How Anchored Are Inflation Expectations in EMU Countries?

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.
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Abstract
Anchored inflation expectations help stabilize inflation. Previous results indicate that monetary policy has been effective in breaking the link between actual and expected inflation at the euro area level. In this paper we examine whether this is also true at the national level. We define the ‘disconnect’ between inflation and inflation expectations and then proceed to examine the extent to which this disconnect exists for a number of euro area countries. Our findings suggest that country-specific inflation experiences still affect national inflation expectations, and certainly more by comparison to the aggregate euro area level. EMU has therefore not made this link disappear at the national level.

Keywords: Inflation expectations, monetary policy, EMU.

J.E.L. codes: E52, E58.

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1 Introduction

Since the formation of European Monetary Union and the advent of the Euro, there has been a significant convergence in prices and inflation rates across all member states. Faber and Stokman (2009) argue that price convergence has been an ongoing process for the last 50 years in the euro area, and it is not therefore uniquely the result of monetary union (also Rogers, 2007). However, even if price convergence is not exclusively the result of monetary union, there is evidence that the latter has contributed to it. And it has done so, either through active policy in the EMU area (Demertzis et al, 2000, Allington et al, 2005 and Beck et al, 2009), or through the achievement of greater homogenization in the underlying structures (for example Faber and Stokman, 2009, argue the increase in country openness). At the same time, we observe that euro area inflation, itself, has been both low as well as relatively stable. Similarly, euro area inflation expectations at the long horizon are anchored at a level just below the 2 percent upper bound and have not followed the circular movements in inflation. This has implied a good anchoring of expectations at the euro area level and, by implication, a monetary policy that is on the whole perceived to be credible by the public (Demertzis et al, 2009).

The question that we pose in this paper is to what extent we can say the same thing about national inflation expectations in the member countries. Are country inflation expectations equally anchored, in the sense of being stable, at a constant, and similar to the euro area level? And are they formed independently of the underlying national inflation process? Our motivation stems from the fact that while euro area inflation is managed by a well-defined euro area interest rate, national inflation may also be affected by national variables, such as wages, domestic competitiveness conditions, etc. (see for example Druant et al 2009 for the relevance of domestic institutional labour market conditions).

Our results indeed suggest that national inflation expectations behave differently than euro area inflation expectations. On average, expectations of national inflation appear less well anchored than expectations of euro area average inflation. Our findings indicate that there is no disconnect between national inflation expectations and country-level actual inflation, and that EMU has not made the relevance of country characteristics for national inflation expectations disappear. In the absence of a domestic interest rate, national inflation rates can therefore only be managed indirectly (through say wage policies) and are therefore more likely to affect the way expectations are formed. Expectations in turn, are more likely to feed back into the rate of inflation and reinforce the relationship between them. So while there appears to be a disconnect between the two variables at the aggregate level, this is not the case at the national level. We argue that this maybe a source of instability for euro area inflation and needs therefore to be monitored.

1 Beyond that, there is a literature on the potential difficulties with a single monetary policy (see Huchet, 2003) or indeed the potential trade-off between nominal and real convergence (Hein and Truger, 2005).
Our paper is organized as follows. Section 2 presents a number of stylized facts about the euro area. We describe actual and expected inflation in the euro area, as well as a number of specific countries: France, Germany, Italy, the Netherlands and Spain. In Section 3 we describe in detail the methodology that would capture a credible ‘disconnect’ between the two variables. We present the results of our analysis in Section 4. Section 5 concludes.

2 Stylized facts

We start by describing a series of stylized facts on the relationship between inflation and long-term inflation expectations for a number of euro area countries. We plot the series, as well as look at a number of descriptive statistics of the series individually and the relationship between inflation and long-run inflation expectations. We do this for five EMU countries that together account for a big percentage of the euro area economy: Germany, France, Spain, Italy and the Netherlands.

2.1 Inflation in EMU

Within the euro area inflation differs from country to country. Figure 1 presents the level of inflation in the EU-12 countries in the past twenty years. Although inflation levels have converged in the last two decades, inflation differentials between countries do remain.

