_{\pi,t} + \varepsilon_t \qquad t = T_{j-1}+1, \dots, T_j \tag{2a}$$

$$\Delta\pi^{e}_{t} = \beta^{+}_{j} z^{+}_{\pi,t} + \varepsilon_t \qquad t = T_{j-1}+1, \dots, T_j \quad . \tag{2b}$$

Tables 3a to 3c present the results of the tests. The Bai and Perron (2003) methodology tests for joint structural breaks for all the coefficients. Since we aim at detecting and testing for possibly disjoint breaks, we proceed by considering separately the negative and positive surprises. Importantly, when introducing both surprises in the same equation we do not find evidence of a regime break.

In the case of the mean expectation (table 3a), a break is detected in 2013:Q3, when the coefficient measuring the sensitivity of long-term expectations to negative surprises increased sharply (to 0.153). No break is found for the positive surprises.

Table 3a. *Sensitivity of long-term expectations to surprises: mean point expectation*

negative surprises

	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	0.039	0.0317	0.0277	1.4212	0.16
β_2: from 2013:Q3	0.153	0.0526	0.0436	3.5058	8.24E-04
R^2	0.130				
		positive surprises			
	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	0.017	0.0306	0.0229	0.7264	0.4701
R^2	0.004				

Note: see Table 2.

As for the median expectations (table 3b), the procedure detects two breaks in the case of the negative surprises: one in the third quarter of 2004 and the other in the last quarter of 2013. However, the coefficient after the first break is not statistically different from zero, whereas the coefficient for the period after 2013:Q4 is large and statistically significant. As in the case of mean expectations, no break is detected for positive surprises.

Table 3b. *Sensitivity of long-term expectations to surprises: median point expectation*

negative surprises

	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	-0.0333	0.1094	0.0791	-0.4213	0.6749
β_2*:* from 2004:Q3	0.0170	0.0452	0.0343	0.4965	0.6212
β_3: from 2013:Q4	0.2812	0.0749	0.0695	4.0465	1.40e-04
R^2	0.1804				
positive surprises					
	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	0.0208	0.0420	0.0332	0.6283	0.5320
R^2	0.0034				

Note: see Table 2.

Table 3c. *Sensitivity of long-term expectations to surprises: mean of the aggregate distribution*

negative surprises

	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	0.1183	0.0328	0.0290	4.0822	1.23e-04
β_2*:* from 2016:Q1	-0.0667	0.1227	0.0982	-0.6791	0.4994
R^2	0.1663				
positive surprises					
	coefficient	SE	robust SE	*t*-stat	*p*-value
β_1	0.0108	0.0365	0.0343	0.3161	0.7529
R^2	0.0003				

Note: see Table 2.

In the case of the mean of the aggregate probability distribution (table 3c), a break is detected in the first quarter of 2016 for the negative surprises. Contrary to the other measures, the coefficient is statistically different from zero in the sample before the break and not in the subsequent one. As for the mean and median inflation expectations, no break is found for positive surprises. These results imply that the mean of the aggregate probability distribution of long-term expectation has always been sensitive to negative inflation surprises, but not positive ones.

To sum up, the break-point analysis detects an upward shift in the sensitivity of long-term inflation expectations to negative inflation surprises in the second half of 2013. Persistently negative surprises are responsible for the de-anchoring of long-term expectations, which, importantly, are not affected by positive surprises. One possible interpretation for this result is that forecasters may perceive the 2 per cent in the Governing Council's definition of price stability as a cap.

3.2 Rolling estimation

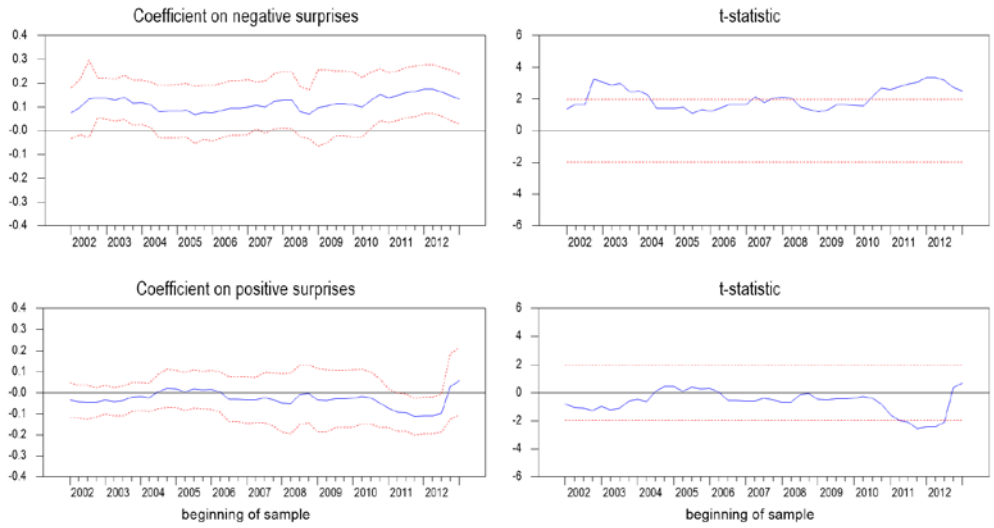
In this section we assess the sensitivity of inflation expectations to surprises using a rolling estimation approach. This alternative approach is meant to evaluate the robustness of the results obtained with the Bai and Perron (2003) methodology.

We estimate equation (1) using a moving window of 24 quarters (six years). We first use the cumulated surprises without distinguishing their sign and then separate them into positive and negative. The results are very similar if we control for oil prices, in line with Miccoli and Neri (2019).

As for the case in which we do not distinguish the sign, Figure A4 in the appendix shows the estimated coefficients and the associated *t*-statistics. The results are similar regardless of the measure of inflation expectations (mean, median and mean of the aggregate probability distribution). The sensitivity to inflation surprises becomes significant after 2010 with a coefficient around 0.10. This implies that, on average, a cumulated 40 basis-points surprise in the inflation releases (such as the one in 2013:Q3) leads to a permanent decrease in long-term expectations by 4 basis points.

