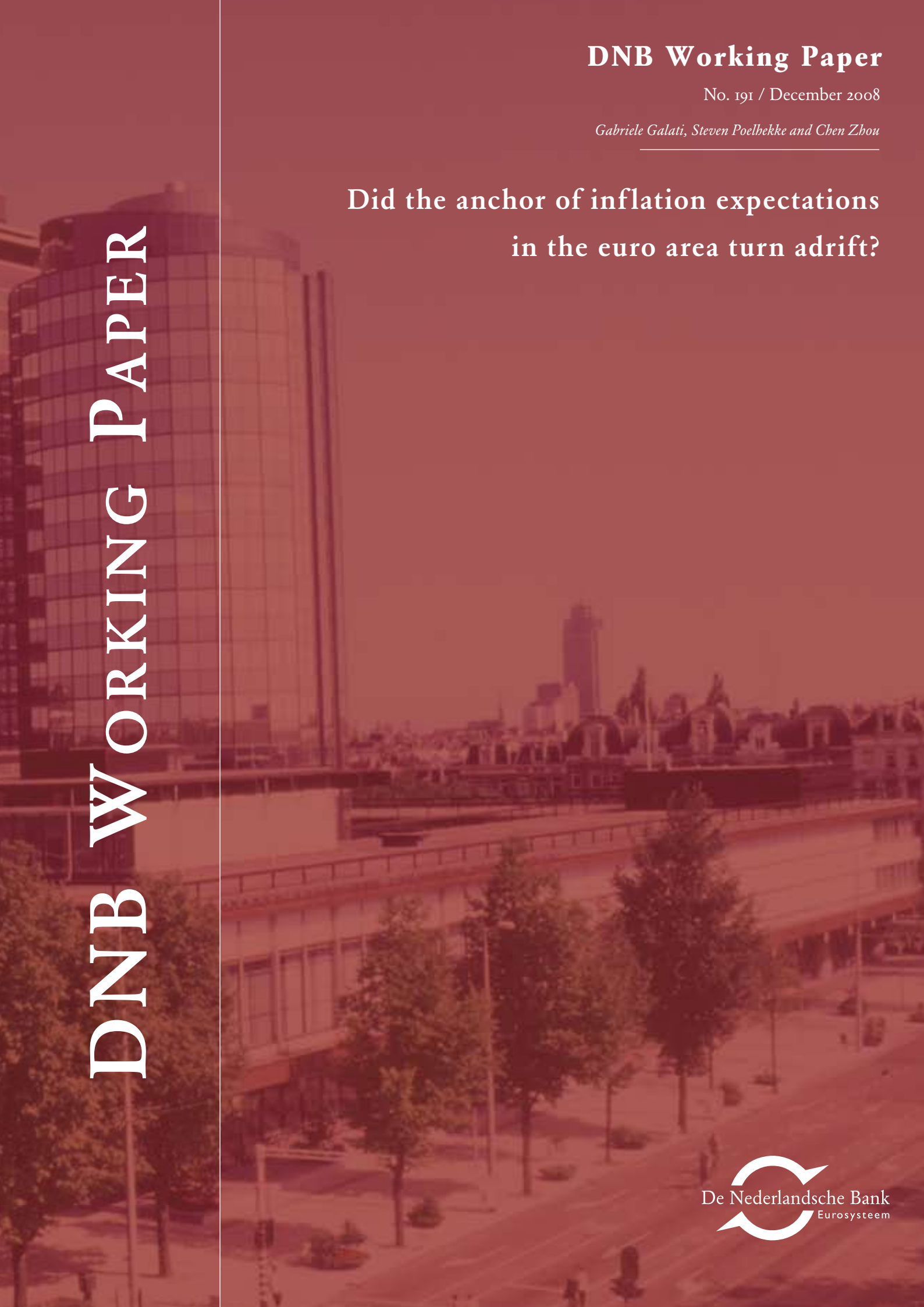

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De Nederlandsche Bank
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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Did the anchor of inflation expectations in the euro area turn adrift?

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Abstract

Survey evidence indicates that inflation expectations increased after HICP inflation rose markedly in the course of 2007 and the first half of 2008, underpinning a general view that inflation expectations may have become unanchored from the ECB's target. However, until now there has been no formal test of whether this has in fact been the case. We fill this gap by testing the reaction of financial market-based measures of long-term expectations inflation expectations to news about inflation and other macroeconomic variables in the main euro area economies. If long-term inflation expectations are anchored, they should not react to the arrival of news. We find evidence that long-term inflation expectations have started to drift away from the ECB's anchor in the course of 2007.

JEL Classification: E44, E52, E58.

Key words: ECB, euro-area inflation and inflation compensation, anchors for expectations, news announcements.

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1. Introduction

> *"It remains imperative to avoid broad-based second-round effects in price and wage-setting. Keeping inflation expectations firmly anchored in line with our objective and securing price stability in the medium term will support sustainable growth and employment and contribute to financial stability." ECB press release, 8 October 2008.*

In this paper we investigate whether the sharp rise in euro area inflation in 2007 and the first half of 2008 – underpinned by rallying commodity and food prices – led to an un-anchoring of long-term expectations from the ECB's target. Policy makers in the euro area expressed concerns that this might indeed have been the case. On 5 July 2008, the ECB acted on these concerns by raising its policy rate by 25 basis points "to prevent broadly based second-round effects and to counteract the increasing upside risks to price stability over the medium term." (Trichet and Papademos, 2008).