Table 1 summarizes then a number of descriptive statistics for inflation pre- and during EMU, for a number of countries as well as the euro area. We observe that both the level as well as the standard deviation of inflation have declined with the start of EMU in almost all countries (Ireland and Luxembourg exempt). The ECB’s definition of price stability is an inflation rate of ‘close to, but below two percent’, the level at which it aims to stabilize average inflation. Only a handful of countries have managed to conform to this level (Austria, Finland, France and Germany), with the majority being above it. This has implied that average inflation in the euro area lies just above the definition of price stability. Nevertheless, as we will see in the next section, this has not affected long-term expectations for the euro area, which for the same period have stabilized just below 2 percent on average. Based on the literature on credibility (Bomfin and Rudebusch, 2000), we interpret this to mean that agents believe that inflation and the actual definition of price stability are in line with each other in the euro area, at a term beyond the policy horizon.
Figure 1: Inflation in the EU-12 countries.
Note: monthly data of the y-o-y % change of the CPI (CPI/HICP for euro area).

Table 1. Inflation in EMU countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Pre-EMU Mean</th>
<th>Pre-EMU St.Dev.</th>
<th>EMU Mean</th>
<th>EMU St.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2.6</td>
<td>1.0</td>
<td>1.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Belgium</td>
<td>2.3</td>
<td>0.9</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Finland</td>
<td>2.7</td>
<td>2.2</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>France</td>
<td>2.2</td>
<td>0.9</td>
<td>1.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Germany</td>
<td>2.8</td>
<td>1.5</td>
<td>1.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Greece</td>
<td>12.2</td>
<td>5.4</td>
<td>3.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Ireland</td>
<td>2.6</td>
<td>0.9</td>
<td>3.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Italy</td>
<td>4.6</td>
<td>1.6</td>
<td>2.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1.2</td>
<td>0.3</td>
<td>2.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2.3</td>
<td>0.7</td>
<td>2.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Portugal</td>
<td>7.0</td>
<td>4.0</td>
<td>2.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Spain</td>
<td>4.7</td>
<td>1.7</td>
<td>2.9</td>
<td>1.2</td>
</tr>
<tr>
<td>euro area</td>
<td>2.9</td>
<td>1.1</td>
<td>2.0</td>
<td>0.8</td>
</tr>
</tbody>
</table>

We cannot, however, say the same about individual countries. Naturally, the objective of price stability mentioned above, refers to the euro area only and so long as the average level of inflation is within the specified range, then the requirement of price stability is satisfied. However, euro area inflation is the aggregate of all country inflation rates by construction, and therefore, factors that affect the latter are important in terms of understanding the evolution of the former. We investigate next how the relationship between inflation and long-term inflation expectations may differ between the whole area and the countries themselves.

2.2 Inflation and inflation expectations

Table 2 below presents a summary of descriptive statistics for inflation and long-term inflation expectations, for the euro area and five countries, France, Germany, Italy, Spain and the Netherlands. These countries together account for 85% of the EU-12 GDP (source: Eurostat). Figure 2 plots the same series since 1989. We use country data for expectations ($\pi_t^e$) from Consensus Economic Forecasts, which refers to the long-run, 6-10 year horizon ($\pi_{5-10}^e$). In line with the frequency of expectations, we use semi-annual data for inflation, namely the year-on-year percentage change of the Consumer Price Index (CPI) in April and October. For the euro area, we use the ECB’s Survey of Professional Forecasts at the 5-year horizon, which is available at a quarterly frequency and the Harmonized Index of Consumer Prices (HICP). Two main observations characterize our data: first, the level of inflation has declined across the period; second inflation has become less volatile across our countries.

On average inflation has been the highest in Spain (3.7%), followed by Italy (3.3%). Inflation in Germany and the Netherlands was lower and closer to the ECB target. Only in France was inflation on average below 2%. In terms of extreme values, we observe a minimum of -0.7% and a maximum of 7.1% - both in Spain - from the start of the entire 20-year period. Inflation was relatively stable in the Netherlands and France and more volatile in Spain and Italy. Inflation has been the least persistent in the Netherlands (0.6) and the most persistent in Italy (0.9). In almost all countries in our sample, inflation expectations have come closer to the ECB’s target. In line with inflation, long-term inflation expectations in Germany, France and the Netherlands are also close to, although above, two percent. The greatest decline in inflation expectations observed occurred in

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2These inflation expectations are measured twice a year, in April and October, and run from April 1990 till the end of 2008. We present a summary of the these statistics for shorter horizon inflation expectations in Appendix A. These series show a strong and positive correlation with inflation expectations used in the baseline regressions.

