When did inflation expectations in the euro area de-anchor?

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Abstract

Long-term inflation expectations in the euro area remained well anchored during the global financial crisis and were therefore insensitive to the arrival of economic news. This article investigates the behaviour of expectations in the euro area during the most recent period and finds evidence that the de-anchoring of expectations started in December 2011 and never reversed. This is in line with the more aggressive stance held by the ECB in the following months as well as with the pattern of ECB Professional Forecasters’ expectations.

Keywords: Inflation expectations, ECB, Euro area, De-anchoring.

JEL Classification: E31, E52, E58, C22
1. Introduction

The role of expectations in macroeconomics can hardly be overestimated. A rich literature has looked at the effects of alternative monetary regimes (in particular, inflation targeting) and of central bank communication on inflation expectations.\(^1\)

An important feature of inflation expectations is whether they are “well anchored” and do not stray too far from the inflation objective pursued by the authorities. Several authors assessed whether inflation expectations remained anchored in the US and in other monetary areas during the sub-prime financial crisis in 2007/2008 (see Galati et al., 2011; Autrup and Grothe, 2014; Nautz and Strohsal, 2015, among others). While most works concurred that expectations were more firmly anchored in the euro area (EA, hereafter) than in the US before and during the crisis (see, for instance, Beechey et al., 2011; Galati et al., 2011; Autrup and Grothe, 2014; Strohsal and Winkelmann, 2015; Scharnagl and Stapf, 2015), less is known about what happened in the EA in the recent period.\(^2\) This is surprising given that, as shown by Ehrmann (2015), inflation expectations tend to be less well anchored in environments characterized by persistently low inflation, which is the case for the EA in the last few years.

Although long-term inflation expectations in the EA have been recently investigated by Moessner (2014) and Scharnagl and Stapf (2015), these studies refer to samples that end, respectively, on December 2012 and on September 2013. By covering the period up to mid-2015, this work assesses whether inflation expectations have eventually de-anchored as they did in the US and in other countries. More precisely, as done by (Galati et al., 2011; Autrup and Grothe, 2014; Moessner, 2014; Pooter et al., 2014; Nautz and Strohsal, 2015), this work adopts a news-regression approach to assess the sensitivity (or lack thereof) of expectations to the release of unexpected macroeconomic news.\(^3\)

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\(^1\)See Gurkaynak et al. (2010); Capistran and Ramos-Francia (2010); Ehrmann (2015) among the former strand of the literature and Cecchetti and Hakkio (2010); Ehrmann et al. (2012) among the latter.


\(^3\)Alternative approaches to gauge the anchoring of inflation expectations focus on the volatility
To preview our results, we find that long-term inflation expectations in the EA started de-anchoring in December 2011. This is in line with the fact that inflation started falling in 2012 and in accordance with the introduction of extraordinary measures by the ECB in the following quarters. The entrenchment of a low-inflation environment alters the normal functioning of the economy and jeopardizes the ability of the central to reach its inflation objective in the medium term because expectations affect real interest rates when nominal rates are close to zero. Our results are also in line with the observed pattern of the long-term inflation expectations of the Professional Forecasters interviewed by the ECB in its quarterly survey: it is between 2011 and 2012 that Professional Forecasters started envisaging a declining trend for inflation in the future.\footnote{Our results are in line with other studies addressing similar research questions through different approaches. An unpublished work by Pagenhardt et al. (2015) finds that expectations in the EA became less well anchored since September 2011. Buono and Formai (2016) show that short-term inflation expectations by the Professional Forecasters interviewed by Consensus Economics started falling in 2012. Miccoli and Neri (2015) find that medium-term market-based inflation expectations are affected by inflation surprises.}

Section 2 presents the news regression methodology and the data. Section 3 contains the main empirical results. The paper ends with brief closing remarks.