Both the theoretical and the empirical literature have highlighted the crucial importance of long-term inflation expectations – which are influenced to an important extent by the central bank's credibility – for the inflation process.[1] In modern macroeconomic theory, rational agents are forward-looking, making expected future inflation a main driver of current inflation.[2] Central banks can therefore achieve price stability by managing agents' inflation expectations – what is known in the literature as the expectations channel.[3] Morris and Shin (2002) took this argument one step further and show that monetary authorities' steering of agents' expectations can even be detrimental, if market participants tend to focus too much on information provided by the central bank and ignore other information that is available to them. In the empirical literature, solidly anchored inflation expectations have been found to be a main driver of the historically stable and low inflation observed between the early 1990s

1 For an overview of the issues, see Bean (2007) and Bernanke (2007).
2 The standard references are Clarida, Gali and Gertler (1999) and Woodford (2003).
3 King (2005) provides a practice-oriented discussion of the expectations channel.

and mid- 2000s (Mishkin, 2007). They arguably also led to lower inflation persistence, a flattening of the Phillips curve and a lower sensitivity of inflation to supply shocks in the long-run.[4]

Analysing the process by which agents form expectations – both from a theoretical and empirical perspective – requires a departure from the standard rational expectations framework. If the central bank's objective function is known and constant, the rational expectations hypothesis implies that long-run inflation expectations do not change over time in response to the arrival of new information. Recent theoretical models long-run expectations have taken a different route and emphasised the role of learning (Orphanides and Williams, 2005) and informational games (Demertzis et al., 2008a). Empirical studies suggest that long-run inflation expectations are only imperfectly anchored. These studies typically compare information on actual inflation or other macroeconomic variables with inflation expectations. If the latter are responsive to the former, this is taken as evidence that expectations are not perfectly anchored.

Until now there has been no formal test of euro area long-term inflation expectations have become un-anchored as a consequence of the rally in commodity and food prices between 2006 and mid-2008. Instead, the debate has relied mostly on indirect evidence on wage growth or on core inflation, and on the inspection of inflation expectations surveys of consumers or professional forecasters. At least until the end of August 2008, these indicators were pointing to an increase in inflation expectations at various horizons, underpinning a general view that euro area inflation expectations may have become unanchored. The aim of the paper is to fill this gap.

We proceed in two steps. We first estimate financial market-based measures of long-term inflation expectations. We then investigate the reaction of these inflation expectations to news about inflation and other macroeconomic variables in the main euro area economies. The idea is that if long-term inflation expectations are anchored, they should not react to the arrival of news but rather be stable around the ECB's target of below but close to 2% inflation. By contrast, if in recent months

4 See Roberts (2006) for an overview.

expectations have started to be sensitive to news about HICP inflation or other macroeconomic variables, this would indicate that market participants have come to view the ECB's commitment to price stability as no longer fully credible.

Our main result is that since June 2007, market participants' inflation expectations appear to have become more sensitive to news about actual inflation figures. We interpret this as evidence that expectations of euro area inflation– at least those formed by market participants – have started to drift away from the ECB's anchor. We conjecture that the combination of the slowdown of activity and heightened stress in the financial system in the euro area since the summer of 2008 is likely to dampen inflation expectations substantially in the coming months.

The remainder of the paper is organised as follows. In Section 2 we provide a brief overview of the relevant literature on the anchoring of inflation expectations and discuss alternative measures of inflation expectations. Section 3 describes our approach for backing out long-term inflation expectations from financial instruments. In Section 4 we present our empirical model and the main results. Section 5 concludes.

2. Literature review

Even though expectations and credibility play a central role in the theoretical literature, there is little theoretical work on the concept of "anchoring" of inflation expectations. The reason is that if the central bank's objective function is known and constant, the rational expectations hypothesis implies that long-run inflation expectations do not change over time in response to the arrival of new information. In recent years, a new strand of the literature departed from the rational expectations hypothesis and the assumption of a known and constant central bank objective (Orphanides and Williams, 2005; Brazier et al., 2008; Demertzis et al., 2008a). This approach allows more realistic models of the link between inflation expectations and underlying inflation.

Demertzis et al. (2008a) model monetary policy as an information game, in which individual agents have to interpret new (publicly available and private) information when they form *ex ante* expectations about future long-term inflation. In their model, *ex post* inflation is a function of the monetary policy chosen by the central bank to pursue its objectives and the average of all individual expectations. It is then optimal for agents to form expectations based on three elements: monetary authorities' objectives and their policy decisions; shocks that occur after these decisions; and the average of individual inflation expectations. Once the central bank communicates its inflation objective to the public — such as the ECB's operational definition of price stability as below but close to 2% – agents can either form their expectations based on the above three elements or, alternatively, coordinate their expectations on that target. Demertzis et al. (2008a) then go on to derive a time-varying parameter that captures the credibility of the central bank's target. If the target's credibility is sufficiently high, individual agents will focus their expectations on that target.

In a companion paper, Demertzis et al. (2008b) take their model to the data and estimate the degree to which long-run inflation expectations in the United States have been anchored to the Fed's objective. They test whether long-term inflation expectations – derived from the Fed's FRB model or survey-based measures – are influenced by short-run inflation dynamics. They estimate a time-varying parameter (λ) that measures the extent to which inflation expectations are anchored over time. They find that in recent years, the anchorness of expectations in the United States has weakened but only slightly, without compromising the Fed's credibility.

In Orphanides and Williams (2005), agents do not know the true model of the economy but rather constantly update their estimates based on all information available to them. As a result, inflation expectations are sensitive to economic shocks. Orphanides and Williams (2005) then introduce central bank communication in their model and find that with learning, successful communication reduces the sensitivity of inflation expectations to inflation.

Brazier et al. (2008) model the behaviour of agents that make inflation forecasts using two rules of thumb ("heuristics"). One heuristic is based on lagged inflation, the other on an inflation target announced by the central bank. Agents switch between these two heuristics based on an imperfect assessment of how each has performed in the past.

Recent empirical studies have documented that long-run inflation expectations are indeed only imperfectly anchored. This work is generally based on the idea that if expectations are perfectly anchored, they should not be responsive to news about actual inflation, or more general about macroeconomic conditions.[5]

Levin et al. (2004) analyse the behaviour of private-sector inflation forecasts at horizons up to ten years – measured by quarterly Consensus forecasts – in United States and the euro area over the period 1994–2003. They find that expectations were highly correlated with a three-year moving average of lagged inflation. By contrast, in industrial countries that have adopted inflation targeting (United Kingdom, Sweden, Canada, Australia and New Zealand), inflation expectations were found not to be sensitive to actual inflation. Levin et al. (2004) conclude that inflation targeting has played a significant role in anchoring long-run inflation expectations.

