

ARTICLES

MEASURES OF INFLATION EXPECTATIONS IN THE EURO AREA



The analysis and assessment of private sector expectations for euro area inflation is of great importance for the ECB. The ECB uses measures of inflation expectations to cross-check its own assessment of the inflation outlook in the short to medium term. In addition, longer-term measures of inflation expectations provide indications of the overall credibility of the ECB in the eyes of survey respondents and financial market participants as regards the achievement of its price stability objective.

This article reviews measures of inflation expectations in the euro area beyond the one-year horizon. Surveys ask participants directly about their views on expected inflation and can thus be interpreted as direct measures of inflation expectations. Inflation expectations can also be extracted from financial market instruments for a wide range of horizons. However, these measures may be distorted by unobservable premia, in particular inflation risk premia, which make them more difficult to interpret and analyse.

The strengths and weaknesses of the various indicators argue in favour of a broad range of measures that combine analysis and a regular cross-checking of different sources. Available evidence suggests that, despite a number of upside price shocks and the ongoing deviation of shorter-term inflation expectations from actual inflation outcomes, longer-term inflation expectations have remained well-anchored, consistent with a high degree of credibility for monetary policy as regards the maintenance of price stability in the medium to long term.

I INTRODUCTION

Stabilising the private sector's inflation expectations is a prerequisite for monetary policy to be able efficiently to achieve the objective of price stability. Given the substantial costs associated with inflation (and deflation), this objective helps to increase economic welfare and the growth potential of an economy.¹ Thus, the analysis and assessment of private sector expectations for euro area inflation is of key importance for the ECB. Moreover, the ECB can also use measures of inflation expectations to cross-check its own assessment of the outlook for future inflation.

This article reviews the available measures of inflation expectations in the euro area beyond the one-year horizon, and considers the main aspects that should be borne in mind when interpreting such indicators. It explores several factors that have important implications for the way in which the different measures of inflation expectations should be interpreted: the different sources of price expectations (surveys and financial markets); the different agents (households, professional forecasters and financial market participants) involved in the

formulation of the expectations; and the different horizons of those expectations. The table below summarises the available measures of inflation expectations in terms of their differences and similarities with regard to agents, frequency and forecasting horizons.

Section 2 describes survey-based measures of inflation expectations and Section 3 reviews financial market-based measures. Section 4 concludes by reviewing the relative advantages and disadvantages of both sets of measures and stressing the need to cross-check the signals they provide.

¹ For more information regarding the role of monetary policy and the benefits of price stability, see ECB, "The Monetary Policy of the ECB", 2004.

Summary of available measures of euro area inflation expectations more than twelve months ahead

Source	Agents	Frequency	Horizons
Survey-based measures			
European Commission consumer survey	Consumers	Monthly	Twelve months ahead
ECB Survey of Professional Forecasters	Professional forecasters	Quarterly	– Current and next calendar years (and rolling horizons one and two years ahead) – Five years ahead
Consensus Economics	Professional forecasters	Monthly Biannual	– Current and next calendar years – Six to ten years ahead
Euro Zone Barometer	Professional forecasters	Monthly Quarterly	– Current and next calendar years – Four years ahead
Financial market-based measures			
Break-even inflation rates	Financial market participants	Intra-day	At present, between two and around thirty years ahead
Inflation-linked swap rates	Financial market participants	Intra-day	Two to thirty years ahead

2 SURVEY-BASED MEASURES OF INFLATION EXPECTATIONS

There are several available surveys of private sector inflation expectations in the euro area. These fall into two broad categories: short-term – i.e. one to two years ahead – and longer-term. Private sector inflation expectations up to two years ahead are relevant for monetary policy, since they may help in assessing the possible reaction of agents to different shocks to prices, as well as indicating the nature of shocks as perceived by the private sector. They may help to assess, for example, the risk of second-round effects following an oil price shock. The longer the horizons of inflation expectations, the less they should be affected by the short-term propagation of shocks and the more they reflect the level of credibility accorded to the ECB by economic agents as regards its commitment to achieving price stability for the euro area.

