

ASSESSING THE ANCHORING OF LONGER-TERM INFLATION EXPECTATIONS

Monitoring longer-term inflation expectations helps in gauging the public's perceptions of a central bank's commitment to maintain price stability. This is particularly important in periods of large shocks to the economic and financial environment and strong adjustment processes ensuing from these shocks, as could be witnessed over the past few years. Against this background, this article reviews the evolution of longer-term inflation expectations for the euro area provided by surveys of professional forecasters and extracted from financial market instruments. During the financial and sovereign debt crises of the past few years, the levels of longer-term inflation expectations have continued to move within a rather narrow band, with no signs of systematic changes in either direction. At the same time, the levels have been surrounded by higher uncertainty than in previous years. Nevertheless, overall, the evidence presented in this article suggests a firm anchoring of public perceptions regarding the ECB's commitment to maintain inflation rates below, but close to, 2% over the medium term, also in times of such exceptional uncertainty.

I INTRODUCTION

Developments in longer-term inflation expectations play an important role in central banks' monitoring and assessment activities, because well-anchored expectations are central to the functioning of the monetary transmission mechanism. If economic agents were to believe that inflation would ultimately be out of line with the central bank's objective, they would adjust their price and wage-setting decisions, increasing the risk of self-propelling price spirals. In this respect, the relationship between inflation expectations and inflation can operate in both directions: actual inflation, if systematically away from the central bank's objective, can endanger the anchoring of expectations, and de-anchored inflation expectations can themselves contribute to moving actual inflation away from this objective. Well-anchored expectations are hence an indicator of the success and the credibility of a price stability-oriented monetary policy.

The ECB monitors longer-term inflation expectations derived from surveys and financial market instruments. The focus here is on longer-term rather than shorter-term expectations¹, because inflation in the short term can be heavily affected by shocks, such as may stem from commodity price developments or changes in indirect taxes. Such shocks cannot be counteracted by monetary policy within short time horizons and can therefore lead to considerable volatility in inflation.

By contrast, longer-term inflation expectations should be a measure that reflects more fundamental expectations about the credibility of monetary policy. Monitoring longer-term inflation expectations is particularly important in periods of large shocks to the economic and financial environment. The period since autumn 2008 is a prominent example in this respect. The Lehman bankruptcy and the associated financial crisis triggered the deepest recession since World War II, and together with the more recent tensions in some euro area sovereign debt markets this set off unusually deep adjustment processes. Such strong reactions in the macroeconomy may leave market participants with more uncertainty regarding the prospects for inflation than in normal times.

Against this background, Sections 2 and 3 of this article review the developments of survey-based and market-based measures of longer-term inflation expectations for the euro area, with some focus on the post-Lehman period. They review these developments with regard to different dimensions, such as the level of inflation expectations and its movements over time, but also the uncertainty that can surround this level at any given point. Section 4 concludes.

¹ For an analysis of shorter-term inflation expectations in the euro area, see the article entitled "Inflation expectations in the euro area: a review of recent developments", *Monthly Bulletin*, ECB, February 2011.

2 SURVEY-BASED INDICATORS OF LONGER-TERM INFLATION EXPECTATIONS

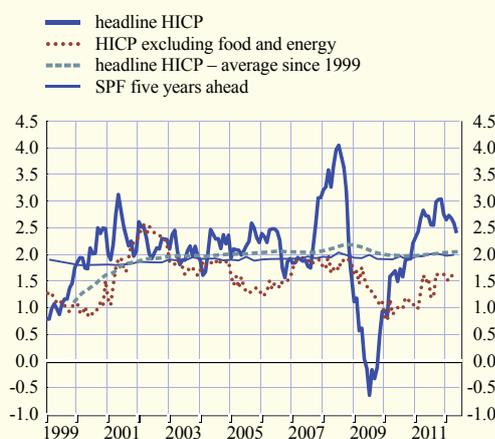
One main source of survey-based indicators for longer-term inflation expectations is the quarterly ECB Survey of Professional Forecasters (SPF), which collects both point forecasts and probability distributions for five-year-ahead inflation expectations.² Point forecasts of inflation several years into the future are also published by Consensus Economics and MJEconomics (the Euro Zone Barometer), although there are some differences between these surveys and the SPF with respect to the reference period and the frequency at which the data are collected.³

2.1 THE MEAN LEVEL OF INFLATION EXPECTATIONS

HICP inflation since 1999 has occasionally displayed strong movements, reflecting in particular the impact of commodity price shocks on the energy and food components of HICP (see Chart 1). But also when these volatile components are excluded, HICP inflation has shown certain movements over time.

Chart 1 Longer-term inflation and inflation expectation developments

(annual percentage changes)



Source: ECB.

Note: The average HICP series is computed as the average annual inflation rate over the period from December 1999 to each of the subsequent months. In 1999 and 2000 the SPF collected five-years ahead inflation expectations only in the first quarter. The latest observation is for April 2012.

Nonetheless, the average of the annual rate of HICP inflation computed over the period from December 1999 to each of the subsequent months has hovered within a rather narrow band around 2%. This measure reflects how closely average inflation was in line with the price stability objective during Monetary Union.

In this context, it is apparent that longer-term inflation expectations have been much more closely aligned with longer-term averages than with shorter-term movements in actual inflation. In the period since 2001, when the SPF longer-term expectations became available on a regular basis, the mean level (point forecasts for inflation five years ahead) has moved in a narrow band between 1.80% and 2.03%.