2. Methodology and data

Inflation expectations are unobservable and must be calculated using either survey-based or market-based data.\footnote{Market-based measures are available at higher frequency and over a wider range of horizons than survey-based measures. Moreover, the accuracy of survey-based expectations, already questioned by Capistran and Timmermann (2009), has worsened in the most recent period Trehan (2015). For these reasons, we follow the literature and employ market-based measures. As market-based measures of inflation expectations suffer the confounding effects of time-varying liquidity premia (see Hordahl and Tristani, 2012), we address this issue by controlling for them before assessing the empirical specification of interest. For an overview of survey- and market-based measures, we refer to Grothe and Meyler (2015).} Break-even inflation rates can be calculated using the differentials between the yields of nominal and inflation-indexed securities with the same maturity. More precisely, spot break-even rates refer to the securities whose transaction and exchange occur on the spot. As these rates average all the inflation and persistence of expectations (Davis and Presno, 2014), on the disagreement among forecasters (Ehrmann, 2015), on the dispersion of inflation forecasts (Capistran and Ramos-Francia, 2010; Cecchetti and Hakko, 2010), or on the sensitivity of long-term expectations to short-term expectations (Buono and Formai, 2016).
rates expected over the years up to the maturity of the underlying bonds, rates are then affected by the fluctuations in expected inflation over all years after the transaction of the securities. Forward break-even rates of inflation, which can be derived from inflation swap rates, appear more suitable measures of long-term inflation expectations because they are less influenced by the volatility over the nearest horizons. Accordingly, in line with the literature, we employ the 5-year forward rate 5 years ahead, on the basis of the current value of the yield of a 5-year security starting in 5 years and maturing in 10 years. This proxy for long-term inflation expectations, closely monitored also by the ECB, is calculated as follows:

\[
 f_{5,10}^{t} = \left( \frac{(1 + y_{10, t})^{10}}{(1 + y_{5, t})^{5}} \right)^{\frac{1}{5}} - 1
\]

where \( y_{10, t} \) and \( y_{5, t} \) are respectively the five-year and the ten-year spot rates.

We estimate a specification (introduced later as equation 3) whereby the daily difference in the adjusted 5-year forward inflation swap rates 5 years ahead is explained in terms of unanticipated macroeconomic information (i.e., surprises). We consider several variables to identify economic surprises that might have affected inflation expectations, had these latter become sensitive to news. For the EA, we include consumer price inflation (HCPI, %YoY), GDP growth (%QoQ), industrial production growth (%YoY). Besides the data for the EA as a whole, we consider news for the three major economies in the EA, namely Germany, France and Italy: we employ data on industrial production growth (%YoY) for each country, as well as factory orders growth (%MoM) for Germany. Finally, we consider news about industrial production in the US to proxy for news on external demand. In days with no announcement, news variables are evaluated at zero.

As maintained, when long-term inflation expectations are firmly anchored, the relationship between the expectations and the explanatory news-related variables should not be statistically significant. In such a case, the regression of expectations on the covariates would lead to news-related coefficients that are not different from

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\(^6\)Forecasts, actual values, dates and hour of the announcements were obtained by Thomson Reuters and by Investing.com.
zero. When the response of expectations to economic news changes over time, then a de-anchoring process is likely to have taken place. De-anchoring is thus associated with a structural break in the estimated relationship and an increase in the explanatory power of the news variables.

We estimate the model in two steps. As the implied forward inflation rates may be affected by changes in market liquidity, the news-regression approach is preceded by a preliminary step in which we control for confounding effects associated with liquidity premia and other factors. As done in the literature, we include the Chicago Board Options Exchange Volatility Index (VIX) to control for liquidity premia and other technical factors. Moreover, given the peculiar conditions of the European bond markets since the beginning of the sovereign debt crisis, we include also the Italy-Germany 10 Year Bond spread (IGS) so as to capture the climate of high uncertainty in the period.

The regression we estimate is

\[ f_{t}^{5.10} = \alpha_0 + \varphi_1 VIX_t + \varphi_2 IGS_t + \mu_t \]  

(2)

where \( f_{t}^{5.10} \) is the five-year forward inflation swap rates five years ahead, \( VIX \) and \( IGS_t \) have been defined above and \( \mu_t \) is the error term.

In the second step, we estimate the following news-regression in first differences:

\[ \Delta f_{t}^{5.10} = \alpha_1 + \sum_{i=1}^{8} \beta_i x_{i,t} + \epsilon_t \]  

(3)

where \( \Delta f_{t}^{5.10} = f_{t}^{5.10} - f_{t-1}^{5.10} \) is the first difference in the five-year forward inflation swap rates five years ahead adjusted for the liquidity and credit premia (i.e., \( \tilde{\mu}_t \)). The data cover the range from July 22, 2008 (when Thomson Reuters Datastream started collecting inflation swap rates data for the EA) to September 29, 2015. Considering only business-days, the sample contains \( T = 1,874 \) observations. The term \( x_i \) is the i-th surprise series, out of the sample of the eight series mentioned above. Surprises are calculated as the differences between the actual values of the macroeconomic or

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7As noted by Beechey et al. (2011), fluctuations in implied volatility could cause a type I error, whereby a structural break in the regression is found that is not associated with changes in the anchoring of inflation expectations.
sentiment data released in the period \( t \) and the forecasts published by information providers before the release date \( t \) for each variable. Finally, \( \epsilon_t \) is an error term. All variables are standardized so as to make coefficients comparable.