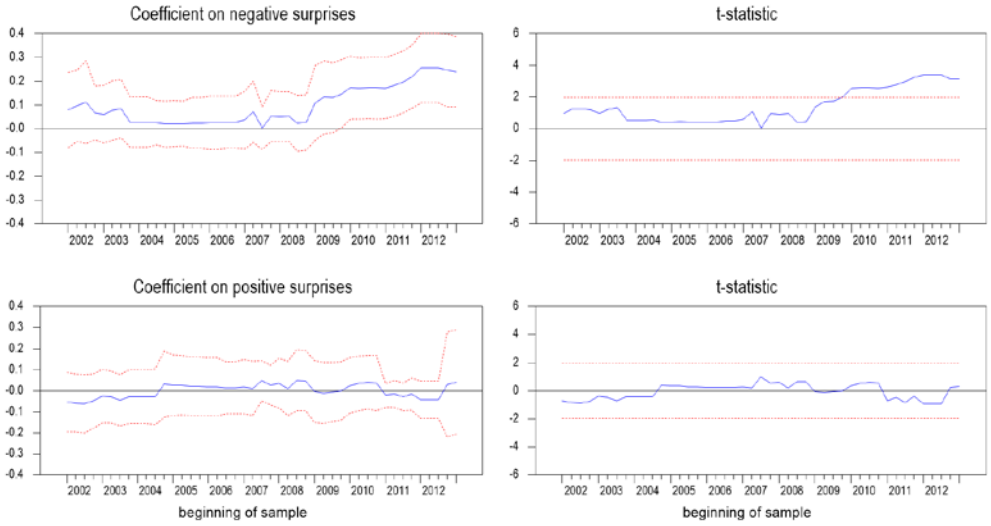
Figures 4a to 4c show the estimated coefficients and the *t*-statistics for the cases in which the sign of the surprises is taken into account.

Figure 4a. *Sensitivity to positive and negative inflation surprises: recursive estimates mean expected inflation*



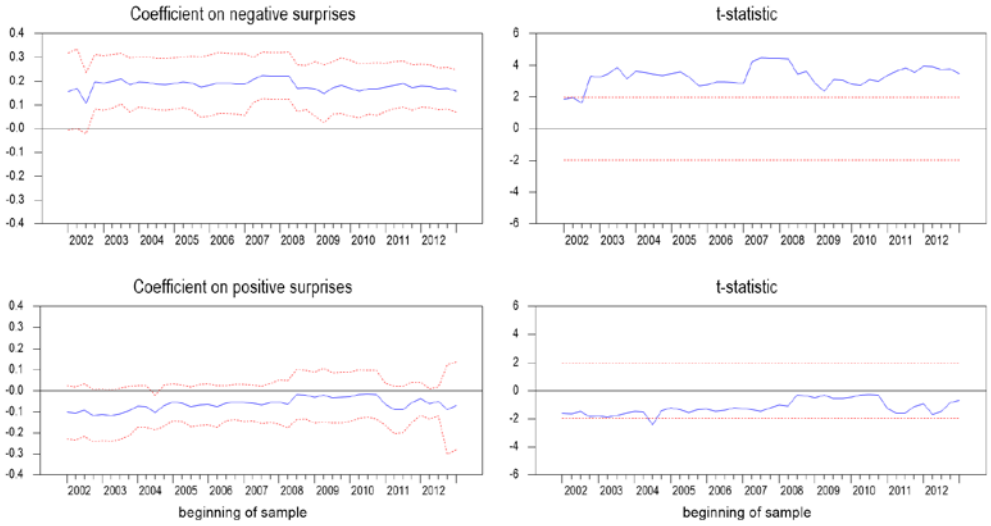
Note: the charts in the left column report the estimated coefficients; the charts in the right column the associated *t*-statistic for the null hypothesis of a zero coefficient. The horizontal axis reports the beginning of each estimation sample.

Figure 4b. *Sensitivity to positive and negative inflation surprises: recursive estimates median expected inflation*



Note: see Figure 4a.

Figure 4c. *Sensitivity to positive and negative inflation surprises: recursive estimates mean of the aggregate distribution of expected inflation*



Note: see Figure 4a.

The rolling estimates of the coefficients and the associated *t*-statistics show that only the negative surprises occurred in 2013 and 2014 affected the anchoring of long-term inflation expectations, as forecasters' started questioning the willingness and the ability of the ECB to maintain price stability. This result holds for all three measures of long-term inflation expectations. Using the mean of the aggregate distribution, the coefficient on negative surprises is statistically different from zero for most of the rolling samples. The estimated coefficients on the negative surprises are, on average, larger than the coefficients of the surprises without taking their sign into

account. No single coefficient turns out to be statistically different from zero if the last inflation surprise is used in the rolling estimation. This finding suggests that the persistence, as well as the sign, of the inflation surprises matter for the sensitivity of long-term inflation expectations to the surprises.

The results from the rolling estimation confirm the findings obtained with the break-point analysis and suggest that long-term inflation expectations have become increasingly sensitive to negative surprises after the beginning of the disinflation in 2013. The increased sensitivity to inflation developments supports the view that long-term inflation expectations have become de-anchored from the ECB Governing Council's aim. More worryingly from a policy perspective, this sensitivity has not disappeared with the introduction of the APP.

4. Insights from individual forecasters

In the previous Sections we have assessed the degree of anchoring of long-term expectations using aggregate data. However, the SPF allows exploiting the expectations of individual forecasters. The panel consists of 74 survey rounds from 2001:Q1 to 2019:Q2 for a total of 104 professional forecasters indexed by their numerical ID. Figure A5 in the appendix shows the participation by each forecaster to the SPF since its introduction. Additional information on individual forecasters, such as their nationality and the sector of activity, is not publicly available. For an overview of the survey and details on the composition of the panel, see Garcia (2003).

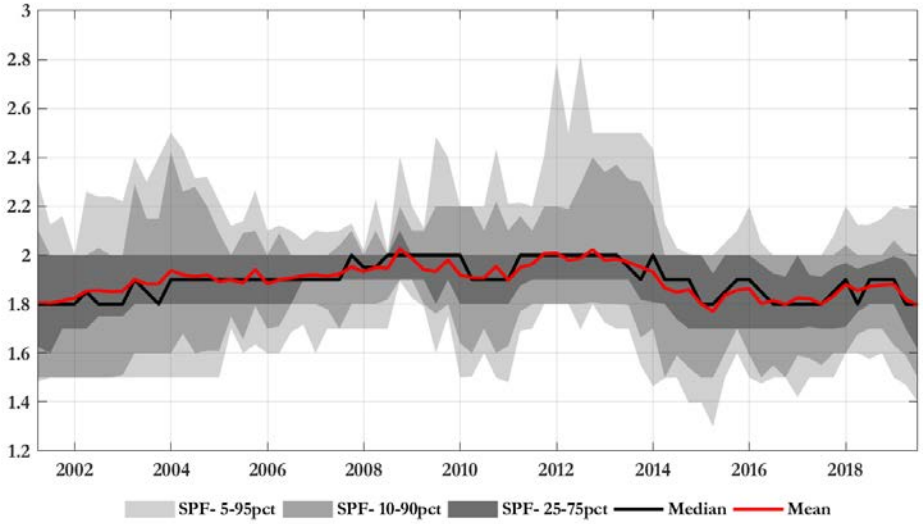
The ECB has carried out three ad-hoc surveys to understand how forecasters produce their forecasts, which models they use, and the role of judgement. These surveys were conducted in 2008, 2013 and 2018. Importantly for our analysis, a special question was introduced in 2013 and replicated in 2018 to find out which variables forecasters take into account when forming their long-term inflation expectations. Forecasters rely mainly on the ECB's inflation objective, on trends in actual inflation and wages, and on market-based inflation expectations (ECB, 2019 and Lane, 2019). Interestingly, the role of judgment in forming long-term inflation expectations has increased after the global financial crisis (ECB, 2019).