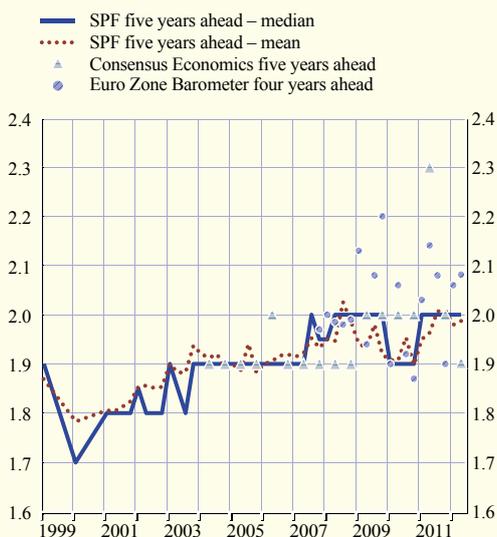
Developments in the mean level of SPF longer-term inflation expectations can be broken down into three broad phases (see Chart 2). The first phase covers a slight upward movement in the period prior to 2003. This coincided with a gradual upward movement in both overall HICP inflation and HICP inflation excluding volatile components from the low levels prevailing at the start of Monetary Union. The phase ended in mid-2003, possibly also reflecting the clarification at the time that, within the ECB definition of price stability as a year-on-year increase in the HICP for the euro area of below 2% over the medium term, the Governing Council aims to keep inflation “below” but “close to” 2%. This clarification is likely to have provided a more precise anchor for private sector expectations.

2 For a detailed description of the SPF, see Bowles, C. et al., “The ECB survey of professional forecasters (SPF) – A review after eight years’ experience”, *Occasional Paper Series*, No 59, ECB, April 2007.

3 The Euro Zone Barometer and the Consensus Economics survey report longer-term forecasts at a quarterly and bi-annual frequency, respectively. The SPF asks for longer-term expectations in each of the quarterly rounds. The reference horizon for longer-term forecasts is extended by one year in the January issue of the Eurozone Barometer, while it is extended only in the second half of the year for the Consensus Economics survey and the SPF. The longest forecast horizons covered by the SPF and the Euro Zone Barometer are the five and four-year ahead horizons, respectively, while the horizon in the Consensus Economics survey goes beyond five years, covering the period from six to ten years.

**Chart 2 Longer-term inflation expectations
from various surveys**

(annual percentage changes)



Sources: ECB, Consensus Economics and the Euro Zone Barometer.
Note: In 1999 and 2000 the SPF collected five-years-ahead inflation expectations only in the first quarter.

The second phase from mid-2003 to mid-2007 was one of broad stability in longer-term inflation expectations, which remained around this level of below, but close to, 2%. It coincided with a period in which developments in headline inflation and in HICP inflation excluding food and energy were relatively stable.

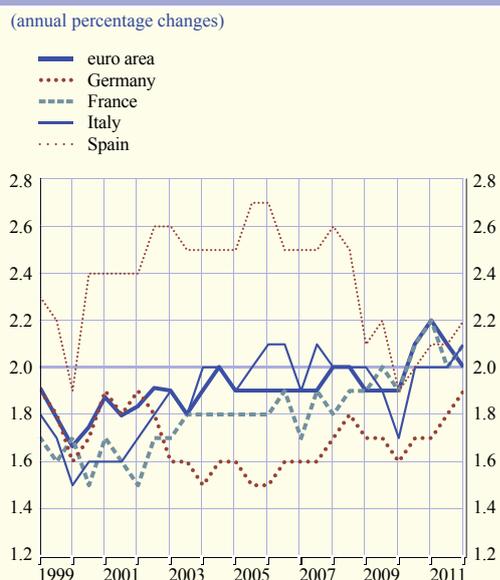
Since mid-2007, inflation expectations have again shown slightly stronger movements. This coincided with particularly large swings in actual inflation owing to global shocks related to commodity prices⁴ and world growth dynamics, and a generally more uncertain macroeconomic, fiscal and financial environment. Average longer-term inflation expectations in the SPF reached a peak of 2.03% in the third quarter of 2008, moderated to 1.90% in 2009, before increasing again to around 2.0% as from the second half of 2011. The median of the point forecasts, which is less influenced by outliers in the individual survey responses, has generally shown somewhat less variation than the mean but has also fluctuated in the period since mid-2007.

As shown in Chart 2, the mean point forecasts in the different private sector surveys have been typically very close to one another. However, Consensus Economics and Euro Zone Barometer longer-term forecasts have also displayed more volatility in recent years than before the Lehman bankruptcy. When comparing the movements in these means from one survey round to the next, it is important to note that Chart 2 reports data from the Consensus Economics survey and the Euro Zone Barometer with one decimal, which – due to rounding – can then suggest either stronger or weaker movements compared with the SPF, given the narrow bands in which longer-term inflation expectations move. Moreover, when comparing the mean levels across the different surveys, some differences in the degree of movement from one round to the next can be associated with the impact of outliers or of changes in the composition of the panel. The relatively large number of respondents in the SPF compared to the other surveys (approximately 45, on average, for the question on longer-term inflation expectations) implies that the survey mean in the SPF survey should be less affected in its reliability by outliers or by changes in the panel composition than that in other surveys.

The fact that longer-term inflation expectations for the euro area as a whole hovered within a narrow band around 2% conceals some differences across euro area countries (see Chart 3). Consensus Economics data (for the average inflation rate between six and ten years ahead, available only at one decimal) for the four largest euro area economies point to both different averages and more movement in the mean levels of longer-term expectations. For instance, for Germany expectations fluctuated around 1.7% and have never exceeded 1.9%, while for France they have been generally higher than for Germany. Longer-term inflation expectations for Spain have been at a significantly higher level compared with other large euro area countries and with the euro area average up until

4 The oil price peaked at almost 150 USD per barrel in July 2008, falling below 40 USD per barrel in December of the same year.