3Note that semi-annual inflation based on the Harmonized Index of Consumer Prices (HICP) shows a similar trend as the semi-annual CPI inflation. We prefer to use the latter as there is the data is available for longer periods.

4Inflation persistence is measured by summing up the coefficients of the lags in a AR(2)-model with inflation at the left-hand side and two lags of inflation at the right-hand side of the equation (4 lags for EA because of quarterly data).
Italy. Italian inflation expectations have remained close to the target despite abrupt movements in inflation in the latter period. In Spain long-term inflation expectations declined, and stabilized at a constant that is about half a percentage point higher than the target of the ECB. Inflation expectations are the least persistent in Spain (0.5) and the most persistent in Germany, France and Italy (0.9). We also observe that the volatility of inflation expectations is almost zero for the whole euro area, but it is significantly higher in all countries in the sample (ranging from 0.26% for Spain to 0.95% for Italy).

Table 2. Actual inflation and long run inflation expectations

<table>
<thead>
<tr>
<th></th>
<th>EA</th>
<th>FR</th>
<th>DE</th>
<th>IT</th>
<th>NL</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.04</td>
<td>1.89</td>
<td>1.84</td>
<td>2.14</td>
<td>2.10</td>
<td>2.04</td>
</tr>
<tr>
<td>Median</td>
<td>2.11</td>
<td>1.90</td>
<td>1.88</td>
<td>1.90</td>
<td>1.90</td>
<td>1.90</td>
</tr>
<tr>
<td>Max</td>
<td>3.96</td>
<td>2.00</td>
<td>3.77</td>
<td>3.30</td>
<td>6.28</td>
<td>2.90</td>
</tr>
<tr>
<td>Min</td>
<td>-</td>
<td>1.80</td>
<td>-</td>
<td>1.50</td>
<td>0.00</td>
<td>1.50</td>
</tr>
<tr>
<td>St.Dev.</td>
<td>0.33</td>
<td>0.21</td>
<td>0.82</td>
<td>0.05</td>
<td>0.89</td>
<td>0.54</td>
</tr>
<tr>
<td>Persistence</td>
<td>0.09</td>
<td>0.80</td>
<td>0.67</td>
<td>0.89</td>
<td>0.81</td>
<td>0.94</td>
</tr>
<tr>
<td>Cor (πe, π)</td>
<td>-0.08</td>
<td>0.50*</td>
<td>0.65*</td>
<td>0.88*</td>
<td>0.33</td>
<td>0.66*</td>
</tr>
<tr>
<td>Start data</td>
<td>99Q1</td>
<td>90S1</td>
<td>90S1</td>
<td>90S1</td>
<td>90S1</td>
<td>95S1</td>
</tr>
</tbody>
</table>

Note: π = y-o-y, semi-annual (April and October) CPI inflation (for ECB CPI/HICP). Inflation data ranges from 1989S2-2009S2. πe = long-term (6-10 year ahead), Consensus Economics inflation expectations, semi-annual (April and October), except EA: 5-year ahead, from ECB Survey of Professional Forecasters, quarterly. * indicates significance at the 5% level, based on Fisher’s transformation test.

The correlation between inflation and inflation expectations is positive in all countries and significant in all but the Netherlands and the euro area. The correlation is the highest in Italy (0.9), and the lowest - and insignificant - in the Netherlands (0.3). This is a first signal that inflation expectations might be anchored differently across countries. Furthermore, the correlation between national inflation expectations and national inflation is higher than the correlation between expected euro area inflation and actual euro area inflation. This finding is and indication that the relationship between the two variables maybe different between the whole area and the countries themselves.

We examine the significance of the correlation coefficients between the variables in question by applying Fisher’s transformation:

\[
z = 0.5 \ln \left( \frac{1 + \rho}{1 - \rho} \right)
\]

This statistic is approximately normally distributed, with mean zero and standard deviation \( \sigma = (n - 3)^{-1/2} \), where \( n \) is the sample size. The hypothesis tested is \( H_0 : \ \rho = 0 \) against the alternative \( H_1 : \ \rho \neq 0 \). Bold indicates significantly different from zero at the 5% level.
Figure 2: Long-term inflation expectations compared to actual inflation. Source: ECB Survey of Professional Forecasters (euro area, $\pi^e_{t-10}$) and Consensus Economics (EMU-countries, $\pi^e_{t-10}$).