Figure 5 shows the time series of the percentiles of the distribution for each survey round constructed using the individual replies.

The chart highlights a clear downward shift in the distribution after 2013. Since then, the distribution has remained skewed to the left. This asymmetry is responsible for the difference between the mean point and the mean of the aggregate distribution in Figure 1.

The cross-sectional dimension of the survey allows for a richer analysis along two dimensions. First, we explore the heterogeneity of individual expectations according to two criteria: (*i*) the overall participation by the respondents since the beginning of the survey (section 4.1); (*ii*) the accuracy in predicting inflation in the short-term (section 4.2). We then test for breaks in the level of long-term expectations by group of forecasters as in Section 3.1 and replicate the analysis in Łyziaka and Paloviita (2017) for the various groups. Second, we use the distribution of long-term inflation expectations to validate the results obtained using the aggregate expectations by estimating a panel model (section 4.3).

Figure 5. *Long-term inflation expectations: mean, median and percentiles*
(*per cent*)



Note: authors' calculation on SPF data. The grey shaded areas represent the range of individual mean forecasts.

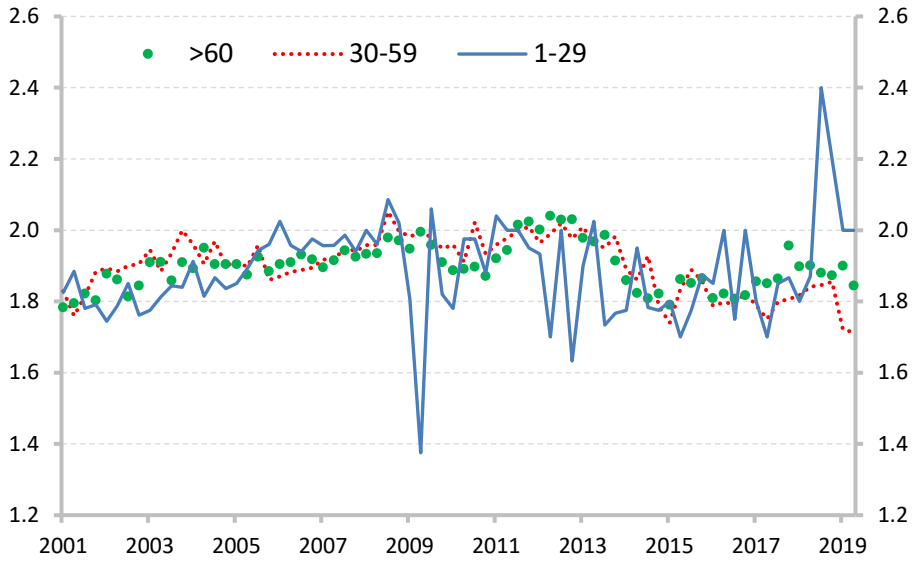
4.1 Grouping forecasters by participation

A relevant share of participants – roughly around 50 per cent of the respondents providing long-term inflation expectations in each round – has replied to at least 60 out of the 74 total rounds since 2001:Q1 (Figure A6 in the appendix). We consider these participants as the most "active" forecasters that have consistently contributed to the SPF from its beginning, which stands for a strong commitment to the survey. These participants are likely to have followed the ECB monetary policy closely over time; in this sense they may be considered as the most "experienced". For these reasons, this group of active forecasters represents a valuable sample to evaluate the degree of anchoring of long-term inflation expectations. A second group of forecasters has participated to the SPF on average to between 30 and 59 rounds (i.e. between 40 and 80 per cent of all the rounds). Finally, a small group of forecasters has participated in less than 30 rounds (about 10 per cent of surveys), on average. Forecasters in this group are referred to as the "less active".

The grouping of forecasters according to the participation in the SPF can offer some additional insights on the properties of the aggregate distribution. After forming the groups, we average the responses of the individuals forecasters. The pattern of long-term inflation expectations of the three groups differs substantially over time (Figure 6). The mean expectation of the less-active forecasters is more volatile, fluctuating between a minimum of 1.4 per cent (2009:Q2) to a maximum of 2.4 (2018:Q3). The expectations of the two more active groups of forecasters behave more similarly and have been more stable over time, hovering between 1.7 and just above 2.0.

Figure 6. *Long-term inflation expectations by participation to the SPF*

(*per cent*)

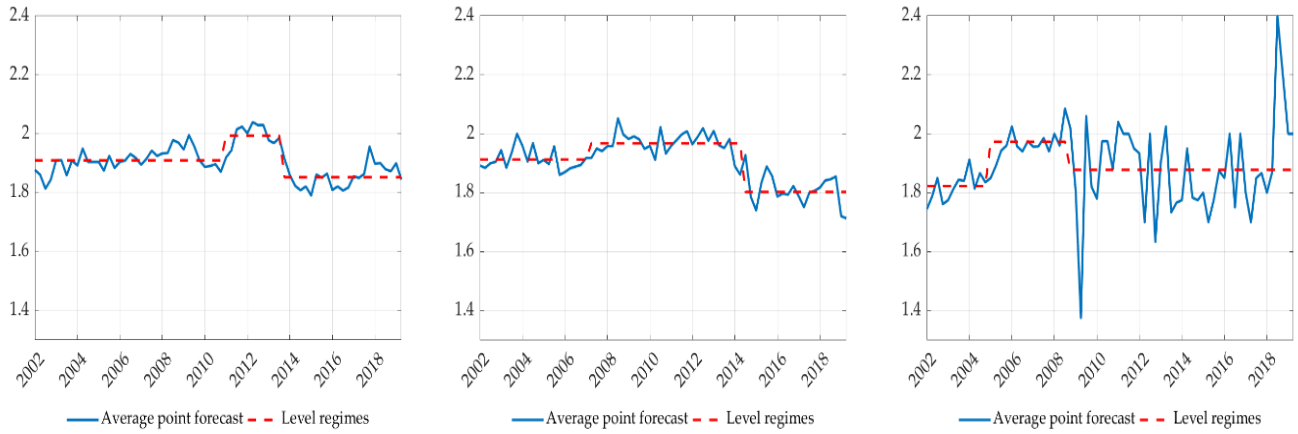


Source: authors' calculation on SPF data.