THE EUROPEAN COMMISSION CONSUMER SURVEY ON INFLATION EXPECTATIONS

Every month since 1985 the European Commission has reported consumers' expectations for consumer price trends over the following 12 months on the basis of a survey of nearly 20,000 consumers in the euro area. This

consumer survey is conducted at the national level and the results for the euro area are compiled by aggregating the country data. Consumers are not asked to put a precise figure to the average rate of inflation they anticipate, but simply to indicate whether they expect inflation to rise, fall or remain unchanged.² The indicator of expected inflation thus remains qualitative in nature and, as a result, provides information only on the expected direction and pace of change in prices, and therefore inflation expectations, over the following 12 months.³ The results of the survey are generally summarised using a balance statistic indicating the difference between the percentage of

² Participants in the European Commission's survey of consumers specifically reply to the following question, which is harmonised across countries: "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will ...
– increase more rapidly;
– increase at the same rate;
– increase at a slower rate;
– stay about the same;
– fall".

See also http://europa.eu.int/comm/economy_finance/indicators/businessandconsumersurveys_en.htm.

³ It is also possible to derive a quantified measure of inflation expectations from the qualitative replies to the European Commission's survey. See Forsells, M., and Kenny, G., "Survey Expectations, Rationality and the Dynamics of Euro Area Inflation", *Journal of Business Cycle Measurement and Analysis*, Vol. 1, No 1, 2004, pp. 13-41.

consumers thinking that consumer prices will increase and the percentage of consumers stating that prices will decrease or remain unchanged.

Prior to the euro cash changeover in January 2002, there was a close relationship between the European Commission's qualitative indicator of consumers' inflation expectations and actual inflation developments, with a correlation coefficient close to 1 (see Chart 1). A cross-correlation analysis between the two series reveals that consumers' inflation expectations tend to be more strongly correlated with inflation developments in the recent past, at the time of the survey and up to seven months ahead, than with the inflation levels one year ahead, on which they purport to focus. This suggests that the indicator of consumers' inflation expectations may contain information about horizons that are shorter than the 12-month horizon to which the survey question refers, and also that consumers' expectations may be strongly influenced by recent and current inflation developments.

After the euro cash changeover, the close relationship between consumers' expectations and actual inflation broke down and the correlation between the two series dropped (to

stand at around 0.4 since 2002). It thus appears that the surge in consumers' perceptions of past inflation linked to the introduction of the euro banknotes and coins distorted, at least for a while, consumers' expectations of future inflation (see the box entitled "Consumers' inflation perceptions: still at odds with official statistics?" in the April 2005 issue of the Monthly Bulletin).

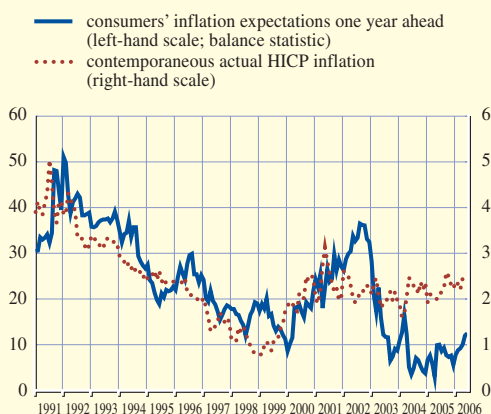
THE ECB SURVEY OF PROFESSIONAL FORECASTERS

Every quarter since the beginning of 1999 the ECB has carried out its Survey of Professional Forecasters (SPF). The SPF collects information about forecasts for euro area HICP inflation one, two and five years ahead, as well as for a few other relevant variables (mainly real GDP growth and the unemployment rate).⁴ The panel comprises more than 70 forecasters located across the European Union. These forecasters are required to possess the necessary expertise to provide macroeconomic forecasts relating to the euro area. Around 60% of the SPF panel are participants from the financial sector (mainly banks), while the remainder are non-financial research institutes, employers' associations and labour organisations.

Since the beginning of the SPF in 1999, SPF panellists have underestimated inflation by an average of 0.5 percentage point at both one and two-year forecasting horizons. SPF average errors appear to be strongly correlated with the cluster of large, unanticipated and generally upward shocks that have hit HICP inflation between 1999 and 2006 (e.g. oil price increases in 2000 and between 2004 and 2006; unprocessed food price increases linked to the outbreaks of BSE and foot-and-mouth disease in 2001; and rises in administered prices and tobacco taxes announced in late 2004).

Despite this underestimation of inflation, there is some evidence that inflation expectations derived from the SPF compare reasonably well

Chart 1 Consumers' inflation expectations and actual HICP



Sources: Eurostat and European Commission.