Chart 3 Longer-term inflation expectations for the euro area and the larger euro area economies

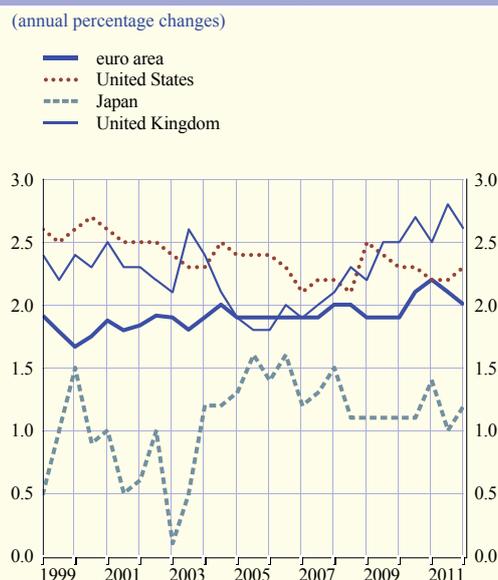


Source: Consensus Economics.
 Note: The latest observation is for April 2012.

the onset of the crisis in 2008. This is likely to reflect the boom period in the first decade of Monetary Union, which has now proven to be unsustainable. After the beginning of the crisis, the mean level of longer-term inflation expectations for Spain clearly declined, while that for Germany edged up somewhat. Overall, this implies more convergence in longer-term inflation expectations towards the euro area average across euro area countries in recent years, a phenomenon which should be natural for a monetary union in the longer-term.

There have also been differences between longer-term inflation expectations for the euro area as a whole and those for other advanced economies (see Chart 4). These differences relate to both the level of longer-term inflation expectations and the movements in this level over time. The mean level for the euro area from the Consensus Economics survey has generally been lower than those for the United States and the United Kingdom, and has also moved within a narrower band.⁵ Since the onset of the crisis in late 2008, the difference between the levels has narrowed vis-à-vis the

Chart 4 Longer-term inflation expectations for the euro area, the United States, the United Kingdom and Japan



Source: Consensus Economics.
 Note: The latest observation is for April 2012.

United States, but has widened vis-à-vis the United Kingdom, where expectations have displayed a broad upward movement in recent years.

Differences in the level and its movements can be related to the nature of the sample, but may also be a reflection of the clarity of definitions of the monetary policy objectives. In this respect, most central banks now provide quantifications of their price stability objectives that can serve to anchor longer-term inflation expectations. While the Federal Reserve has not given a quantitative definition of its price stability objective for a long time, in December 2011 the Federal Open Market Committee of the Federal Reserve Board specified that inflation at 2%, as measured by the price index for personal consumption expenditures, would be most consistent with the Federal Reserve's statutory mandate over the longer run.

5 The same conclusions can be drawn when comparing longer-term inflation expectations for the euro area with those for the United States and the United Kingdom, according to the respective surveys of professional forecasters by the Federal Reserve Bank of Philadelphia and the Bank of England.

In December 2003 the Bank of England defined its inflation target as 2.0% on average over time, based on the Consumer Prices Index measure.⁶ In February 2012 the Bank of Japan also introduced a price stability goal for the medium to long-term as part of its monetary policy framework: the goal is defined as a positive range of 2% or lower in terms of the year-on-year rate of change in the consumer price index, the specific goal being set at 1% for the time being to overcome deflation and achieve sustainable growth with stable prices. It is notable that inflation expectations in the euro area appear to be relatively close to the price stability objective when seen in international comparison. This conclusion also emerges from the J.P. Morgan Inflation Expectations Survey,⁷ which shows that, since 2009, the average percentage of respondents expecting medium-term inflation to be close to the policy objective has been above 50% for the euro area, compared with around 30% for the United Kingdom and the United States.

Overall, the limited movements in the mean level of longer-term inflation expectations for the euro area, both when compared with actual inflation developments and when compared with other economies, point to relatively well-anchored expectations in the period since 1999. However, the higher volatility in longer-term inflation expectations observed in recent years points to the need to closely monitor such expectations in the future.

2.2 UNCERTAINTIES SURROUNDING THE LEVEL OF INFLATION EXPECTATIONS

The relatively sound anchoring of the mean level of the SPF longer-term inflation expectations can conceal uncertainties surrounding this aggregate level at any point in time. The SPF offers two main ways of assessing such uncertainties.

First, uncertainty can be reflected in the disagreement among panellists about the level of longer-term inflation. Measured by the

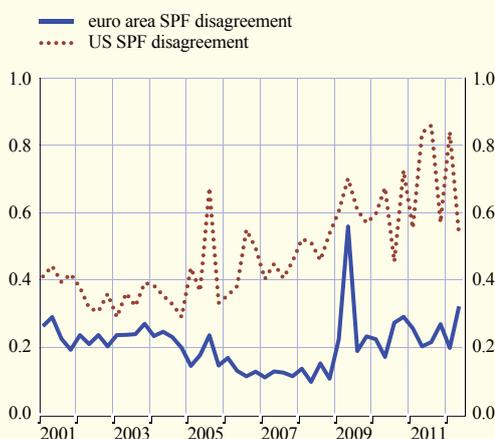
standard deviation of the individual point forecasts, this disagreement in the SPF has been mostly in the range of 0.1 to 0.3 percentage point (see Chart 5). Only in the second quarter of 2009 was there a one-off surge in disagreement. However, this reflected some extreme replies given by a small number of respondents. It took place when the euro area economy was in recession and downside risks to price stability were rising. The degree of disagreement has fallen again in the subsequent period, but has remained somewhat higher than in the years immediately preceding the crisis. By contrast, the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia shows that, in the United States, the disagreement about the level of longer-term inflation was not only higher than

6 This was equivalent to the former target of 2.5% defined in terms of the retail prices index excluding mortgage interest payments (RPIX), a symmetrical target introduced in 1997.

7 Launched in July 2009 and addressed to financial market participants, the J.P. Morgan Inflation Expectations Survey is conducted three times a year and covers expectations for the euro area, the United States, the United Kingdom, Japan and Australia. Among other questions, it asks about medium-term (two to five-year horizon) inflation expectations with respect to the respective central bank's objective.