The striking evidence from Figure 6 is that the mean of the long-term expectations of the more active forecasters fell considerably after 2013 and has consistently remained below the levels that prevailed before the sovereign debt crisis. The sequence of negative inflation surprises during the deflationary phase in 2013 and 2014 period had some long-lasting impact on the expectations of the active forecasters (>60 and between 30 and 59 rounds). These developments can also be seen in Figure 7, which shows the results for the test for regime changes in the level of long-term expectations for the three different groups: panels a) and b) highlight a clear fall in the mean expectation after 2013 for the most and medium active forecasters.

Figure 7. *Testing for level-shifts: grouping of forecasters by participation*

a) Most active forecasters b) (Medium) active forecasters c) Less active forecasters



Source: authors' calculation on SPF data.

In order to test for possible heterogeneity of the sensitivities to negative inflation surprises among the three groups, we carried out the Bai and Perron (2003) test for each group.[9] Table 4 reports the results.

Table 4. *Sensitivity of long-term expectations to negative inflation surprises across groups of forecasters*

	1-29 rounds		30-59 rounds		> 60 rounds	
	coefficient	*p*-value	coefficient	*p*-value	coefficient	*p*-value
β_1	0.127	0.4569	0.053	0.1615	0.0195	0.5395
β_2 : from 2013:Q3	-	-	-	-	0.1678	0.0002

Note: the regime break for each coefficient is estimated using the sequential procedure of Bai and Perron (2003). The *p*-values are calculated using the Heteroskedasticity and Autocorrelation Consistent standard errors.

While a downward shift in the average level of inflation expectations occurred for the three groups, a regime break in the sensitivity to negative surprise is detected only for the most active group. This result raises serious concerns regarding the anchoring of long-term inflation expectations. The more active forecasters are likely to have a significant stake in the ECB monetary policy, investing time and resources in understanding the rationale for the policy decisions and assessing their adequacy and effectiveness. To the extent that processing all the relevant information is costly, the more a respondent contributes to the SPF, the more valuable is her long-term inflation expectation for assessing the degree of anchoring to the ECB Governing Council's inflation aim.

4.2 Grouping forecasters by their forecast accuracy

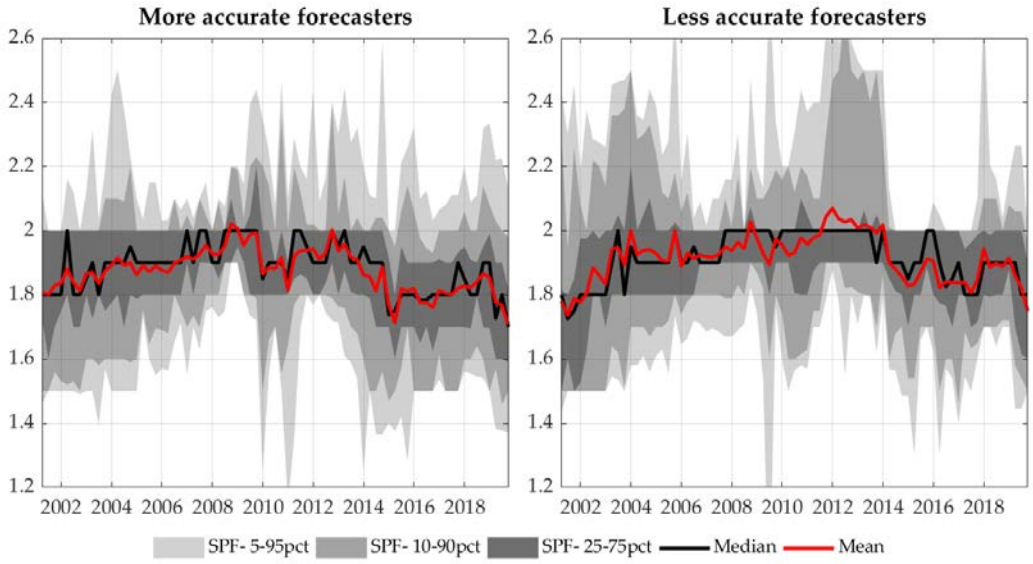
Another possibility to exploit the disaggregated data on the long-term expectations is to group SPF participants according to their forecast accuracy, as in Nechio (2015). To do so, we split the sample into two subgroups. We evaluate the performance of each SPF participant looking at the their forecasts for the next calendar year. We compute the root mean square error (RMSE) for each forecaster over the whole sample. We define as "more accurate" the forecasters with a RMSE below the average and as "less accurate" those with a RMSE above the average.

Figure 8 shows the distribution of long-term expected inflation for the more accurate group (left panel) and for the less accurate group (right panel). The average long-term expected inflation of the latter group is slightly higher than the average of the more accurate forecasters, with a statistically significant difference of 5 basis point. Moreover, the distribution of the less accurate forecasters is more dispersed than the distribution of the more accurate forecasters.

[9] The sensitivity to positive surprises is not statistically significant for none of the groups.

Figure 8: *Long-term inflation expectations by forecast accuracy*

(*per cent*)



Source: authors' calculation on SPF data. The shaded areas represent the range of mean forecasts.

Interestingly, the level-shift analysis applied to the expectations of the two groups identifies two breaks. Figure A7 in the appendix shows that the second half of 2013 was a turning point in long-term inflation expectations, even when controlling for the forecast accuracy of the participants.

Regarding the sensitivity to the inflation surprises, the mean long-term expected inflation of both groups is sensitive to the negative surprises; while in the case of the most accurate forecasters this sensitivity holds for the whole sample, in the case of the less accurate forecasters the sensitivity arises only for the period after 2013:Q4. Importantly, and in line with the results obtained with the grouping by participation, the long-term expectations of both the more and the less accurate groups are not sensitive to the positive inflation surprises.

4.3 Sensitivity of long-term expectations to short-term ones

In this section we consider the sensitivity of long-term inflation expectations to movements in short-term expectations as the indicator of de-anchoring. We follow Łyziaka and Paloviita (2017) and carry out rolling regressions of the long-term expectations on the short-term ones. We conduct this estimation for the three groups of forecasters based on the participation to the survey and for the two groups identified by their forecast accuracy.

To this end we estimate the equation:

$$\pi_{i,t}^{L} = \alpha_i + \beta_i \pi_{i,t}^{S} + \varepsilon_{i,t} \qquad (3)$$

using the levels of long-term and short-term (next calendar year) inflation expectations over a 24-quarters (six years) rolling window. Subscript *i* denotes the group of forecasters.