Consistently with Levin et al. (2004), Paloviita and Viren (2005) find that inflation expectations, proxied by OECD inflation forecasts, respond to changes in output and actual inflation. The results are based on a simple VAR model with inflation, inflation expectations, estimated with pooled annual data for euro area countries over the period 1979–2003.

A series of papers looked at the relationship between inflation expectations and macroeconomic variables at high (daily or intraday) frequency.[6] Gürkaynak et al. (2003, 2005) derive inflation expectations from financial instruments and examine their sensitivity to surprises about

5 Clark and Davig (2008) provide a detailed survey of research on drivers of inflation expectations.
6 These papers are surveyed in Swanson (2006).

macroeconomic announcements at the daily frequency. They find that between 1990 and 2002, long-term inflation expectations in the United States were not perfectly anchored. This analysis is extended in Gürkaynak et al. (2006a) and Gürkaynak et al. (2006b), which document that long-term inflation expectations are more solidly anchored in the United Kingdom, Sweden and Canada – countries that adopted formal inflation targets. Consistently with Levin et al. (2004), they conclude that a numerical inflation target has helped anchoring long-term inflation expectations.

The same methodology is followed by Beechey et al. (2007), who compare the anchoring properties of long-run inflation expectations in the United States and the euro area over the period 1 June 2003–31 December 2006. They find that surprises about monetary policy decisions and macroeconomic data releases – the core CPI but also indicators of economic activity such as the National Association of Purchasing Managers (NAPM) index or non-farm payrolls – have significant effects on US forward inflation compensation at different horizons. By contrast, long-term inflation compensation does not significantly react to any news about price or output developments in the euro area. Beechey et al. (2007) therefore conclude that long-run inflation expectations are more firmly anchored in the euro area than in the United States.

One critical assumption in the empirical work that uses financial instruments to back out measures of inflation expectations is that long-term expectations of future real short-term interest rates and long-run term premia do not respond to macroeconomic news at the daily frequency. Changes in far-horizon nominal forward rates can then be interpreted as a revision of market participants' long-run inflation expectations in response to new information, indicating that inflation expectations are not solidly anchored. Beechey et al. (2008) test this assumption by decomposing US nominal yields into three components: nominal yields, real yields, and the spread between these two – i.e. inflation compensation. They then estimate effect of news on these three components using intra-day data, which in the finance literature have been found to allow more precise estimates of announcement effects than daily data (Andersen et al., 2007). They find that different types of news – about prices, the real economy or monetary policy – have quite different effects on real rates and rates of inflation

compensation. Beechey et al. (2008) find that at the intra-day frequency, only news about prices affect inflation compensation. They also test whether the impact of news has changed over time as the market for inflation indexed bonds in the United States – Treasury Inflation Protected Securities (TIPS) – has deepened. Their evidence suggests that the reaction of long-term inflation compensation to inflation news has not changed between 17 February 2004 and 13 June 2008, implying no significant change in inflation expectations' anchoring properties during this period.[7]

3. Measuring inflation expectations in the euro area

A major problem in the discussions on the anchoring of long-term expectations is that it is very difficult to obtain accurate and timely evidence on their behaviour. There are three broad approaches: indirect evidence from core inflation or labour market data; survey-based expectations measures and financial market-based inflation measures. All of these have important limitations.

The first approach consists in looking at indirect evidence from either core inflation or labour market data. When euro area core inflation, which had been on an upward trend since 2006, accelerated and crossed 2% around the end of 2007, observers interpreted this as evidence that second round effects had started to work (Graph 1). Similarly, the fact that labour market data into August 2008 indicated persisting wage pressures, in spite of the moderation of euro area growth, has been used as an argument in support of second round effects.

This type of approach is widely referred to in central bank speeches and market reports, but has several main disadvantages.[8] First, the evidence it yields is very indirect and may instead reflect other forces. This said, Stock and Watson's (2007) estimate of trend inflation has been found to track survey-based measures of long-run expectations fairly well (Mishkin, 2007). Second, labour market

[7] By contrast, Beechey et al. (2008) find evidence of a structural break around 16 February 2004. They interpret this result as suggesting that the improved liquidity and functioning of the TIPS market since 2004 may have allowed TIPS yields to become more responsive to new information.

[8] To give an example, in an interview on 18 July 2008, ECB President Trichet answered the question on whether second-round effects were already at work in the euro area by stating "The recent rise in unit labour costs is an indication that we have to take into account. So there are risks that we had to counter." (Trichet, 2008).

data are available only with a lag of several months, making a timely judgement of second round effects difficult. Third, core inflation and labour market data are available only at monthly frequency, which is too low to rigorously test for changes in the behaviour of inflation expectations over the past two years.

The second approach consists in looking directly at the behaviour of euro area inflation expectations using survey-based measures.[9] The two main measures are the *European Commission Consumer Survey on Inflation Expectations* and the *ECB Survey of Professional Forecasters (SPF)*. The European Commission survey polls every month some 20,000 consumers in the euro area on their expectations for consumer prices over the following 12 months. Survey participants are not asked a quantitative estimate but rather to indicate whether they expect inflation to rise, fall or remain unchanged, which makes it hard to compare this measure with quantitative estimates of inflation expectations.[10] The SPF collects, on quarterly basis, forecasts by a panel of some 70 professional forecasters on euro area HICP one, two and five years ahead. Surveys on longer-term inflation expectations are also available from private data providers. The most frequently used survey, by *Consensus Economics*, provides semi-annual data on expectations of a panel of some 30 professional forecasters six to ten years ahead.

Surveys are the most direct and comprehensive way to obtain information on inflation expectations, and as such appear well-suited for analysing longer-term properties of inflation expectations in a systematic way. Moreover, survey data can provide information not only on the mean but also the entire distribution of inflation expectations. This said, survey data suffer also from important shortcomings. One criticism is that survey results may not be reliable to the extent that respondents do not have to act on the basis of their responses – i.e. they "do not put their money where their mouth

9 A detailed analysis of the properties of these measures is provided in ECB (2006). For a careful analysis of the properties of survey measures, see Clark and Davig (2008).