Chart 5 Disagreement on longer-term inflation expectations in the euro area and the United States

(standard deviation of the point estimates)



Sources: European Central Bank and Federal Reserve Bank of Philadelphia.
Note: The latest observation refers to the second quarter of 2012 for the ECB SPF and for the US SPF.

in the euro area, but has also remained on a rising trend in recent years.⁸

Second, uncertainty can be reflected in the probability distribution that SPF panellists provide together with the point forecasts. These probabilities are expressed as a percentage and denote the likelihood that future outcomes for longer-term inflation will fall within specific intervals. The flatter the distribution, the more likely the respondents consider it that outcomes other than their central forecast for longer-term inflation will materialise. Using these individual probability distributions, an “aggregate” probability distribution can be obtained by averaging the probability assigned by the respondents to each specific range. This aggregate probability distribution typically has a stable shape, with the highest probability mass assigned to the interval between 1.5% and 1.9% and that between 2.0% and 2.4% (see Chart 6). Looking at the results of the survey in the first quarter of 2007 compared to the second quarter of 2009, it appears that the probability distribution became somewhat flatter after the onset of the crisis. This flattening may

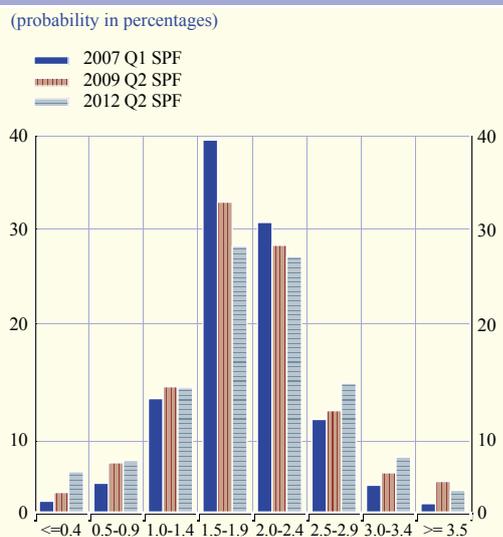
even have become somewhat more pronounced in the most recent survey rounds.

Condensing these aggregate probabilities in broader ranges shows that the probability assigned to longer-term inflation being in a range between 1.5% and 2.4% is currently slightly below 60% and has thus visibly declined since the onset of the financial crisis (see Chart 7). At the same time, the probabilities attached to longer-term inflation outcomes below 1% and at or above 3% rose to close to 10% in recent years for both of these extreme intervals. This confirms again that the distribution has flattened somewhat since the crisis, with higher probabilities assigned to the tail intervals.

The picture of flatter distributions and hence a higher uncertainty surrounding point forecasts is confirmed by looking at the standard deviations of probability distributions. In this

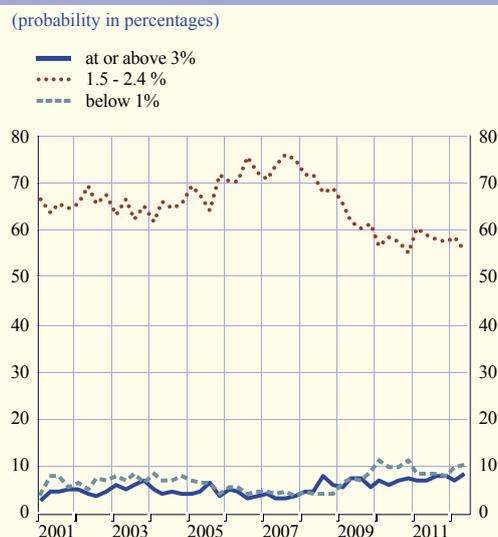
8 Data for the United States refer to the expectations for the average CPI rate over the next ten years. The higher degree and different trend of disagreement in the past few years in the United States relative to the euro area also hold when adjusted for the different levels of longer-term inflation expectations in the two economies.

Chart 6 Aggregate probability distribution of longer-term inflation expectations in selected SPF rounds



Source: ECB.

Chart 7 Probability of inflation outcomes falling in various ranges in the long term

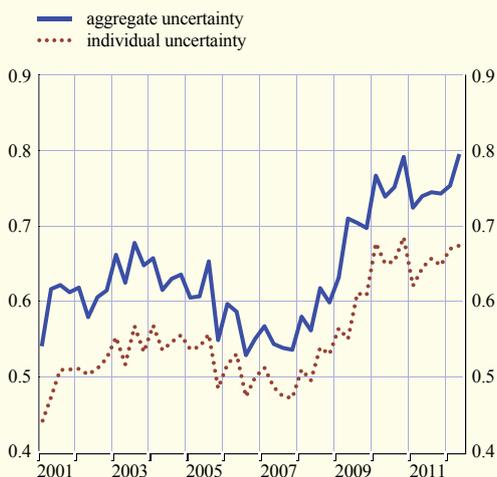


Source: ECB.

Note: The latest observation refers to the second quarter of 2012.

Chart 8 Uncertainty about longer-term inflation expectations from the SPF

(percentage points)



Source: ECB.

Note: Aggregate uncertainty is measured as the standard deviation of the aggregate probability distribution, while individual uncertainty is defined as the average standard deviation of the individual probability distributions. The latest observation refers to the second quarter of 2012.

respect, aggregate uncertainty is measured as the standard deviation of the aggregate probability distribution (see Chart 8), while individual uncertainty is defined as the average standard deviation of the individual probability distributions. Both these measures started to increase somewhat during 2008 and continued to do so up to end-2010. Since then, uncertainty around the longer-term inflation outlook has remained at relatively high levels.

Overall, the SPF results therefore suggest that the average level of inflation expectations is surrounded by uncertainty, and that this uncertainty has increased somewhat in the past few years. This again supports the conclusion that such expectations need to be closely monitored.

3 MARKET-BASED MEASURES OF LONGER-TERM INFLATION EXPECTATIONS

Market-based indicators of longer term inflation expectations are derived from inflation-linked instruments, notably inflation-linked bonds,

but also derivatives, such as inflation-linked swaps. They are available in real time and at a high frequency and are hence in principle more suitable for the real-time assessment of new movements in inflation expectations than survey-based measures. However, market-based measures are at the same time subject to higher volatility and distortions through risk premia.