If long-term expectations were perfectly anchored to the Governing Council's inflation aim, then movements in short-term expectations should not affect the long-term ones. In the opposite

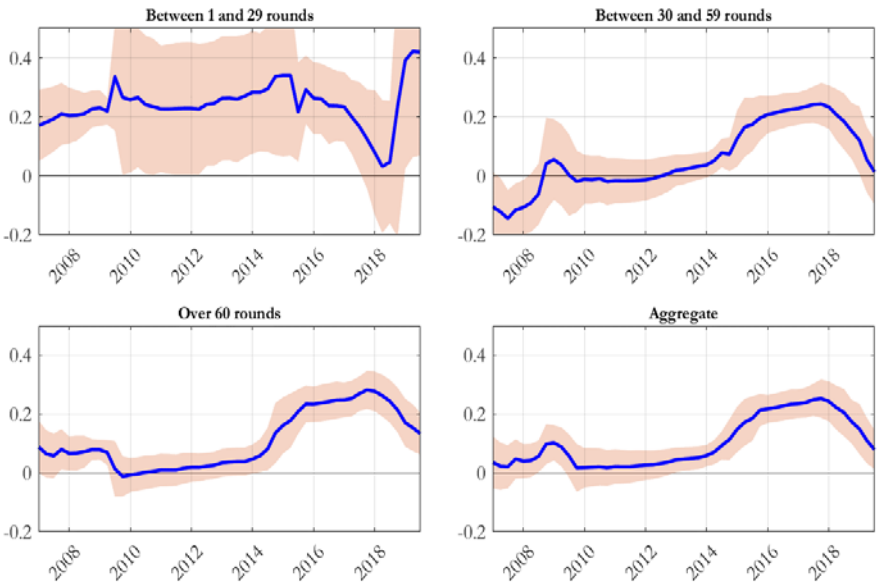
case, long-term expectations would be de-anchored. Figures 9 and 10 show the rolling coefficients together with the confidence intervals for the two methods for grouping the forecasters.

The rolling coefficients for the aggregate expectations (bottom right panel in Figure 9) suggest that after 2013, when the largest negative inflation surprises were recorded, long-term expectations have become de-anchored. They have remained de-anchored until the end of the sample, although the coefficient has become smaller but still statistically significant towards the end of the estimation period. The launch of the APP and, more importantly, its recalibration in March 2016 may have contributed to reducing, although not eliminating, the sensitivity of long-term expectations to short-term ones.

Turning to the grouping by participation, Figure 9 shows that aggregate developments are driven primarily by the more active forecasters, which are also the most sensitive to inflation surprises (Table 4). The less active group seems to have been always de-anchored. In the case of the middle group, the estimated coefficient, after increasing during the disinflationary phase, declined and became not statistically significant towards the end of the sample.

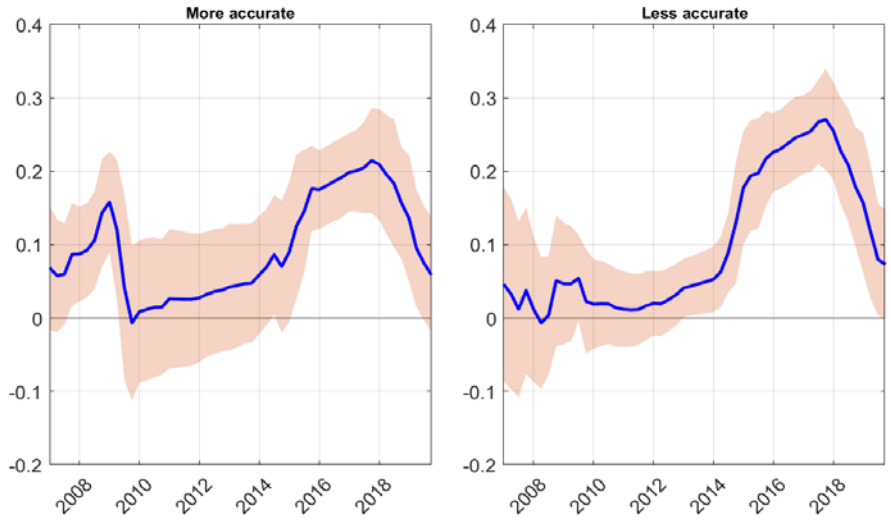
Regarding the results obtained by grouping SPF participants according to their forecast accuracy, the two groups behave very similarly, as shown in Figure 10. The sensitivity to short-term inflation expectations becomes statistically significant after 2014 for both groups. In almost all the cases, the coefficient measuring the sensitivity to short-term inflation expectations reached a peak in the period between 2013 and 2018.

Figure 9. *Sensitivity of long-term inflation expectations to short-term ones: forecasters grouped by participation*



Source: authors' calculation on SPF data.

Figure 10. *Sensitivity of long-term inflation expectations to short-term ones: forecasters grouped by forecast accuracy*



Source: authors' calculation on SPF data.

The results obtained by grouping SPF participants can be summarised as follows. First, the two criteria used to categorize individual forecasters lead to groups of that are quite different: the forecast accuracy criterion does not lead to heterogeneity in the behaviour of aggregate long-term expected inflation between the two groups; on the contrary, the participation criterion identifies groups of forecasters whose long-term expectations show different degree of anchoring. A good forecasting performance is not a necessary condition for being capable of assessing the anchoring of long-term inflation expectations. This assessment requires an in-depth understanding of the ECB monetary policy, the motivations for the policy measures and the implications for price stability. In this regards, the forecast accuracy criterion is not informative and must be seen more as a robustness check.[10] Second, the results support the view that long-term inflation expectations have become de-anchored since 2013 and have not re-anchored yet, despite the very accommodative stance of the ECB monetary policy.

4.4 Panel estimation

Taking advantage of the availability of individual replies, we have estimated an unbalanced panel regression of the changes in each forecaster's reply between two consecutive rounds on the positive and negative cumulated surprises:

$$\Delta\pi^{e}_{t,i} = \beta^{+} z^{+}_{t} + \beta^{-} z^{-}_{t} + \varepsilon_{i,t}$$

where $\Delta\pi^{e}_{t,i}$ is the change in the expectation of individual forecasters *i* between two consecutive survey rounds. We focus on the cumulative surprises since these are the ones that have affected

[10] Looking at the intersection between the groups formed with the two criteria, only 14 of the 30 forecasters with at least 60 forecasting rounds are categorized as the more accurate forecasters. This result is not surprising given that forecasting inflation in the short-term and at five-years horizon (which is used to measure the degree of anchoring) are two very distinct exercises which require different tools, inputs, and judgment.

long-term expectations at the aggregate level. The equation is estimated with fixed effects. This estimation is an additional robustness check. Table 5 shows the results of the panel analysis.