10 The question asked is "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?". Consumers answer one of the following: + + increase more rapidly, + increase at the same rate, = increase at a slower rate, − stay about the same, − − fall, N don't know. From these answers a measure between -100 and 100 is constructed according to the percentages of respondents answering each option, such that 0 means no change, and a positive (negative) number indicates an upward (downward) expected trend.

is". Another problem is that, given their low (monthly or quarterly) frequency, survey measures are not very useful in identifying the existence and timing of breaks in the expectation formation over a short horizon. Third, there are important differences across different types of survey measures. Mankiw et al. (2003), for example, looked at 50 years of data on inflation expectations in the United States, and documented substantial disagreement among both consumers and professional economists about expected future inflation. They found that this disagreement varied substantially through time, moving with inflation, the absolute value of the change in inflation, and relative price variability.

The third approach consists in using financial market-based measures. In a number of countries, bonds or interest rate swaps that are linked to some measure of domestic inflation are actively traded. These inflation-indexed bonds or inflation swap rates can be combined with nominal bonds or nominal interest rate swaps to back out financial markets' inflation expectations.

The main advantage of this type of measure is that, given its high frequency, it allows examining changes in the behaviour of expectations over a relatively short horizon. Financial market-based inflation expectations are therefore most useful in investigating whether the recent rise in commodity and food prices has weakened the anchoring of inflation expectations to the ECB's inflation objective.

At the same time, financial market-based inflation expectations suffer from several important shortcomings. First, in the conduct of monetary policy, central banks pay attention to inflation expectations not only by market participants but also households and firms. Second, it is not straightforward to identify inflation compensation from nominal and inflation-indexed paper. As discussed above, Beechey et al. (2008) documented how long-term expectations of future real short-term interest rates and long-run term premia might also be time-varying. Market-derived measures of inflation expectation are also influenced by liquidity premia, as well as a number of institutional and technical factors, which change over time. In an empirical analysis, however, there are ways to control at least in part for the spurious influence of liquidity aspects and other factors unrelated to inflation expectations. Third, in order to translate inflation compensation into an estimate of expected long-term

inflation, it is necessary to make assumptions about the premium paid to investors to compensate them for inflation risk. However, the magnitude of the inflation term premium is likely to be of second-order importance (Mishkin, 2007). Moreover, one could also interpret an increase in inflation compensation driven to a large extent by a rising inflation risk premium as a sign that the central bank is becoming less credible.

4. Measuring long-term inflation expectations

We derived inflation expectations from euro area markets on nominal interest rate swaps and inflation swaps. These instruments are liquid and actively traded. According to market commentary, the monthly trading volume of 10-year euro area inflation swaps averaged around 6bn in 2007 (JP Morgan, 2008). Buyers of inflation swaps primarily include insurance companies and pension funds, which suffer a loss of income if the actual inflation rate increases. Typical inflation swap sellers include firms whose income is linked to inflation while their expenses are not, or only to a lesser degree, such as public authorities, utilities, real estate companies, or distribution companies. By selling inflation in an inflation-linked swap, they are able to protect future income linked to inflation. Alternatively, we could have used nominal and inflation-indexed bonds, which in the past years have become increasingly liquid. Our preference for swaps is motivated by their greater liquidity along the whole maturity spectrum, particularly in earlier years.[11]

Inflation expectations are measured by the difference between one-year zero-coupon forward rates of inflation swaps and nominal interest rate swaps. Since we focus on long-term inflation expectations, we chose one-year zero-coupon forward rates ending ten year ahead. Hence, at day t, we measured inflation expectation by

$$(1) \qquad f_t = f_{t,10}^{is} - f_{t,10}^{in},$$

[11] For a discussion of these instruments, see Deacon et al. (2004) and JP Morgan (2008).

where $f_{t,10}^{is}$ and $f_{t,10}^{in}$ denote the one-year zero-coupon forward rates ending ten year ahead for inflation swaps and interest swaps respectively.

We collected daily data on euro area swap markets for the period 1 January 2004 to 31 August 2008. For each day, swap rates are available for different maturities, allowing us to estimate a whole yield curve. The forward rates ending ten year ahead can be calculated from the swap rates with 9- and 10-year maturities as

$$(2) \qquad f_{t,10} = \frac{(1+y_{10})^{10}}{(1+y_9)^9} - 1,$$

where y_9 and y_{10} are the 9-year and 10-year swap rates, respectively.[12] However, these forward rates are contaminated by different levels of liquidity in the underlying swap markets, as well as technical factors (Barclays Capital Research, 2008). In particular, since the market for swaps with a 9-year maturity may not be very liquid, estimates of forward rates based on 9-year swaps may exhibit a high level of noise.

In order to smooth out the impact of liquidity and technical factors on the swap rates, we follow a standard technique of the finance literature – the Nelson-Siegel method (see, e.g. Nelson and Siegel, 1987) – to estimate a smooth yield curve for each day. Details on this method are presented in Appendix 1. Söderlind and Svensson (1997) argue that estimating yield curves by a simple curve fitting rather than by a structural model for interest rate dynamics is appropriate when the purpose is to extract market expectations about future interest rates without making additional assumptions about the model structure.

We obtained two smoothed yield curves for each day: one for inflation swaps, the other one for interest rate swaps. From these, we got the smoothed 9- and 10-year swap rates. We then estimated 10-

[12] The same formula to calculate the forward rates applies to both inflation swaps and interest swaps. This argument holds for the rest of the section.

year ahead forward rates, from which we derived the inflation expectation measures as a difference between inflation swaps and nominal interest rate swaps.

Note that our smoothing procedure is applied for each specific day but it gives also a smoother measure of inflation expectations across time. This smoothing effect can be explained in terms of a smaller impact of liquidity effects.