3.1 INFLATION EXPECTATIONS DERIVED FROM FINANCIAL MARKETS

Daily information on inflation expectations is derived from market pricing of financial products linked to euro area HICP excluding tobacco. The ECB uses inflation-linked bonds issued by German and French sovereigns and inflation swaps. Break-even inflation rates (BEIRs) are computed as the difference between yields on nominal bonds and yields on comparable inflation-linked bonds at the same maturity.⁹ The BEIR level contains information on expected inflation over the maturity of the bond. However, BEIRs also include risk premia reflecting the uncertainty about future inflation outcomes, as well as changes related to the trading conditions.

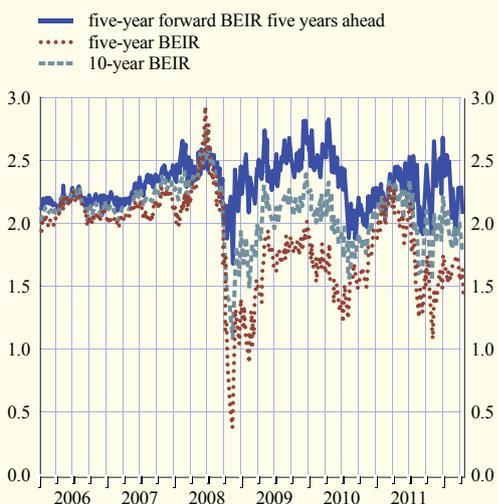
Spot measures of break-even inflation rates are much more volatile than longer-term forward measures, as they should also reflect shorter-term shocks to inflation (see Chart 9). For example, the five-year spot BEIR measures the average inflation expected for the next five years and therefore captures expectations for temporary deviations of inflation from the ECB's objective, for instance due to oil price shocks.

For the purpose of monitoring longer-term inflation expectations, the five-year forward BEIR five years ahead is one of the most suitable indicators. It measures the expected inflation for a five-year period starting in five years and is therefore not

⁹ In 2011 the ECB changed the method for estimating break-even inflation rates for the euro area to reduce distortions stemming from widening spreads between German and French bond yields, see the box entitled "Estimating real yields and break-even inflation rates following the recent intensification of the sovereign debt crisis", *Monthly Bulletin*, ECB, December 2011.

Chart 9 Euro area break-even inflation rates

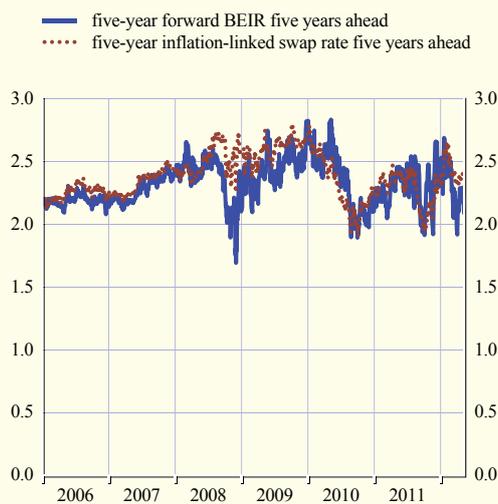
(percentage points)



Sources: Reuters and ECB calculations.
Note: Rates are seasonally adjusted. The latest observation refers to 9 May 2012.

Chart 10 Long-term forward euro area inflation expectations

(percentage points)



Sources: Reuters and ECB calculations.
Note: Rates refer to five-year forward inflation rates five years ahead. Bond-based rates are seasonally adjusted. The latest observation refers to 9 May 2012.

affected by short-term shocks as much as spot BEIRs are. As a result, it has for instance remained much more stable in the post-Lehman period than five and ten-year spot break-even rates. The same holds for the five-year inflation-linked swap rates five years ahead (see Chart 10).

Another important message arising from Chart 10 is that before the outbreak of the financial crisis, these forward measures of long-term inflation expectations had remained relatively stable at slightly above 2%. However, like the survey-based measures, the market-based measures have been more volatile thereafter.

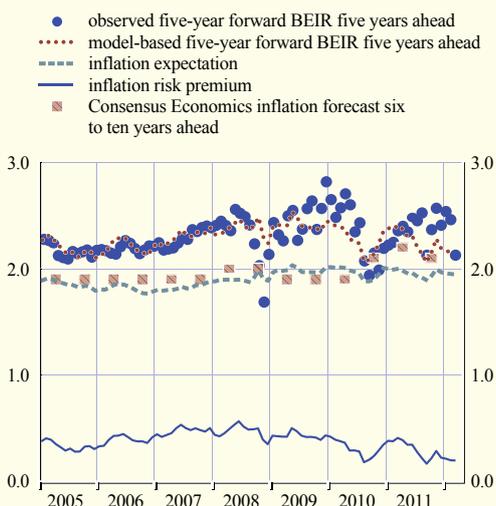
In this context, an assessment of the level and volatility of market-based measures of inflation expectations needs to take the risk premia in these measures into account. While these risk premia are not observable, they can be derived with models that decompose market prices into “pure” inflation expectations and inflation risk premia. The model used in Chart 11 is a term structure model of nominal and real yields, including information on realised inflation as well as survey-based inflation

expectations.¹⁰ Comparing the observed break-even inflation rates with the model-based break-even inflation rates shows that model residuals increased during the crisis. This is due to the increased volatility during the periods of market tensions. Going beyond these effects, a model-based decomposition suggests that “pure” inflation expectations have remained relatively stable and close to 2% (see Chart 11). Hence, while inflation risk premia usually cause market-based measures of longer-term inflation expectations to exceed survey-based measures, model-based analysis shows that correcting for these premia brings market-based and survey-based measures more closely in line with each other (see Chart 12).