3 A credible ‘disconnect’

We present next the econometric set-up to investigate the nature of the relationship between the two variables. We argue that anchored expectations manifest themselves in a ‘disconnect’, in which inflation movements are the result of unexpected shocks that are iid in nature.

3.1 A conjecture

Demertzis et al (2008) argue that a credible monetary policy regime will be associated with a disconnect between inflation and inflation expectations dynamics. In what follows we summarize how this disconnect would manifest itself in the form of 5 hypotheses.
We model inflation, $\pi_t$, and inflation expectations, $\pi_e^t$, in the following VAR specification:

$$
\begin{pmatrix}
\pi_t \\
\pi_e^t
\end{pmatrix} = 
\begin{pmatrix}
c_1 \\
c_2
\end{pmatrix} + 
\begin{pmatrix}
a(L) & b(L) \\
c(L) & d(L)
\end{pmatrix}
\begin{pmatrix}
\pi_{t-1} \\
\pi_{e,t-1}
\end{pmatrix} + 
\begin{pmatrix}
e_{1t} \\
e_{2t}
\end{pmatrix},
$$

(1)

The intuition behind this framework is that the two variables are intrinsically related, such that when the level of credibility is low, inflation will not reach its target because expectations will drive it away, and expectations themselves will not be anchored at the level the Central Bank wishes. A credible disconnect between the two variables is then captured by the following five hypotheses.

**Conjecture 1** A credible inflation expectations disconnect would imply that the following hypotheses are satisfied:

- **H1**: Inflation expectations are not affected by lagged actual inflation, i.e., $c(L) = 0$.
- **H2**: Inflation expectations are anchored to a constant on average, i.e., $c(L) = 0$ and $d(L) = 0$.
- **H3**: Actual inflation is not affected by inflation expectations, i.e., $b(L) = 0$.
- **H4**: The persistence of actual inflation, the sum of the coefficients of $a(L)$, decreases with credibility.
- **H5**: There is no contemporaneous transmission of shocks from actual to expected inflation and vice versa, i.e., $\sigma_{12} = 0$.

Following this methodology we also use standard Wald tests to test the first three hypotheses. For hypotheses 1 and 3 we use Granger non-causality tests. We examine H2 by looking at the restrictions and the estimated inflation expectations persistence. It is difficult to verify the fourth hypothesis, because we need to be able to compare estimated inflation persistence in different credibility periods. While this is easier for the US, where there have been periods of both high as well as low credibility (Demertzis et al 2008), this is a lot more difficult to do for the euro area, where the data is for a shorter period. Moreover, judging from the fact that inflation has been both stable as well as mean-reverting in the last 10 years, it is not clear that the euro area has been switching between regimes of various levels of credibility. Despite this, we investigate differences between the period before and after the start of EMU. The last hypothesis is satisfied when the VAR errors are uncorrelated ($\text{cor}_{e_{1t}, e_{2t}} = 0$). These correlations are based on heteroskedasticity consistent versions of the VARs. We also look at impulse response functions (IRFs) of actual inflation to a shock in inflation expectations and vice versa. Meeting H1, H3 and H5 would require that all elements in these IRFs be zero.
4 The euro area versus euro area countries

4.1 Euro area

We present the results for the euro area in Table 3. The results show that no causality runs between the two variables (H1, H3) in either direction, nor is there any contemporaneous transmission of shocks (H5).

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Excluded</th>
<th>df</th>
<th>$\chi^2$</th>
<th>(Pr)</th>
<th>$\text{cor}_{e1,e2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro Area</td>
<td>$\pi$</td>
<td>$\pi^e$</td>
<td>1</td>
<td>1.52</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>$\pi^e$</td>
<td>$\pi$</td>
<td>1</td>
<td>0.00</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Notes: Inflation expectations 5-years ahead from ECB Survey of Professional Forecasters. Bold indicates significance at a 5% level. The lag length selection is based on the Schwarz information criterion (df).

We also observe that there is no dynamic transmission of shocks in either direction. Figure 3 shows this in the two graphs off the main diagonal, where the response of shocks from one variable to the other is never significant. By contrast there appears to be some persistence in the two variables (main diagonal, figure 3), which becomes insignificant after 4 periods (one year). In particular for inflation expectations, we observe also that the degree of persistence comes down rapidly. Hypothesis 2 is therefore only partially satisfied ($c(L) = 0$), while some persistence in expectations ($d(L) \neq 0$) remains in the short-term.