Table 5. *Sensitivity of long-term expectations to inflation surprises: panel estimation*

	Coefficient	*SE*	*t-stat*	*p-value*
β^+	0.0134	0.0251	0.532	0.594
β^-	0.0817	0.0297	2.747	0.006
R^2	0.0450			
# obs. (# missing)	2525 (4754)			

Note: observations: 104 individual forecasters, 69 survey rounds (2002:Q2 - 2019:Q2). Estimation with fixed effects.

In line with the results presented and discussed in Section 3, the coefficient on the positive surprises is not statistically different from zero whereas the coefficient on the negative surprises is positive and highly significant. The coefficients on negative surprises are almost identical if the model is estimated using data for the survey rounds between the second quarter of 2012 and the second quarter of 2019 (Table A1 in the appendix). The results are very similar if we control for the lagged changes in spot oil prices. If we do not distinguish the surprises by their sign, the estimated coefficient is statistically different from zero.

5. Conclusions and policy implications

Concerns about the de-anchoring of long-term inflation expectations from the ECB Governing Council's inflation aim have resurfaced since the beginning of 2019, as market-based indicators have reached new historical lows.

Our econometric analyses based on the ECB's Survey of Professional Forecasters show that long-term expectations have become de-anchored after the beginning of the disinflationary phase in early 2013. Long-term inflation expectations have become sensitive to negative surprises to inflation and also to short-term expectations. Such sensitivities have not disappeared with the introduction of the Asset Purchase Programme in January 2015 and its subsequent recalibrations.

The need to re-anchor expectations to the Governing Council's aim should be a priority. Re-anchoring expectations is essential for preserving the credibility of the ECB, which is a necessary condition for ensuring and ensuring the effectiveness of the accommodative stance of monetary policy. Moreover, clarifying the quantitative definition of the Governing Council's definition of price stability and stressing its symmetry (Draghi, 2019) may also contribute to re-anchoring long-term inflation expectations.

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Appendix

Description of the data

Inflation: Year-on-year changes in the Harmonized Index of Consumer Prices, flash release, Eurostat.

Inflation forecast: analysts' expectation of the Eurostat flash release, Bloomberg.

Inflation surprises: inflation forecast of the flash estimate minus the flash estimate.

Oil prices: crude oil spot price, historical close, ECB Statistical Data Warehouse.

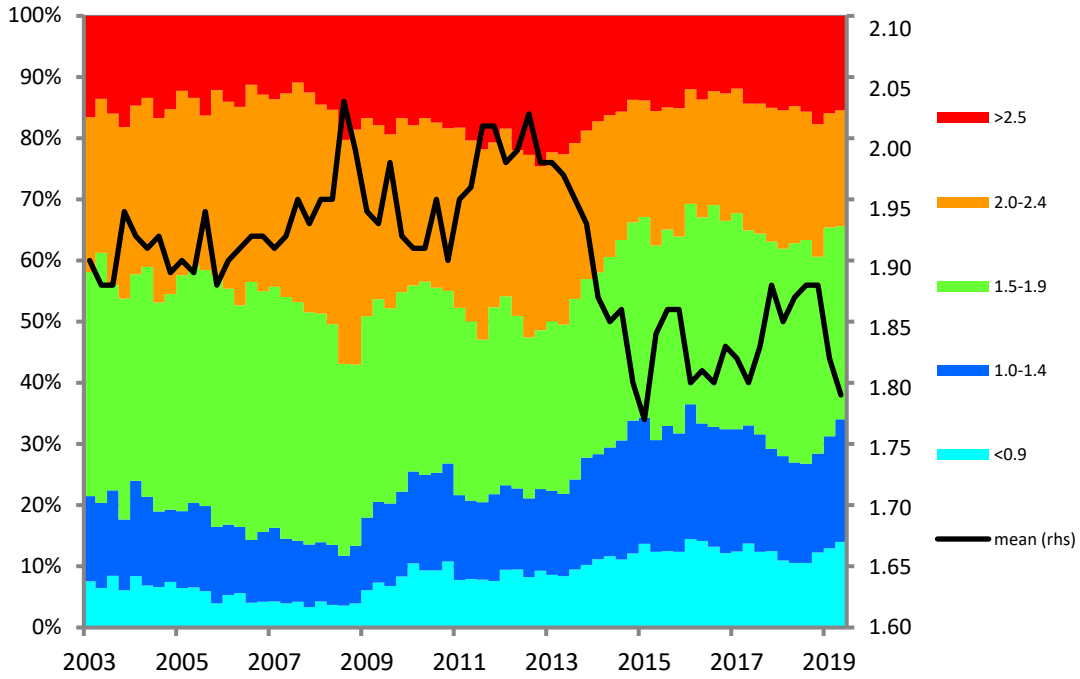
Long-term inflation expectations: five-year ahead forecast of HICP inflation. More precisely, four calendar years ahead in the Q1 and Q2 rounds and five calendar years ahead in the Q3 and Q4 rounds. For example, in the surveys of the first two quarters of 2018, the long-term forecast refers to 2022, while in the last two it refers to 2023. Three measures of long-term expectations are used: the mean of the SPF participants' point forecast; the median of the SPF participants' point forecast; the mean of the aggregate probability distribution is constructed using SPF participants' individual probability distribution. See the description of the data at the ECB Statistics webpage: https://www.ecb.europa.eu/stats/prices/indic/forecast/shared/files/SPF_dataset_description.pdf

Individual data for the long-term forecasts can be found at the following address: https://www.ecb.europa.eu/stats/prices/indic/forecast/shared/files/SPF_individual_forecasts.zip

Short-term expectations: forecasts of HICP inflation for the next calendar year.