In our regression analysis, we used the smoothed measure on long-tem inflation expectations as dependent variable.

4. Empirical results on anchoring

In order to test for second round effects, we examined the impact of news on HICP inflation and other macroeconomic variables on our measure of inflation expectations. We followed the standard approach of capturing news by the difference between actual releases of the main euro area macroeconomic variables and values anticipated by market participants according to surveys conducted by Bloomberg and JP Morgan. Rigobon and Sack (2008) find that because of measurement errors, this approach tends to underestimate the responses to true news. Bartolini et al. (2008) discuss shortcomings of survey-based measures of news and conclude that this approach may be the only one available in practice.

While data releases on inflation variables are most important, we looked also at other macroeconomic variables – such as GDP growth, the unemployment rate or wage growth – that can give indications about possible inflationary pressures. We concentrated on data releases for the three main economies in the euro area – Germany, France, and Italy – since these are most likely to have a primary influence on views on future euro area inflation.[13]

[13] A complete list of these variables is provided in Appendix 2.

More formally, we followed Beechey et al. (2007), Gürkaynak et al. (2006), who developed this approach to compare the credibility of the Fed, the ECB and inflation targeting central banks. We regressed our measure of long-term inflation expectations on a constant, a set of macroeconomic news variables and a set of control variables, according to the following model:

$$\Delta f_t = \alpha + \beta X_t + \gamma Z_t + \varepsilon_t \quad (3)$$

where the dependent variable $\Delta f_t = f_t - f_{t-1}$ is the change in one-year inflation compensation ten years ahead and the explanatory variables X_t are a vector of news variables on various measures of the state of the main euro area economies: France, Germany and Italy. Since euro area bond markets have been found to react strongly to the surprise component in US macro releases[14], we also include US news in the matrix X_t as a control. Z_t includes the implied volatility of bond yields to control for the influence that shorter-term changes in liquidity premia unrelated to inflation expectations may have on swap rates. Most macroeconomic news arrive at 8:30 am (GMT+1) in the euro area, before stock markets open.[15] Our expectations variable therefore measures the change in inflation expectations between the end-of-day swap quote of the day before news arrives (*t-1*), and the end-of-day quote on the same day as news arrives (*t*).

To detect changes in the anchoring properties of expectations, we use a rolling version of the Chow break-point tests. Anchored expectations imply that news have no significant effect on expectations and should predict changes in expectations rather poorly, resulting in a small R-squared. If, on the other hand, the same model starts to explain changes in expectations much better during a later sample period, then this change in model performance will be picked up by the Chow test if the change is statistically significant. Changing the date at which we split the sample gives us a measure of when, if at all, the model starts to predict changes in inflation expectations. This would imply that expectations have become unanchored.

14 See e.g. Andersson et al. (2006).

15 See for example the monthly JP Morgan Global Data Watch issues.

We use the model to verify whether the sensitivity of inflation expectations to news about HICP inflation and other macroeconomic variables has increased in the course of 2007, as the prices of oil and other commodities and food rose sharply. Our results, summarised in Table 1, indicate that this has indeed been the case. We identify a statistically significant change (at the 99% confidence level) in behaviour of inflation expectations around June 2007. In the period June 2007–August 2008, the reaction of inflation expectations to some news on euro area inflation was much higher than in the period 1 January 2004–May 2007.[16] In particular, we found that the coefficient on news about HICP inflation in Germany and France increased five-fold and became more significant statistically. Subject to the important caveats about the quality of our inflation expectations measure discussed above, we interpret this result as suggesting that around the end of last year, long-term inflation expectations in the euro area may have started to drift away from the ECB's anchor.

Our results are robust to using alternative variables that measure market liquidity, such as the Chicago Board Options Exchange Volatility Index (VIX), a widely used measure of the implied volatility of S&P 500 index options. Beechey et al. (2007) do not use explanatory variables that explicitly control for liquidity effects but document that the announcement effects persist for about one business week. They interpret this as evidence that the reaction of the dependent variable is not driven primarily by liquidity effects. We also control for day-of-the-week effects but these turned out not to be statistically significant.[17]

To get a sense of the economic importance of our results, during the period after June 2007, a one standard deviation surprise on French CPI inflation was followed by an increase by 0.02 of inflation expectations. Taken together, during that period all surprises on the French CPI taken together raised inflation expectations by 0.3. If we add all surprises on the German CPI, we get a total effect of about 0.4 on inflation expectations. These figures suggest that during the period June 2007 to August 2008,

16 Breusch-Pagan/Cook-Weisberg tests cannot reject constant variance in both regressions, so we do not have to correct our standard errors for heteroskedasticity.

17 The latter are introduced to capture day-of-the-week effects that have been documented in the empirical literature on announcement effects on asset prices. The results for these dummies are therefore not reported here.

the impact of surprises on inflation announcements on log-term inflation expectations was not only statistically significant but also substantial from an economic point of view.

When we compare these findings with the ECB's Survey of Professional Forecasters, we notice that the pattern of the latter also changed in the second half of 2007 (Graph 1). A similar picture emerges from survey data on long-term inflation expectations provided by Consensus Forecasts (not shown). However, as Graph 1 shows, the change in survey data on inflation expectations is much more contained. Graph 2 does show an upward trend in consumer expectations one year ahead but short-term expectations are generally more volatile, therefore making inferences on long-term expectations difficult. The reason behind this difference in behaviour is an important topic for future research.

[Graph 1 here]

[Graph 2 here]

Our empirical work also offers a possible interpretation of why market participants' long-term inflation expectations may have become more reactive to news about actual inflation. In 2007 and the first half of 2008, market participants tended to be more surprised by rising inflation, particularly in France. Table 2 summarizes the mean and standard deviation of the three inflation news measures in Table 2. The second and third columns show the overall summary statistics over all the periods of the corresponding regressions of Table 1. For France, Germany and Italy we see that average inflation news became positive after June 2007. On average, inflation in France was over-predicted by survey participants (i.e. inflation was surprisingly low) before June 2007, while the opposite holds during the more recent sample (inflation was surprisingly high) (Graph 3). If we take the mean news of only those days on which actual inflation numbers were released, we see an even starker difference. On average, actual inflation in France was 0.16 percentage-points higher than expected, leading to significantly higher inflation expectations at a horizon of nine to ten years.