![Figure 3: Impulse response functions for euro area (EMU-period), with 95% confidence intervals.](image-url)
With this we conclude that there is a ‘disconnect’ between inflation and inflation expectation at the euro area level.\(^6\) The small and short-lived persistence observed may be due to the underlying shocks, but in any case is always economically very small. This is line with the perceived notion that monetary policy in the euro area has been effective in breaking the link between inflation and inflation expectations and therefore provides price stability.\(^7\)

Establishing a credible disconnect between the two variables allows us to take this analysis further, in terms of identifying both the degree to which expectations are anchored, as well as the level at which they are anchored. As we will not be able to do this exercise for every country in our sample, we present these results for the euro area in Appendix B. We discuss next the country results.

### 4.2 Euro area countries: EMU period

We do this in two steps. First we discuss the country results for the EMU period (1999-2009). We apply country data to a VAR specification (as in 1), and test hypotheses 1-5.\(^8\) We summarize the results in Table 4. Figures 4-8 in appendix C show the respective country impulse response functions.

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Excluded</th>
<th>df</th>
<th>(\chi^2)</th>
<th>(Pr)</th>
<th>(\text{cor}_{\pi_1,\pi_2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>3</td>
<td>14.24</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>3</td>
<td>11.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Germany</td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>1</td>
<td>3.35</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>1</td>
<td>2.43</td>
<td>0.12</td>
</tr>
<tr>
<td>Italy</td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>2</td>
<td>7.52</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>2</td>
<td>0.49</td>
<td>0.78</td>
</tr>
<tr>
<td>Netherlands</td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>1</td>
<td>1.39</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>1</td>
<td>0.35</td>
<td>0.55</td>
</tr>
<tr>
<td>Spain</td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>2</td>
<td>0.36</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>(\pi)</td>
<td>(\pi_{6-10})</td>
<td>2</td>
<td>0.66</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Notes: Bold indicates significance at 5% level. Lag length selection is based on Schwarz information criterion (including 4 lags, df).

The results indicate that for the case of Germany and the Netherlands, we fail to reject all three hypotheses. There are neither significant causal effects of actual inflation on long-term inflation expectations and vice versa, nor is there evidence of contemporaneous shock transmission. The respective IRFs

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\(^6\) These results are based on the use of the last month of the quarter HICP data. Outcomes are robust to the use of first month of the quarter HICP data.

\(^7\) See Becker (2009) and the whole volume of Economic Modelling dedicated to evaluating the first 10 years of EMU, and Gali (2003) with a discussion on the early years.

\(^8\) As Demertzis et al. (2008) note it would be better to use a single equation approach instead of a VAR framework if there is perfect collinearity between inflation and inflation expectations. In practice, however, correlations are at most 0.88 (see Table 2).
(figures 5 and 7) show a somewhat similar to the euro area picture, with the dynamic responses also being insignificant (although for the Netherlands the 1 to 2 period effect from expectations to inflation appears significant). In both countries, the level of persistence is again significant but short-lived and is higher for inflation than it is for expectations. So, again, hypothesis 2 is only partially rejected. By contrast, France, Italy and Spain show much more of a connection between inflation and inflation expectations. In the case of France there is causal transmission both ways (H1 and H3 rejected); in Italy there is a significant impact of inflation expectations on inflation (H3 rejected); and last in Spain, contemporaneous shocks are significantly correlated (H5 rejected). The IRFs (figures 4, 6 and 8 respectively for the three countries) show also a greater instability in the relationships estimated. We observe therefore, that there are differences in the way the two variables are related when we look at individual countries, by comparison to the euro area as a whole. Stemming from our original motivation, we therefore argue that although monetary policy at the euro area level has indeed managed to break the link between inflation and inflation expectations, this is not the case for all countries, or indeed most member countries in our sample. There are differences both in the ways inflation expectations are generated country by country, as well as in terms of the way they feed into inflation.

4.3 Anchoring of national inflation expectations: whole period

Last, we repeat the same exercise but this time for the whole period for which data is available. We do this as an alternative to repeating the exercise for the pre-EMU period alone, since the data available to us is by itself too short. Table 5 presents the outcomes based on the whole period. The IRFs are shown in Figures 9-13 in Appendix C.