10 For a description of the model, see Garcia, J.A. and Werner, T., “Inflation risks and inflation risk premia”, *Working Paper Series*, No 1162, ECB, March 2010. Similar models are used by the Bank of England and the Federal Reserve System. For a description of these models, see Joyce, M., Lasaoa, A., Stevens, I. and Tong, M., “Extracting inflation expectations and inflation risk premia from the term structure. A joint model of the UK nominal and real curves”, *Working Paper*, No 360, Bank of England, 2010 and Kim, D.H. and Wright J.H., “An Arbitrage-Free Three Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates”, *FEDS Working Papers*, The Federal Reserve Board, 2005.

Chart 11 Model-based contributions of inflation expectations, risk premia and observation noise to five-year forward BEIR five years ahead

(percentage points)



Sources: Bloomberg and ECB calculations.
Note: The model is based on that described in Garcia, J.A. and Werner, T. "Inflation risks and inflation risk premia", *Working Paper Series*, No 1162, ECB, March 2010. The latest observation refers to March 2012.

3.2 VOLATILITY OF MARKET-BASED INFLATION EXPECTATIONS AMID TURBULENCES

In the period before the collapse of Lehman, the differences between bond and swap-implied measures were relatively small as arbitrage operations under normal market conditions tie the swap and bond market together. However inflation-linked swap and inflation-linked bond markets are somewhat different; they often involve divergent market players and can therefore develop in different ways, especially at times of market tensions when arbitrage channels do not work efficiently, as has been the case for periods since 2008. The signals about the pricing in of inflation expectations from the two markets therefore need to be monitored together.

Differences in the level of inflation expectations received from inflation-linked bond and inflation-linked swap markets often occur during periods of significant flights-to-safety and flights-to-liquidity towards government bonds, which

Chart 12 Market-based and survey-based measures of inflation expectations in the euro area

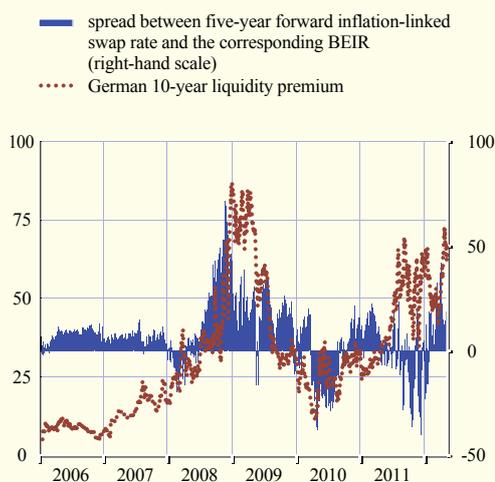
(percentage points)



Sources: Reuters, ECB and Consensus Economics.
Note: Rates are seasonally adjusted. The latest observation refers to 9 May 2012.

Chart 13 Liquidity premium and discrepancy between break-even inflation and swap rates

(basis points; 2 January 2006 to 9 May 2012)



Sources: Reuters and ECB calculations.
Note: Rates underlying the difference refer to five-year forward five-years ahead inflation rates. Bond-based rates are seasonally adjusted. The liquidity premium is measured by the spread between yields of German government-guaranteed agency bonds (issued by the Kreditanstalt für Wiederaufbau) and German sovereign bonds. The methodology is based on Ejsing, J., Grothe, M. and Grothe, O., "Liquidity and credit risk premia in government bond yields", *Working Paper Series*, No 1440, ECB, June 2012. The latest observation refers to 9 May 2012.

mostly benefit nominal bond markets, weighing on break-even inflation rates. Chart 13 shows that the discrepancy between five-year forward BEIR five years ahead and the corresponding inflation swap rates is correlated with an indicator of liquidity premia in the German nominal bond market, computed as a spread between government-guaranteed agency bonds and German nominal bonds.¹¹

Overall, the volatility of market-based measures of inflation expectations therefore depends

on general conditions in the broader financial markets. Tensions in inflation-linked markets are highly correlated with indicators for liquidity, market volatility and risk. Moreover, the short-term responsiveness of market-based measures of inflation expectations to economic surprises also seems to have increased during the crisis (see Box 1).

11 For the documentation of such effects in the euro area bond markets during the crisis, see the box entitled “New evidence on credit and liquidity premia in selected euro area sovereign yields”, *Monthly Bulletin*, ECB, September 2009.

Box 1

THE RESPONSIVENESS OF MARKET-BASED INFLATION EXPECTATION INDICATORS TO MACROECONOMIC ANNOUNCEMENTS – AN EVENT STUDY

Market-based inflation expectations are derived from inflation-linked financial products, which are traded at a high frequency. These measures therefore quickly reflect new information available to market participants. This box analyses the short-term reaction of euro area market-based inflation expectation indicators to surprises in macroeconomic news releases.

The focus of this analysis is on ten important economic announcements related to prices and real activity in the euro area and the United States. The surprise is defined as the difference between the actual release and the median of analysts’ expectations before the release as collected by Bloomberg. Daily changes in spot and forward break-even inflation rates (BEIRs) and inflation-linked swap rates are regressed on the economic announcement surprises.¹ Tables A and B show the regression results. As efficient markets should react quickly, the analysis focuses on daily changes of market-based indicators of inflation expectations on the day of the announcement. To account for the changes in the functioning of markets for inflation-linked products observed during the financial crisis, the analysis encompasses two periods of similar length: the pre-crisis period from 2004 to 2007 and the period from 2008 onwards.

The results suggest that markets for inflation-linked financial products reacted to only very few macroeconomic announcements in the pre-crisis period in a significant way.² Spot inflation expectations react more strongly than the forward measures, which is a positive result as spot inflation expectations should reflect the developments in the near future and thus also respond to transitory economic shocks. By contrast, if monetary policy is credible, longer-term forward inflation expectations are less expected to react to temporary business cycle movements.

1 A GARCH(1,1) methodology is used to take heteroscedasticity into account.

2 The magnitudes of the coefficients are interpreted as changes in basis points to a one unit surprise in the level of the economic indicator unless otherwise noted. The regression coefficients are rounded.