⁴ See Garcia, J. A., "An introduction to the ECB's Survey of Professional Forecasters", ECB Occasional Paper No 8, September 2003.

with those of other available surveys and indicators. Standard forecast performance statistics, such as the root mean square error, show that SPF forecasts are more accurate than a naive, purely backward-looking forecast, and that they contain information about future inflation rates beyond that already contained in the inflation rate for the most recent past. Since 1999, SPF forecasts have also been slightly more accurate than a quantified measure of consumers' inflation expectations derived from the replies to the European Commission survey described earlier. This is in line with the idea that professional forecasters have specialist knowledge that allows them to form more accurate estimates of future inflation.

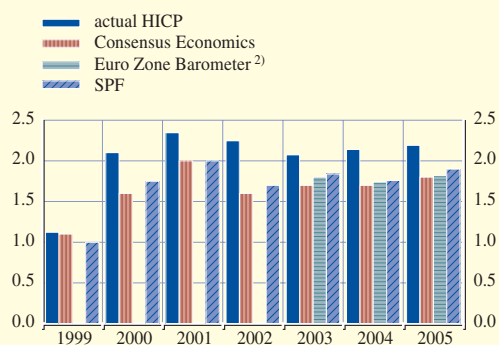
The SPF forecasters also report longer-term inflation expectations (five years ahead). Evidence up to the latest SPF round conducted in April 2006 has shown long-term average inflation expectations remaining unchanged at 1.9% for 18 consecutive quarters. However, this unchanged mean since early 2002 conceals regular revisions by individual forecasters which have offset each other. In fact, many respondents continuously review and update their estimates of longer-term inflation expectations. An analysis of individual responses shows that, on average between 2002 and the first half of 2006, around half of all survey participants changed their long-term expectations from one year to the next.

Finally, another feature of the SPF is that it provides a probability distribution for expected inflation at both shorter and longer-term horizons. This useful information helps to assess risks to the average inflation forecasts as perceived by the private sector over various horizons.

OTHER SURVEYS ON INFLATION EXPECTATIONS

Two other surveys also report forecast averages derived from panels of professional forecasters. Consensus Economics Inc., a private company, has published monthly average forecasts for major economic variables for several countries since 1989. It publishes the forecast averages of

Chart 2 Professional forecasters inflation expectations¹⁾ versus actual HICP



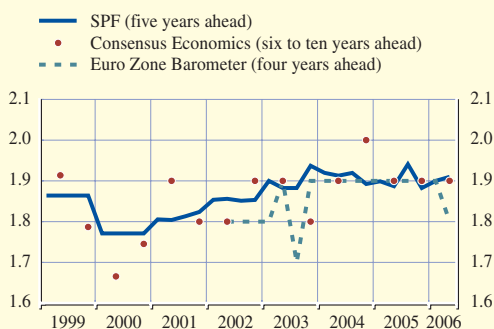
Sources: Eurostat, ECB, MJEconomics and Consensus Economics.
 1) Forecasts made in January for the current year.
 2) Started in 2003.

professional forecasters (mainly banks and financial institutions) for euro area consumer prices for the year in question and for the following calendar year based on a panel of around 30 participants. Twice a year, in April and October, it also publishes longer-term forecasts (i.e. six to ten years ahead), which, although based on a smaller panel than the SPF, provide an additional, complementary measure of longer-term inflation expectations.

Similarly, since 2002, MJEconomics, a London-based consultancy, has been publishing its "Euro Zone Barometer", which also contains forecasts for euro area HICP inflation one and two calendar years ahead, based on a panel of professional forecasters, as well as a quarterly breakdown of the outlook over the two years ahead. Longer-term forecasts (up to four years ahead) are available on a quarterly basis.

Looking at recent years, inflation expectations one year ahead derived from these surveys have, like those of the SPF, not surprisingly failed to predict the impact of the cluster of upward shocks to prices experienced since 1999 (see Chart 2). However, this period has also been quite exceptional, and one should not generalise on the basis of such a small sample. For example, the average root mean square error of the Consensus Economics forecasts between 1990

Chart 3 Longer-term inflation expectations



Sources: ECB, MJEconomics and Consensus Economics.
Note: In 1999 and 2000 longer-term inflation expectations were only polled in the January SPF.

and 1998 was twice as small as that of the most recent period. In general, evidence shows that by pooling individual private sector forecasts, the forecast error variance tends to be reduced. As a result, pooled forecasts typically outperform individual forecasts.

Turning to longer-term horizons, the inflation expectations of Consensus Economics and the Euro Zone Barometer have, as in the case of the SPF, remained broadly stable in recent years, below but close to 2% (see Chart 3).