Table 5: H1, H3 and H5 - Whole sample period

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Excluded</th>
<th>df</th>
<th>$\chi^2$</th>
<th>(Pr)</th>
<th>$\text{cor}_{e_1,e_2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>$\pi$, $\pi_{0-10}$</td>
<td>2</td>
<td>1.80</td>
<td>(0.41)</td>
<td>0.00</td>
</tr>
<tr>
<td>Germany</td>
<td>$\pi$, $\pi_{0-10}$</td>
<td>1</td>
<td>1.20</td>
<td>(0.27)</td>
<td>0.01</td>
</tr>
<tr>
<td>Italy</td>
<td>$\pi$, $\pi_{0-10}$</td>
<td>1</td>
<td>2.05</td>
<td>(0.36)</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>$\pi$, $\pi_{0-10}$</td>
<td>1</td>
<td>1.47</td>
<td>(0.23)</td>
<td>0.01</td>
</tr>
<tr>
<td>Spain</td>
<td>$\pi$, $\pi_{0-10}$</td>
<td>1</td>
<td>0.69</td>
<td>(0.41)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Notes: Bold indicates significance at the 5% level. Lag length selection is based on Schwarz information criterion (including 6 lags, df).
Comparing Tables 4 and 5 we see that there are no big differences in the results shown. One notable difference is the fact that inflation expectations were indeed affected by inflation changes in Germany, whereas in the period of EMU this effect has diminished. Most of the other results carry over, with the two periods being practically indistinguishable from each other. We conclude that the adoption of a single currency has not altered the link between inflation and inflation expectations at the country level.

5 Conclusions

Monetary policy theory has emphasized the importance of managing expectations in stabilizing inflation. The first ten years of monetary policy at the euro area are characterized by low and stable inflation, and well anchored expectations at the ECB’s inflation objective. To the extent that anchored expectations reflect faith, on the part of the public, that monetary policy can deliver price stability, the ECB has then earned credibility. In this paper we concentrate on the relationship between inflation and inflation expectations at the country level of euro area members. If the ECB has managed to break the relationship between inflation and inflation expectations at the aggregate level, and inflation in countries has decreased since the inception of the single currency, is it also the case that expectations at the country level are also stable and disconnected from local inflation?

Our results indicate that there is a much stronger relationship between inflation and long-term inflation expectations at the country level, by comparison to the euro area as a whole, which manifests itself differently for different countries. This implies that country conditions still contribute to country inflation expectations and through them also to inflation. While it is reasonable to say that long-term inflation expectations at the euro area level do not affect and are not affected by the level of inflation, this should not mask the fact that at the country level, this is not necessarily the case and certainly not to the same degree. We raise a flag of caution: unlike inflation, inflation expectations at the euro area level are not a simple average of the country magnitudes. Country dynamics in the relation between the two variables may be a source of instability and should therefore be monitored.
References


APPENDICES

A Inflation expectations: alternative horizons

Alternative inflation expectations series correlate strongly with the inflation expectations that we have used in our baseline analyses. Table A1 gives a summary of these alternative inflation expectations series with shorter horizons.