3. Results

The de-anchoring/re-anchoring of inflation expectations is identified on the basis of structural breaks observed in the estimated relationship \( \Phi \). To assess whether the long-term inflation expectations in the EA stopped being well anchored, we need to test for the presence of a structural break in the series that we have previously purged from liquidity and credit premia. The estimates of equation \( \Theta \) are reported in Table 1. Endowed with \( \hat{\varphi}_1 \) and \( \hat{\varphi}_2 \), we then calculate \( \hat{f}_{5,10} \).

Had we known the date of the break in the relationship, we could have simply tested whether the coefficients of equation \( \Phi \) vary over the two sub-periods defined by the break date. Such a test could be either a Wald or an LR test: as they provide equivalent results in this sample, we shall employ only the Wald test. The fact is, however, that the break date is unknown: this creates an issue of nuisance parameters (when some coefficients are present only under the alternative hypothesis) that, in turn, affects the approach to conduct inference on the presence of a structural break. Following the literature, we consider two tests statistics for the presence of a structural break at an unknown date: the supremum test statistics and the exponential of the average of the sample tests (which is a more demanding but also more powerful test). Both these tests are based on the series of simple Wald test statistics computed for each date in the sample as if this was the known date of break.\(^8\) Given that the unknown break date is a nuisance parameter, the limiting distributions of the supremum and the exponential average test statistics are non-standard but can be calculated. The rejection of the null hypothesis of no structural break by these tests provides evidence in favour of a change in the degree of anchoring of expectations.

The supremum and the exponential average test statistics consider all the single

\(^8\) The sample is in fact restricted by 15% of the observations (7.5 on each side) to allow for a minimum number of observations both at the beginning and at the end of the sample.
Wald tests for each date over the sample. If these tests reject the null hypothesis, it is then natural to try and identify the period when the structural break has presumably occurred. Two approaches are applicable to this end. First, one can look at the break date associated with the supremum test statistics (i.e. the date associated with the highest value of the Wald test) and use this to identify the day in which the probability of a break is the highest. This date allows then to estimate the functional form both before and after the break date. This said, the break date identified by the supremum test statistics is be interpreted with a grain of salt: the statistics provides evidence about the presence of two long sub-periods in which the functional form has significantly different estimated parameters and the break date is inferred from it only as a by-product. A second approach can then be used to complement the first: a visual representation of a rolling Wald test for the presence of a structural break in which each and every day is treated as the known date of break. This allows to spot all the days in which simple Wald tests (assuming the break is known) provide evidence to reject the null hypothesis.\footnote{It is worth noting that in a rolling Wald test, one considers each day in the series as the known date of break and no adjustment is made for the problem of nuisance parameters. Hence, the p-value of the simple Wald test statistics for the date of break found using the supremum test statistics is different from the p-value of supremum test statistics: only this latter considers the problems associated with nuisance parameters.}

Table 2 reports the values of these tests and their p-values. Both reject the null hypothesis of no structural break and this provides evidence that inflation expectations changed their degree of anchoring in the period under scrutiny. The supremum test statistics suggests that a break has likely happened a couple of years after the beginning of the European sovereign debt crisis, precisely on December 5, 2011.\footnote{We controlled for the presence of additional structural breaks through the Bai and Perron (2003) algorithm for the detection of simultaneous estimation of multiple breakpoints. The test confirms the presence of a unique structural break in the series.}

Assuming such break is correct, we can explore the change in the size and significance of the coefficients for the surprise variables included in the regression. The estimates for the two sub-periods (i.e. pre and post December 5, 2011), reported in Table 3, show that the first period is characterized by well-anchored inflation expectations (as the surprise variables are not significant) whereas expectations seem
to de-anchor in the second period for the null hypothesis of jointly insignificant surprise variables can be rejected and also individual variables become statistically significant.

To visualize the results of simple Wald tests for structural break where the tested date is treated as if the break was known, we report Figure 1. On the vertical axis there is the p-value of the simple Wald test statistics for a break in the day on the horizontal axis. This figure shows that there is as large set of days between December 2011 and early 2012 that are associated with p-values of the Wald test lower that 5%. This corroborates the idea that expectations started de-anchoring in the period around December 2011. This rolling test confirms also what found by Galati et al. (2011); Autrup and Grothe (2014); Strohsal and Winkelmann (2015), namely that, contrary to what observed in the US and UK, there was no structural break in inflation expectations in the EA during the sub-prime crisis period.