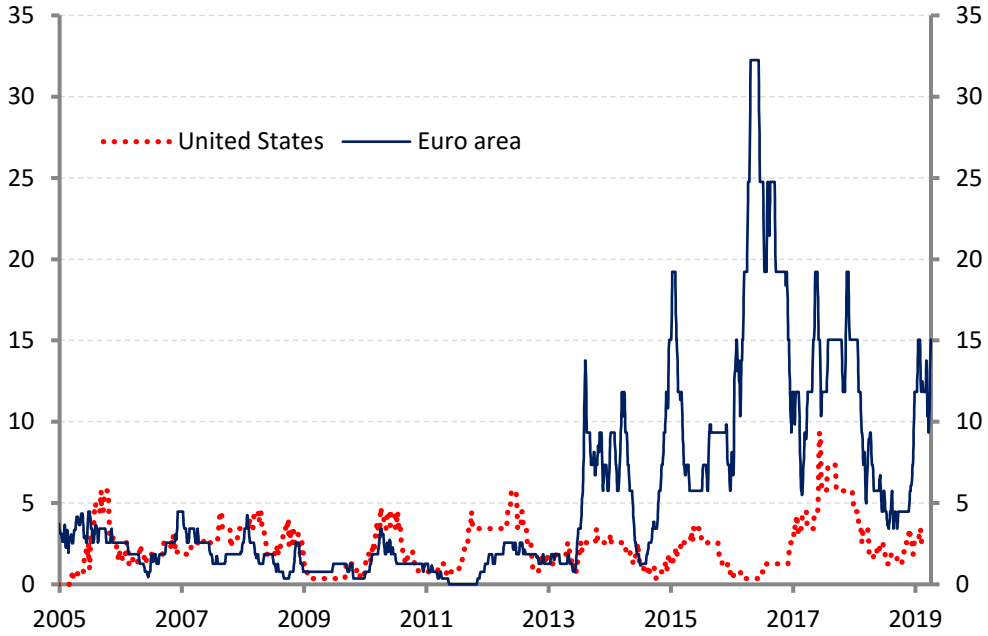
Figures and tables

Figure A1. *Distribution of long-term inflation expectations*



Note: probability distribution of five-year ahead inflation expectations.
Source: authors' calculations on SPF data.

Figure A2. *Indicator of downside de-anchoring of long-term expectations*

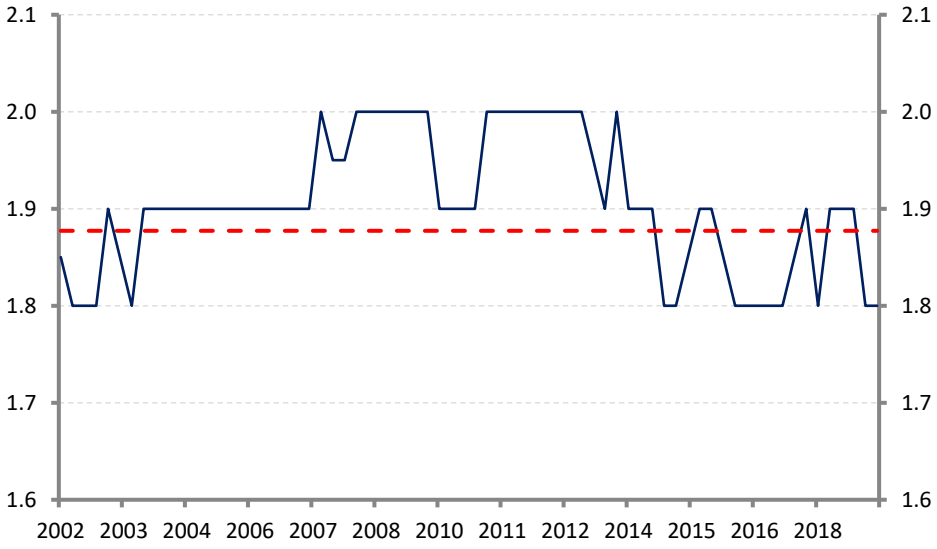


Note: the indicator is based on the probability of co-movement of long-term and short-term (ILS-based) inflation expectations. An increase indicates a closer link between sharp decreases in short-term and in long-term expectations. Low values indicate a low risk of downside de-anchoring of inflation expectations.
Source: Natoli and Sigalotti (2017) "*An indicator of inflation expectations anchoring*", Banca d'Italia, Working Paper, no. 1103.

Figure A3. *Testing the level shifts of long-term inflation expectations in the SPF*

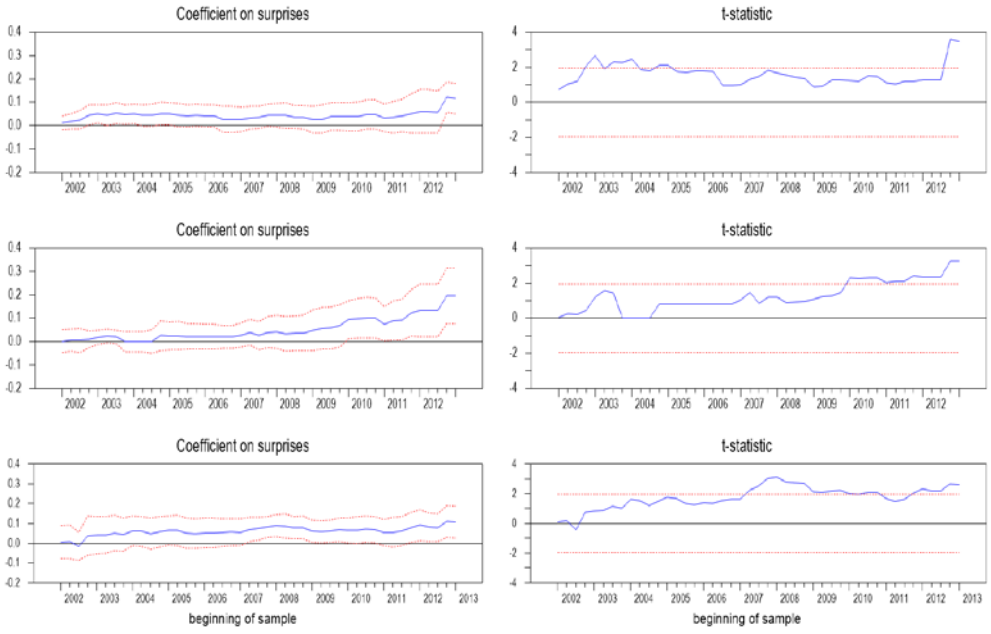
Median point expectations

(*per cent*)



Note: authors' calculations on SPF data.

Figure A4. *Sensitivity to inflation surprises: recursive estimates*



Note: first row: mean point expectations; second row: median point expectation; third row: mean of the aggregate probability distribution. The charts in the left column report the estimated coefficients; the charts in the right column the associated *t*-statistic for the null hypothesis of a zero coefficient. Each value corresponds to the regression estimated over a 24 quarters moving sample beginning in the period indicated in the horizontal axis.