Table A Responsiveness of market-based inflation expectation indicators during the years 2004-07

(regression coefficients; estimates in basis points; 1 February 2004 to 31 December 2007)

Announcement	Five-year BEIR	Ten-year BEIR	Five-year forward BEIR five years ahead	Five-year swap	Ten-year swap	Five-year forward swap five years ahead
Eurozone Services Purchasing Managers' Index	-1	0	1	0	0	-1
Eurozone Flash HICP	6***	3***	3	8***	4***	1
Eurozone GDP Constant Prices	0	2	2	10***	7	4
Eurozone Manufacturing Purchasing Managers' Index	0	0	1	-1	0	0
German Import Prices	1	1	1	0	1	1
IFO Germany Business Climate	0	0	0	0	0	0
US Purchasing Managers' Index	0***	0	0	0	0**	0*
US Producer Price Index	0	0*	1	1**	1	1
US initial jobless claim ('00,000)	1	-1	-1	-1	-1	0
US non-farm payrolls (net change) ('00,000)	0	0	0	0	0	0

Sources: Bloomberg, Xetra and ECB calculations.

Note: *, ** and *** denote statistical significance at the 10%, 5% and 1% levels using two-sided t-tests.

Table B shows that in the crisis period more variables are significant for explaining daily movements in inflation expectation indicators, notably for swap market measures. The results for the two periods suggest that particularly long-term spot measures of inflation expectations have reacted more strongly in the latest subsample. The fact that, overall, news has had a stronger effect on market-based measures of inflation expectations since the outbreak of the financial crisis most likely reflects the increased pricing of inflation risk premia among market participants. Nonetheless, the conclusion holds that forward rates are significantly less affected by economic news than spot rates, which is a comforting signal for monetary policy credibility.

This analysis is an event study; the results assess the impact of economic news on the inflation expectation measures on the day of the announcement and, for example, do not show whether the effects on the indicators were caused by changes in inflation expectations or by factors affecting the functioning of inflation-linked markets such as an increase in the liquidity risk premia. Similarly, the regressions do not directly reveal whether the reactions are transitory or have a persistent effect. Therefore the results of this empirical analysis should be assessed with caution.

Table B Responsiveness of market-based inflation expectation indicators during the period from 2008 onwards

(regression coefficients; estimates in basis points; 1 January 2008 to 31 March 2012)

Announcement	Five-year BEIR	Ten-year BEIR	Five-year forward BEIR five years ahead	Five-year swap	Ten-year swap	Five-year forward swap five years ahead
Eurozone Services Purchasing Managers' Index	2	2	1	0	0	0
Eurozone Flash HICP	10*	5	-1	9***	6***	2
Eurozone GDP Constant Prices	-3	0	9	6	6	6
Eurozone Manufacturing Purchasing Managers' Index	1	1	-2	4***	3***	3***
German Import Prices	1	2**	4***	0	1	2***
IFO Germany Business Climate	0	0	-1	0	0	0
US Purchasing Managers' Index	0	0	0	0	0***	0
US Producer Price Index	1	1	1	1	1*	1
US initial jobless claim ('00,000)	-4	-2	0	-3	-2	-2
US non-farm payrolls (net change) ('00,000)	1	0	-1	1***	1***	1

Sources: Bloomberg, Xetra and ECB calculations.

Note: *, ** and *** denote statistical significance at 10%, 5% and 1% level using two-sided t-tests.

4 CONCLUSIONS

The evidence from survey-based and market-based measures of longer-term inflation expectations for the euro area suggests that these expectations have remained relatively well-anchored. This holds through periods in which actual inflation developments have been heavily affected by commodity price developments, but also in the midst of the financial and sovereign debt crises of the past few years. At the same time, while the level of longer-term inflation expectations has continued to hover within a relatively narrow band around 2%, there has been somewhat more uncertainty surrounding this level since the onset of the crisis in 2008. This probably reflects the substantial financial, fiscal and macroeconomic disturbances associated with the crisis and the strong

economic adjustment processes in response to these disturbances.

Keeping longer-term inflation expectations well-anchored is of paramount importance in such an environment. Box 2 illustrates this again on the basis of a structural model. In the euro area, well-anchored inflation expectations have not only helped in ensuring price stability, but also in containing the fallout from the financial crisis and the associated slowdown in economic activity. The remarkable stability of longer-term inflation expectations documents the ECB's credible commitment to deliver price stability and its solid track record in this respect since the inception of the single monetary policy in 1999. At the same time, the high uncertainty in recent years indicates the need to continue monitoring these expectations closely in the future.

Box 2

THE CONSEQUENCES OF A DE-ANCHORING OF LONGER-TERM INFLATION EXPECTATIONS IN A STRUCTURAL MODEL

A de-anchoring of longer-term inflation expectations would undermine the central bank's ability to maintain price stability and would give rise to more widespread macroeconomic instability. This box employs the ECB's New Area-Wide Model (NAWM)¹ to illustrate the economic consequences of an upward shift in longer-term inflation expectations. This shift is implemented through a shock to the private sector's perceptions of the central bank's price stability objective, whereas the actual price stability objective remains unchanged.

The panels in the chart portray the effects on the perceived price stability objective, consumer price inflation, real GDP growth and the short-term nominal interest rate of a one-off 25 basis points shock to agents' perceptions of the objective.² It is assumed that all variables are equal to their long-run values prior to the shock, represented by the zero lines in the chart.

The model-based illustration covers three distinct monetary policy reactions: (A) the central bank follows the prescriptions of the interest rate-reaction function embedded in the model;³ (B) the central bank reacts also to the de-anchoring of inflation expectations by responding to deviations of the perceived price stability objective from the actual objective; and (C) the central

1 See Christoffel, K., Coenen, G. and Warne, A., "The New Area-Wide Model of the euro area: A micro-founded open-economy model for forecasting and policy analysis", *Working Paper Series*, No 944, ECB, October 2008.