### Table A1. Alternative long run inflation expectations

<table>
<thead>
<tr>
<th>Country</th>
<th>( \pi_e^1 )</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>St.Dev.</th>
<th>Cor.(( \pi_e^2 ), ( \pi_e^1 ))</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>( \pi_e^2 )</td>
<td>1.81</td>
<td>1.80</td>
<td>2.1</td>
<td>1.5</td>
<td>0.12</td>
<td>0.34*</td>
<td>99Q1-09Q4</td>
</tr>
<tr>
<td>DE</td>
<td>( \pi_e^3 )</td>
<td>2.16</td>
<td>1.90</td>
<td>4.0</td>
<td>1.4</td>
<td>0.67</td>
<td>0.92*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^4 )</td>
<td>2.14</td>
<td>1.90</td>
<td>3.4</td>
<td>1.5</td>
<td>0.56</td>
<td>0.96*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^5 )</td>
<td>2.10</td>
<td>1.90</td>
<td>3.2</td>
<td>1.6</td>
<td>0.51</td>
<td>0.97*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^6 )</td>
<td>2.08</td>
<td>1.90</td>
<td>3.0</td>
<td>1.5</td>
<td>0.48</td>
<td>0.97*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td>FR</td>
<td>( \pi_e^2 )</td>
<td>2.10</td>
<td>1.80</td>
<td>3.4</td>
<td>1.4</td>
<td>0.61</td>
<td>0.95*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^3 )</td>
<td>2.14</td>
<td>1.90</td>
<td>3.4</td>
<td>1.4</td>
<td>0.58</td>
<td>0.96*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^4 )</td>
<td>2.15</td>
<td>1.90</td>
<td>3.4</td>
<td>1.6</td>
<td>0.54</td>
<td>0.98*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^5 )</td>
<td>2.13</td>
<td>1.90</td>
<td>3.3</td>
<td>1.5</td>
<td>0.54</td>
<td>0.99*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td>ES</td>
<td>( \pi_e^2 )</td>
<td>2.58</td>
<td>2.50</td>
<td>4.1</td>
<td>1.8</td>
<td>0.44</td>
<td>0.91*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^3 )</td>
<td>2.52</td>
<td>2.50</td>
<td>4.1</td>
<td>2.0</td>
<td>0.39</td>
<td>0.91*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^4 )</td>
<td>2.49</td>
<td>2.50</td>
<td>3.6</td>
<td>2.1</td>
<td>0.31</td>
<td>0.91*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^5 )</td>
<td>2.48</td>
<td>2.50</td>
<td>3.4</td>
<td>2.1</td>
<td>0.28</td>
<td>0.90*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td>IT</td>
<td>( \pi_e^2 )</td>
<td>2.85</td>
<td>2.00</td>
<td>5.7</td>
<td>1.5</td>
<td>1.37</td>
<td>0.97*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^3 )</td>
<td>2.75</td>
<td>2.00</td>
<td>5.5</td>
<td>1.5</td>
<td>1.24</td>
<td>0.98*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^4 )</td>
<td>2.66</td>
<td>2.00</td>
<td>5.2</td>
<td>1.5</td>
<td>1.16</td>
<td>0.99*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^5 )</td>
<td>2.60</td>
<td>2.00</td>
<td>5.1</td>
<td>1.5</td>
<td>1.08</td>
<td>0.99*</td>
<td>89S2-09S2</td>
</tr>
<tr>
<td>NL</td>
<td>( \pi_e^2 )</td>
<td>2.04</td>
<td>2.10</td>
<td>2.6</td>
<td>1.0</td>
<td>0.41</td>
<td>0.77*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^3 )</td>
<td>1.99</td>
<td>2.00</td>
<td>2.6</td>
<td>1.1</td>
<td>0.37</td>
<td>0.83*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^4 )</td>
<td>2.03</td>
<td>2.05</td>
<td>2.7</td>
<td>1.3</td>
<td>0.30</td>
<td>0.87*</td>
<td>95S1-09S2</td>
</tr>
<tr>
<td></td>
<td>( \pi_e^5 )</td>
<td>2.13</td>
<td>2.10</td>
<td>2.7</td>
<td>1.6</td>
<td>0.27</td>
<td>0.82*</td>
<td>95S1-09S2</td>
</tr>
</tbody>
</table>

Source: ECB Survey of Professional Forecasters (Euro Area two years ahead) and Consensus Economics (other inflation expectations series).

Note: \( \pi_e^1 \) is inflation expected \( t \) years from now. \( \pi_e^2 \) are the inflation expectations used in the baseline regressions. EA = Euro area, DE = Germany, FR = France, ES = Spain, IT = Italy, NL = the Netherlands. A * indicates significance of cor.(\( \pi_e^2 \), \( \pi_e^1 \)).

B Anchoring and anchors

Note that to the extent that all five hypotheses are validated then there is a stable relationship between inflation and inflation expectations. This then allows us to identify the degree of anchoring as well as the anchor itself. In a generalized framework, Bomfin and Rudebusch (2000) model long-run inflation
expectations at time \( t \) as a weighted average of a constant \( \pi^* \) (which in their case is the current target) and last period’s inflation rate, i.e.:

\[
\pi^e_t = \lambda \pi^* + (1 - \lambda) \pi_{t-1}.
\] (2)