Figure A5. *Participation to the SPF*

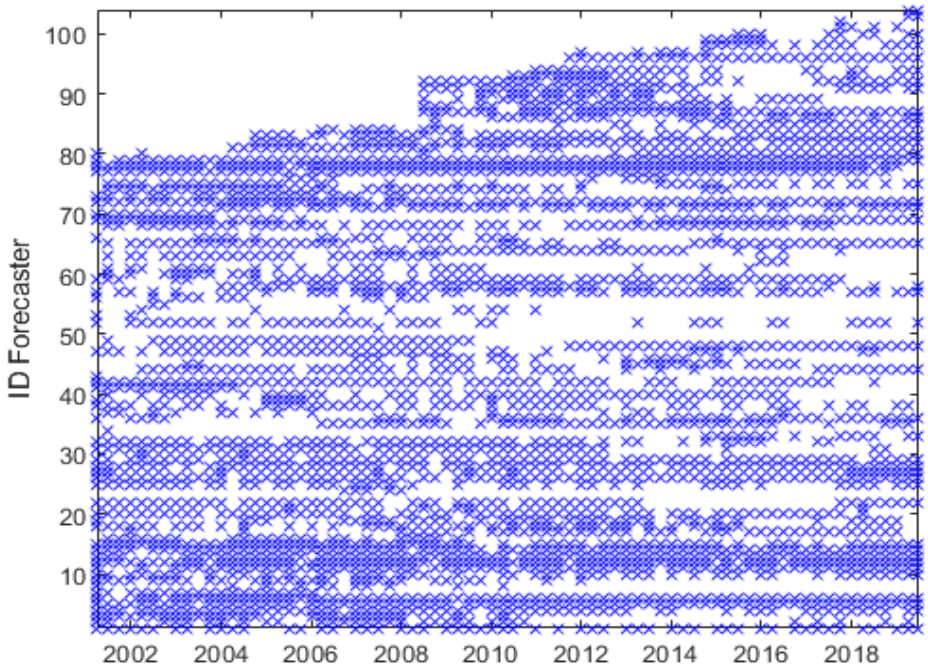
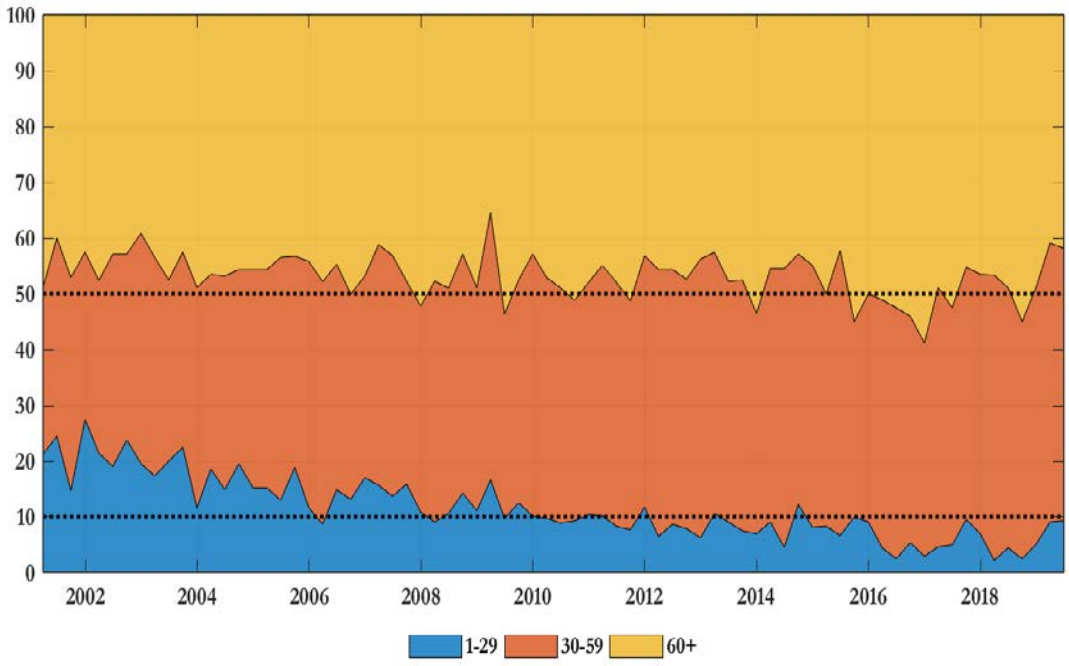


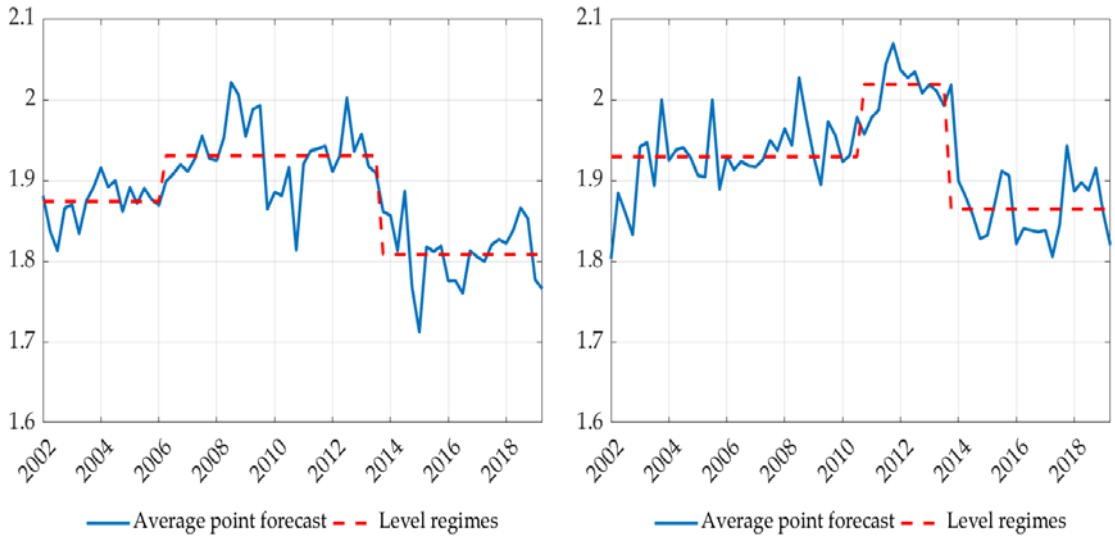
Figure A6. *Share of respondents by overall participation*
(*per cent*)



Note: authors' calculations on SPF data.

Figure A7. *Testing for level-shifts : grouping by forecast accuracy*

a) More accurate forecasters b) Less accurate forecasters



Source: authors' calculation on SPF data.

Table A1. *Sensitivity of long-term expectations to inflation surprises: panel estimates: 2012:Q2 – 2019:Q2*

(*mean point expectations*)

fixed effects	*coefficient*	*SE*	*t-stat*	*p-value*
β^+	0.0139	0.0253	0.549	0.583
β^-	0.0788	0.0299	2.628	0.008
R^2	0.0446			
# observations (missing)	2507 (4732)			

Source: calculations on ECB's SPF data. Number of observations: 104 individual forecasters, 29 survey rounds.