[Graph 3 here]

5. Conclusions

Over the past two years, euro area policy makers expressed increasing concerns that inflation expectations may have become un-anchored from the ECB's target. In this paper we formally tested whether the sharp increase in HICP inflation has led to an un-anchoring of long-term expectations in the euro area. Our focus on long-term inflation expectations is motivated by their link to central bank's credibility.

Using daily data from 2004 to August 2008, we estimated measures of long-term expectations inflation expectations based on euro area nominal and inflation swaps. We then investigated the reaction of these inflation expectations to news about inflation and other macroeconomic variables in the main euro area economies. If long-term inflation expectations are anchored, they should not react to the arrival of news but rather be stable around the ECB's target. We found evidence that since June 2007 market participants' inflation expectations have become more sensitive to news about actual inflation figures. We interpreted this as evidence that expectations of euro area inflation – at least those formed by market participants – have started to drift away from the ECB's anchor.

Looking ahead, euro area inflation expectations are likely to drift back towards the ECB's target in the coming months, as the ongoing slowdown of growth and major financial strains will probably dampen market participants' inflation outlook. Still, assessing the anchoring properties of inflation expectations will remain a crucial task. To quote from the ECB's press release on 8 October 2008: "It remains imperative to avoid broad-based second-round effects in price and wage-setting. Keeping inflation expectations firmly anchored in line with our objective and securing price stability in the medium term will support sustainable growth and employment and contribute to financial stability."

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Tables

Table 1: Regression results

Explatory variable	**22jun2004 – 09jun2007**	**09jun2007 – 18aug2008**
	(1)	(2)
France CPI	**0.005**	**0.032*** **
	(0.006)	(0.011)
Germany HICP MoN 2005=100	**0.009**	**0.061** **
	(0.006)	(0.027)
Italy HICP MoM NSA 2005=100	**0.005**	**-0.001**
	(0.006)	(0.017)
Euro-bund future at-the-money implied volatility	0.003	-0.001
	(0.003)	(0.003)
Constant	-0.010	0.002
	(0.010)	(0.016)
Observations	773	311
R-squared	0.07	0.21
Breusch-Pagan/Cook-Wesiberg test, p-value	0.411	0.203

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Continued on next page.

Table 2: Mean of Inflation Variables

Mean of Inflation Variables (over the whole sample and over only periods with possible news)

regression:	(1)	(2)	(1)	(2)
	Overall		**News periods**	
	sample mean (sd)		sample mean (sd) [obs.]	
France CPI	-.014	0.030	-.08	.16
	(.221)	(.230)	(.240) [35]	(.229) [15]
Germany HICP MoN 2005=100	-.002	.003	-.007	.01
	(.221)	(.089)	(.133) [27]	(.047) [14]
Italy HICP MoM NSA 2005=100	-.011	.000	-.032	-.000
	(.223)	(.149)	(.133) [31]	(.088) [14]

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Explatory variable	**22jun2004 – 09jun2007**	**09jun2007 – 18aug2008**
France Business Confidence overall indicator	0.006	0.019
	(0.007)	(0.013)
France GDP QoQ	0.025**	-0.004
	(0.010)	(0.034)
France Industrial Production MoM SA 2000=100	-0.001	0.010
	(0.006)	(0.014)
France PPI MoM 2000=100	-0.007	0.012
	(0.007)	(0.013)
France Unemployment rate SA	0.002	0.012
	(0.006)	(0.037)
Bundesbank Germany Current Account EUR SA	0.011*	0.012
	(0.006)	(0.011)
IFO pan Germany business climate 2000=100	0.010	-0.009
	(0.006)	(0.014)
Germany Industrial production MoM SA 2000=100	0.002	-0.010
	(0.006)	(0.014)
Germany PPI MoM 1995=100	0.008	0.003
	(0.006)	(0.010)
Germany Unemployment rate SA	0.005	0.006
	(0.005)	(0.015)
Italy Business confidence 2000=100	-0.002	0.008
	(0.006)	(0.014)
Italy Industrial Production MoM SA 2000=100	0.010*	-0.009
	(0.006)	(0.016)
Italy PPI manufacturing MoM 2000=100	0.001	-0.017
	(0.006)	(0.013)
Italy Real GDP QoQ SA WDA	0.009	0.106***
	(0.012)	(0.021)
US Personal Consumption Expenditure Core Price Index MoM SA	0.002	-0.000
	(0.010)	(0.023)
US Capacity Utilization % of Total Capacity SA	0.011*	-0.019*
	(0.006)	(0.011)
Conference board consumer confidence SA 1985=100	-0.000	-0.008
	(0.007)	(0.018)
US Industrial Production MoM 2002=100 SA (rate)	-0.004	0.002
	(0.010)	(0.022)
US initial jobless claims SA	0.001	0.008
	(0.006)	(0.011)
Conference board US leading index MoM	-0.008	-0.012
	(0.005)	(0.016)
Federal Funds Target Rate	0.000	-0.007
	(0.000)	(0.007)
US new privately owned housing units started by structure total	0.005	0.024
	(0.005)	(0.019)
US Employees on Nonfarm payrolls total MoM Net Change SA	0.027***	0.029**
	(0.006)	(0.015)
Advance US GDP chained 2000 dollars QoQ SAAR	0.010	0.000
	(0.011)	(0.000)
Adjusted retail & food services SA total monthly % change	0.005	0.000
	(0.006)	(0.012)
US unemployment rate total in labor force SA	-0.012	-0.034***
	(0.008)	(0.010)

Appendix 1: The Nelson-Siegel method

There is an extensive literature on modeling the term structure of interest rates or inflation swap rates. The seminal paper by Nelson and Siegel (1987) proposes a three-factor model that captures the level, slope and curvature of the yield curve. Empirical studies shows that it fits well for yield curves with different shapes.[18] At each time point t, the model is given as follows:

$$\text{(A1)} \qquad y_t^{(m)} = \beta_{1,t} + \beta_{2,t}\left(\frac{1-e^{-\lambda m}}{\lambda m}\right) + \beta_{3,t}\left(\frac{1-e^{-\lambda m}}{\lambda m} - e^{-\lambda m}\right) + \varepsilon_t^{(m)}.$$

Here $y_t^{(m)}$ is the yield with maturity m, $(\beta_{1,t},\beta_{2,t},\beta_{3,t})$ is the vector of parameters for the three factors, which indicate level, slope and curvature of the yield curve, λ is a decay parameter, which usually assumed to be constant across time, and $\varepsilon_t^{(m)}$ is an error term.