Parameter \( \lambda \ (\in [0,1]) \) then measures the degree to which expectations are anchored.\(^9\) If \( \lambda = 1 \), inflation expectations are perfectly anchored to the constant \( \pi^* \), which for countries for which there is an explicit inflation target, this can be cross-checked against the inflation objective \( \pi^T \) communicated. Credible regimes will then be those for which both \( \lambda = 1 \) as well as \( \pi^* = \pi^T \).\(^10\) It follows that if \( \lambda = 0 \), there is no credibility, the inflation target is ignored in the formation of expectations and expectations simply follow past inflation. Note that the notion of credibility applies to longer horizons, which are no longer affected by policy. That is why expectations considered in this context refer to the long-run (in our case the 10-year horizon). This definition does not necessarily preclude anchored expectations in the short-term, but the movement of expectations in the short-run is not necessarily evidence of lack of credibility. For a generalized VAR length, \( \text{VAR}(p) \), then these two parameters are calculated as follows:

\[
\pi^e_t = c_0 + c_1 \pi_{t-1} + \ldots + c_p \pi_{t-p} + d_1 \pi^e_{t-1} + \ldots + d_p \pi^e_{t-p} + e_{pt},
\] (3)

and

\[
\lambda = 1 - \frac{\sum_{n=1}^{n=p} c_n}{1 - \sum_{n=1}^{n=p} d_n},
\] (4)

\[
\pi^* = \frac{c_0}{1 - \sum_{n=1}^{n=p} d_n}.\] (5)

Given that there is credible ‘disconnect’ between inflation and inflation expectations, in the euro area, discussed in the main text, we can then identify the exact degree of anchoring, \( \lambda \), as well as the anchor itself, \( \pi^* \). Table B1 shows the results for different inflation expectations horizons and number of lags. We find that \( \lambda \) is close to 1 and the implicit inflation target (\( \pi^* \)) is in line with the ECB’s inflation target (of below but close to 2%).

<table>
<thead>
<tr>
<th>( \pi^e )</th>
<th>df</th>
<th>( \lambda )</th>
<th>( \pi^* )</th>
<th>period</th>
</tr>
</thead>
<tbody>
<tr>
<td>euro area (SPF, t=2)</td>
<td>1</td>
<td>0.90</td>
<td>1.80%</td>
<td>99Q2-09Q3</td>
</tr>
<tr>
<td>euro area (SPF, t=5)</td>
<td>1</td>
<td>0.99</td>
<td>1.89%</td>
<td>99Q2-09Q3</td>
</tr>
<tr>
<td>euro area (SPF, t=2)</td>
<td>2</td>
<td>0.95</td>
<td>1.82%</td>
<td>99Q3-09Q3</td>
</tr>
<tr>
<td>euro area (SPF, t=5)</td>
<td>2</td>
<td>0.97</td>
<td>1.89%</td>
<td>99Q3-09Q3</td>
</tr>
</tbody>
</table>

Source: SPF = ECB Survey of Professional Forecasters.

\(^9\)A heuristic expectations formation (Brazier et al 2008), or monetary policy as an information game (Demertzis and Viegi, 2008), or expectations learning (e.g. Orphanides and Williams, 2005), all constitute examples of such an expectations process.

\(^{10}\)It follows that \( \pi^* \) is the central bank’s inflation target, as perceived by those who form expectations.
C  Country IRFs

Figure 4: France - Impulse response functions (EMU-period)

Figure 5: Germany - Impulse response functions (EMU-period)
Figure 6: Italy - Impulse response functions (EMU-period)

Figure 7: Netherlands - Impulse response functions for Netherlands (EMU-period)
Figure 8: Spain - Impulse response functions (EMU-period)

Figure 9: France - Impulse response functions (whole period)
Figure 10: Germany - Impulse response functions (whole period)

Figure 11: Italy - Impulse response functions (whole period)
Figure 12: Netherlands - Impulse response functions (whole period)

Figure 13: Spain - Impulse response functions (whole period)
No. 198  Peter ter Berg, Unification of the Fréchet and Weibull Distribution
No. 199  Ronald Heijmans, Simulations in the Dutch interbank payment system: A sensitivity analysis
No. 200  Itai Agur, What Institutional Structure for the Lender of Last Resort?
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No. 231  Maarten van Rooij, Annamaria Lusardi and Rob Alessi, Financial Literacy and Retirement Planning in the Netherlands
No. 232  Chen Zhou, Are banks too big to fail?
No. 233  Frederick van der Ploeg, Steven Poelhekke, THE PUNGENT SMELL OF “RED HERRINGS”: Subsoil assets, rents, volatility and the resource curse
No. 234  Mark Mink, Is Contagion in the Eye of the Beholder?
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