3 FINANCIAL MARKET-BASED MEASURES

Financial market-based measures of euro area inflation expectations refer mainly to the so-called break-even inflation rates extracted from index-linked and conventional nominal government bonds and inflation-linked swap rates. This section describes inflation expectations in the euro area based on these measures at different longer-term horizons (i.e. more than two and, especially, more than five years ahead). Given the longer-term horizons and the fact that these financial instruments have all become available only after the introduction of the euro, their predictive relationship with realised inflation cannot yet be properly assessed.

BREAK-EVEN INFLATION RATES

The market for inflation-linked bonds represents an important source of information from which to extract market participants' inflation expectations. Index-linked bonds are bonds with a principal value and coupon payments that are linked to a price index. The spread between the yield on a conventional nominal bond and that on an index-linked bond of the same maturity is often referred to as the "break-even" inflation rate, as it would be the hypothetical rate of inflation at which the expected real (i.e. inflation-adjusted) return on the two bonds would be the same if both were held until maturity. Therefore, break-even inflation rates provide information, on the basis of market trades, about market participants' average inflation expectations over the residual maturity of the bonds.

Some caution is warranted, however, in the interpretation of break-even inflation rates as an indication of market participants' inflation expectations.

First, the typical reference index used for bonds linked to euro area inflation is the HICP excluding tobacco. As the inflation rate measured by the total HICP (i.e. including tobacco) has, over recent years, been slightly higher than that derived from the HICP excluding tobacco, there has been a small negative bias in those break-even inflation rates when regarded as indicators of expectations for total HICP inflation.

Second, the break-even inflation rate tends to overstate inflation expectations because of an inflation risk premium and to understate them because of a liquidity premium. As future inflation will erode the stream of payments from the conventional nominal bond, but not that from the index-linked bond, investors are likely to request a risk premium for holding nominal bonds. The difference between comparable nominal and index-linked bond yields is likely, then, to incorporate an inflation risk premium required by investors as compensation for inflation uncertainty

encountered when holding nominal bonds with long maturities.⁵ Moreover, as the liquidity of the index-linked bond is typically lower than that of the conventional nominal bond, this may lead to a higher liquidity premium being embedded in the yields on index-linked bonds than would be the case for the comparable nominal bond. The bid-ask spreads on bonds indexed to the euro area HICP excluding tobacco do indeed tend to be a few basis points higher than those on conventional nominal bonds.

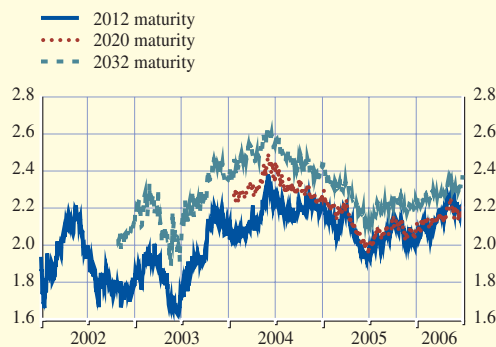
The third and final note of caution regarding the interpretation of break-even inflation rates is that their movements may occasionally reflect institutional and technical market factors. Such factors could be, for instance, tax-related distortions, changes in regulations affecting investors' tax liabilities, incentives affecting the prevailing demand for index-linked instruments or seasonal patterns in inflation owing to the existence of a lag in the indexation structure of index-linked bonds. The last factor particularly affects shorter-term break-even inflation rates, and the way in which this effect manifests itself depends on the circumstances.

All of these potential distortions, although difficult to isolate and quantify, should always be taken into account in the interpretation of break-even inflation rates as a market-based measure of inflation expectations. In particular, the yield spread between nominal and index-linked bonds should be interpreted as reflecting the entire inflation compensation required by market participants, rather than a "simple" expected break-even inflation rate.

Chart 4 depicts the break-even inflation rates calculated from index-linked bonds of different maturities (2012, 2020 and 2032) issued by the French Treasury, starting in January 2002. The first bond indexed against euro area inflation was issued in November 2001. Other maturities of bonds issued by the French, Italian, Greek, and – since March 2006 – German governments are also available. All of those bonds are indexed to the euro area HICP excluding tobacco. Several observations emerge from the chart.

Chart 4 Euro area break-even inflation rates at different maturities

(daily data; percentages per annum)



Sources: Reuters and ECB calculations.