As mentioned in the introduction, finding a structural break at the end of 2011 is in line with anecdotal evidence and with some important subsequent changes in the ECB monetary policy. The detection of a break using time series techniques cannot be performed in real time for many observations after the break date are necessary. The fact that the ECB took various extraordinary measures and initiated a more aggressive form of communication only in the second half of 2012 is consistent with expectations de-anchoring some months earlier. Indeed, narrative evidence suggests that this concern ranked high among those informing the ECB decisions. A surprise decision by the ECB was made on the November 7, 2013, when the Governing Council lowered the main refinancing rate from 0.5% to 0.25%, responding to signs of falling inflation rates. The introductory statement of the press conference reads as follows: “These decisions are in line with our forward guidance of July 2013, given the latest indications of further diminishing underlying price pressures in the EA over the medium term.” Since September 4, 2014, moreover, the traditional locution “firmly anchored inflation expectations” was expunged from the introductory statements to the press conference.
4. Closing remarks

This work addresses the evolution of long-term inflation expectations in the EA. The evidence suggests that, notwithstanding a relative firm anchoring of long-term expectations during the global financial crisis, the situation has changed in the more recent years. Since December 2011, inflation expectations have become more sensitive to unexpected macroeconomic news and this, in turn, reflects a lower degree of anchoring than in the past.

Our findings are consistent with the various pro-active decisions and announcements that the ECB started implementing in 2012. Were expectations firmly anchored, ECB communication would at most be conservative and its importance limited. In the presence of de-anchored expectations, instead, decisions, announcements, and forward guidance started playing an important role in the ECB strategy probably aimed to reduce the risk of low-inflation expectations becoming entrenched.

Acknowledgements

We would like to thank Luigi Bonatti, Giorgio Fodor and Alessandro Flamini for insightful comments. All errors remain ours.

References


**Tables and figures**

**Table 1: Inflation Swap Rates and Liquidity Conditions**

<table>
<thead>
<tr>
<th></th>
<th>Coefficients</th>
<th>Std. Dev.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>2.0230</td>
<td>0.0197</td>
<td>0.0000</td>
</tr>
<tr>
<td>VIX</td>
<td>0.0103</td>
<td>0.0006</td>
<td>0.0000</td>
</tr>
<tr>
<td>ISG</td>
<td>0.0001</td>
<td>5.534e-05</td>
<td>0.026</td>
</tr>
<tr>
<td>F-statistics</td>
<td>193.3</td>
<td></td>
<td>0.000</td>
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<tr>
<td>Adj-R²</td>
<td>0.1286</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively. F-statistics Degrees of Freedom: (2,1872)
Table 2: Tests for the presence of one structural break - unknown date.

<table>
<thead>
<tr>
<th>Type of test</th>
<th>Test statistics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supremum Wald test</td>
<td>26.774**</td>
<td>0.0311</td>
</tr>
<tr>
<td>Average Exponential Wald test</td>
<td>9.733**</td>
<td>0.0385</td>
</tr>
</tbody>
</table>

Note: ** represent significance at 5% level.


Variables: constant, GDP growth EA, industrial production growth EA, Inflation EA, Industrial production in ITA, GER, FRA, US, order GER.

Table 3: News regressions before and after the break, December 5, 2011

<table>
<thead>
<tr>
<th>News regression before break</th>
<th>News regression after break</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>p-value</td>
</tr>
<tr>
<td>constant</td>
<td>-0.000</td>
</tr>
<tr>
<td>GDP growth (EA)</td>
<td>0.0018</td>
</tr>
<tr>
<td>HICP growth (EA)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Industrial production annual growth (EA)</td>
<td>-0.0065</td>
</tr>
<tr>
<td>Industrial production annual growth (ITA)</td>
<td>-0.0051</td>
</tr>
<tr>
<td>Industrial production annual growth (FR)</td>
<td>-0.0099</td>
</tr>
<tr>
<td>Industrial production annual growth (GER)</td>
<td>0.0042</td>
</tr>
<tr>
<td>Industrial production annual growth (US)</td>
<td>-0.0032</td>
</tr>
<tr>
<td>Factory Orders growth (GER)</td>
<td>0.0042</td>
</tr>
<tr>
<td>F-statistics</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Dependent variable $\Delta y_t^{0.10}$

Note: ***, **, and * represent significance at the 1%, 5% and 10% levels.

F-statistics Degrees of Freedom: before (8,871), after (8,994).
Figure 1: Rolling Wald Tests for a structural break: p-value