To estimate this model is by no means an easy task. In particular, taking the dynamics of the beta-parameters into account always involves advanced techniques such as Kalman filter (see Diebold et al.(2006). However, by fixing the decay parameter λ, the estimation becomes a simple OLS regression. An example of this approach is in Diebold and Li (2006).

We did not choose a particular value for the decay parameter ex ante. Rather, we allowed the decay parameter to vary on a certain interval, while estimating the Nelson-Siegel model for each specific value in this interval. We then chose the value of the decay parameter at which the total mean squared error is minimized.

When estimating the Nelson-Siegel model for a specific value of λ, the observations are the yields at different maturities. In our data set, the available maturities are 1,2,3,4,5,6,7,8,9,10,12,15,20 and 30

[18] For a recent discussion of the empirical performance of the Nelson-Siegel method, see e.g. de Pooter (2007).

years. The observations are therefore concentrated at the shorter end of the yield curve, making it more difficult to accurately represent the shape of the yield curve at longer maturities. In order to balance this effect, we introduced other maturities – such as 11,13,14,16,17,18,19,21,22 years – . To obtain yields on those maturities, we used the bootstrapping method in Fama and Bliss (1987).

We followed this procedure to estimate the yield curves for inflation swaps and interest rate swaps for each day t. Based on this estimated yield curve, we obtained the yield with 9- and 10-year maturities. These were used to calculate the 10-year ahead forward rates.