2 For further discussion and details on modelling inflation expectations using the approach taken in this box, see Gürkaynak, R.S., Levin, A.T., Marder, A.N. and Swanson E.T., "Inflation targeting and the anchoring of inflation expectations in the Western Hemisphere", *Economic Review*, pp. 25-47, Federal Reserve Bank of San Francisco, 2007.

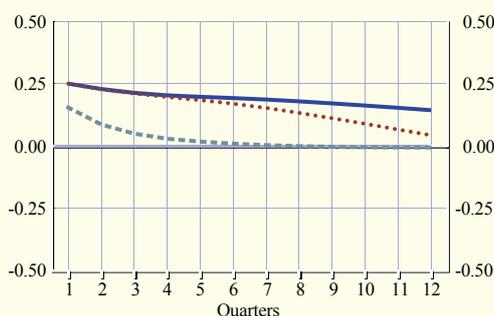
3 The reaction function of the central bank in the NAWM is standard and includes consumer price inflation, the actual price stability objective and real GDP growth. For details, see Christoffel, K., Coenen, G. and Warne A., op cit.

Impact of an upward shift in longer-term inflation expectations and the role of monetary policy

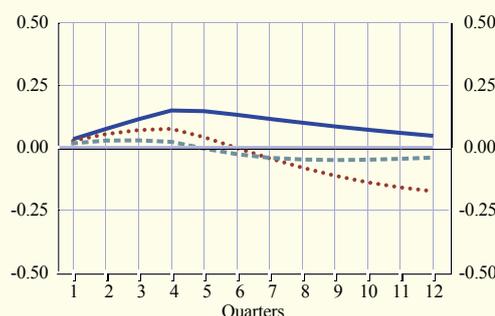
- upward shift in inflation expectations
- ... with offsetting policy and inattentive expectations
- ... with offsetting policy and attentive expectations

(a) Perceived price stability objective

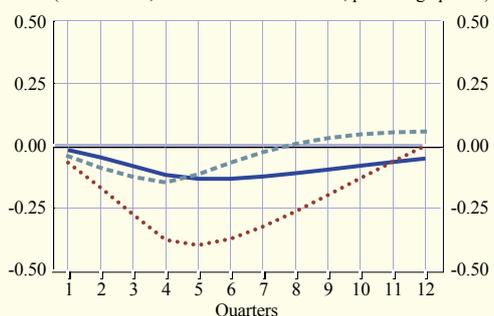
(annualised rates, deviations from baseline, percentage points)

**(b) Consumer price inflation**

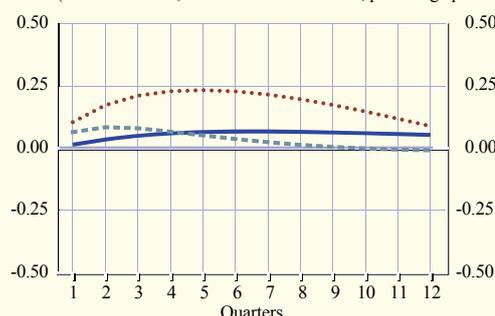
(annual rates, deviations from baseline, percentage points)

**(c) Real GDP growth**

(annual rates, deviations from baseline, percentage points)

**(d) Short-term nominal interest rate**

(annualised rates, deviations from baseline, percentage points)



Source: NAWM-based simulations.

bank, in addition to (B), attempts to influence the private sector's expectation formation directly by means of an effective communication of its intentions.

Turning first to case (A), the perceived price stability objective immediately increases by 25 basis points (solid blue line) in response to the underlying shock. This increase in the perceived objective leads forward-looking firms to adjust their prices upward, while households require higher wages. Because of the implied reduction in households' real income and higher labour costs, aggregate demand and employment fall. As a consequence of these private sector reactions, annual consumer price inflation gradually increases with a peak effect of approximately 15 basis points after about one year. Annual real GDP growth falls by a similar amount, reaching a trough after four to five quarters. According to the reaction function in the model, the central bank raises the interest rate moderately in response to these inflation and output developments. In the absence of further shocks, the perceived price stability objective slowly returns towards the baseline, because the private sector agents gradually correct their misperceptions as they observe that consumer price inflation remains below the perceived objective.

The fact that the return towards the baseline is very slow may tempt the central bank to react directly to the misperceptions of the private sector. An offsetting policy response, as assumed in case (B), leads to a stronger interest rate increase (dotted red line) and, accordingly, real GDP falls more sharply, while consumer price inflation is lower than in the case without the offsetting response. In the absence of a direct impact on the private sector's inflation expectations, i.e. with "inattentive" expectations, the perceived price stability objective adjusts very sluggishly and remains close to the values under case (A) until about five quarters after the shock. By then, consumer price inflation has fallen sufficiently for the offsetting policy response to have a discernible reversing effect on the perceived price stability objective.

To the extent that private sector agents in case (B) do not consider the possibility that their perceptions of the price stability objective differ from the actual objective, an important effect that arises from the central bank's reaction to agents' misperceptions is that the policy response is stronger than in case (A) and, hence, that the actual interest rate is considerably higher than the level that private sector agents had expected. As seen for case (B), this mismatch between actual and expected policy can have notable effects on the economy. However, if the central bank can communicate its intentions clearly and effectively, it is conceivable that the private sector's misperceptions may be corrected more swiftly. This case (C) is referred to as an offsetting policy response with "attentive" expectations (dashed green line), where private agents recognise the mismatch between actual and expected policy at an early stage and correct their misperceptions accordingly.

The chart shows that the direct impact of the underlying shock on the perceived price stability objective is considerably lower for case (C), with the perceived price stability objective falling back to the actual objective after about one year. The consequences for consumer price inflation and real GDP growth as well as for the actual interest rate are therefore much more benign. Hence, by effectively combining "words with deeds", the central bank's monetary policy can succeed in forestalling the risks of an upward shift in inflation expectations.