Appendix 2: Macroeconomic data releases

Germany

Germany Current Account EUR SA

Germany HICP MoN 2005=100

IFO pan Germany business climate 2000=100

Germany Industrial production MoM SA 2000=100

Germany PPI MoM 1995=100

Germany Unemployment rate SA

ZEW Germany Expectation of Economic Growth

France

France Business confidence overall indicator

France GDP QoQ

France Industrial production MoM SA 2000=100

France PPI MoM 2000=100

France Unemployment rate SA

Italy

Business confidence 2000=100

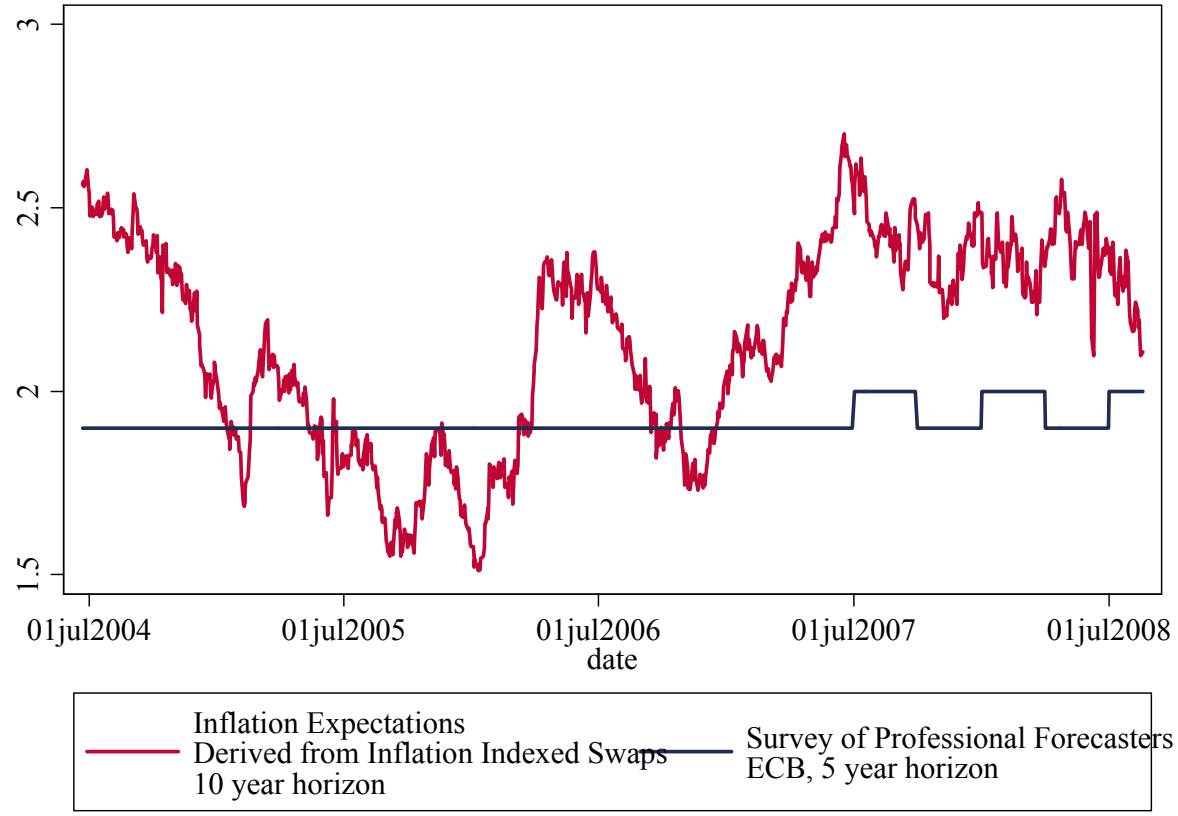
Italy HICP MoM NSA 2005=100

Italy Industrial Production MoM SA 2000=100

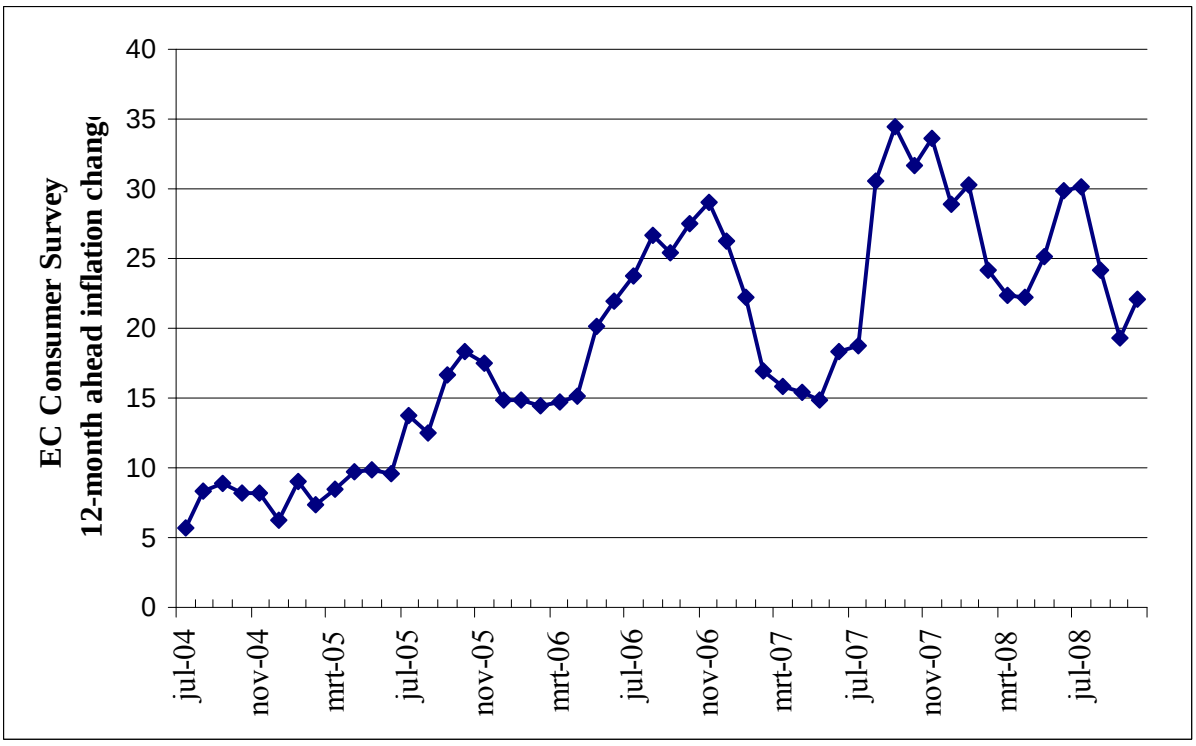
Italy PPI manufacturing MoM 2000=100

Italy Real GDP QoQ SA WDA

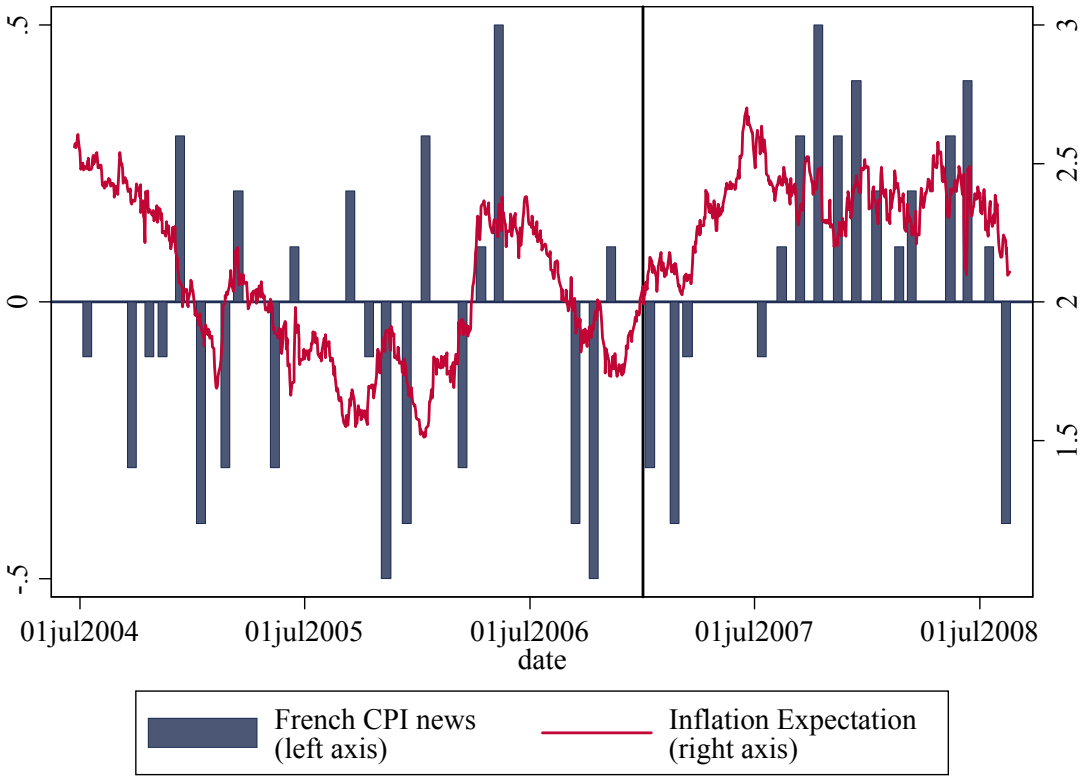
Graph 1: Inflation Expectations from Indexed Swaps and the Survey of Professional Forecasters



Graph 2: Inflation expectations from European Commission Consumer Survey for the Euro Area



Graph 3: Surprises about rising inflation in the euro area



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