First, as expected, break-even inflation rates vary over time and across maturities. In particular, until mid-2004, break-even inflation rates fluctuated substantially. Second, the longer the maturity, the higher the break-even inflation rate tends to be, probably reflecting the fact that the inflation risk premium increases with the horizon. Looking at developments since 2005, the break-even inflation rates derived from the index-linked bonds maturing in 2012 and 2020 have been between 2% and 2¼%, while the break-even inflation rates derived from the bonds maturing in 2032 have fluctuated between 2.1% and 2.4%.

The growing range of maturities for which bonds indexed to the euro area HICP have become available allows a direct comparison of average inflation expectations over different horizons. In this respect, the calculation of the "implied forward break-even inflation rates" embodied in "spot" break-even inflation rates proves to be particularly useful. Spot break-

5 Quantitative estimates for the US inflation risk premium vary substantially, ranging over time between 20 and 140 basis points. See Ang, A., and Bekaert, G., "The Term Structure of Real Interest Rates and Expected Inflation", Columbia Business School, Working Paper, September 2003, and Buraschi, A., and Jiltsov, A., "Inflation risk premia and the expectations hypothesis", *Journal of Financial Economics*, 75, 2, 2005, pp. 429-490. Reliable quantitative estimates for the euro area are even harder to achieve, given the very small euro area sample. Indications of the level of such estimates are provided at the end of this section.

even inflation rates should reflect the average inflation compensation required by investors over the residual maturity of the bond. This period can, for example, be decomposed into the average inflation compensation up to 2012, as measured by the spot break-even inflation rates derived from the French index-linked bonds maturing in 2012, and the average inflation compensation between 2012 and 2015, as measured by the implied forward break-even inflation rate derived from the French bonds maturing in 2012 and 2015. The broadening range of index-linked bonds with different maturities in the euro area also allows the calculation of constant-maturity index-linked bond yields, and thus also constant-maturity break-even inflation rates (see the box entitled “Estimation of constant-maturity index-linked bond yields and break-even inflation rates for the euro area” in this issue of the Monthly Bulletin).

The differential between, for instance, one-year implied forward break-even inflation rates nine and nineteen years ahead can be viewed as a proxy for the additional inflation risk premium over this ten-year period, because there is no reason to alter inflation expectations so far ahead in the future, given the lack of any additional information. Put differently, given that inflation expectations beyond the ten-year forecasting horizon can be expected to remain unchanged, the difference between the two implied forward break-even inflation rates reflects an additional inflation risk premium for very long maturities. Following this approach and ignoring the size of any liquidity premium and technical market factors, the additional inflation risk premium over this ten-year period has, since January 2005, averaged around 25 basis points. It is important to note that the level of the additional inflation risk premium depends on the horizons used in the calculations, because the marginal increases in the inflation risk premium tend to decrease as maturities lengthen.

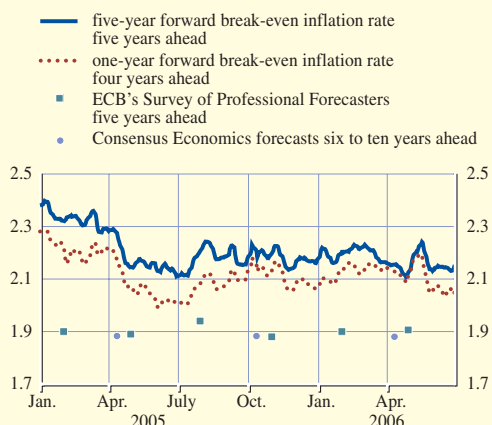
Another way of providing a crude quantification of the inflation risk premium embodied in

break-even inflation rates is to examine the long-run average of differences between implied forward break-even inflation rates and survey-based inflation expectations for a given maturity. This proxy for the inflation risk premium assumes that the expectations of market participants do not generally deviate significantly for long periods of time from those of survey respondents, and that the survey-based measure of inflation expectations provides an unbiased measure of inflation expectations. In addition, this proxy ignores the size of the liquidity risk premium and technical market factors, and can therefore be seen only as a very crude measure of the inflation risk premium.

Following this method, a comparison of the five-year implied forward break-even inflation rate five years ahead with the expected inflation rate six to ten years ahead, as determined by Consensus Economics and plotted in Chart 5, shows that this proxy for the inflation risk premium has averaged around 30 basis points since 2005. Similarly, comparing the one-year implied forward break-even inflation rate four years ahead with the inflation expectations derived from the ECB’s SPF five years ahead shows that this crude proxy of the inflation risk

Chart 5 Euro area implied forward break-even inflation rates and survey measures of inflation expectations

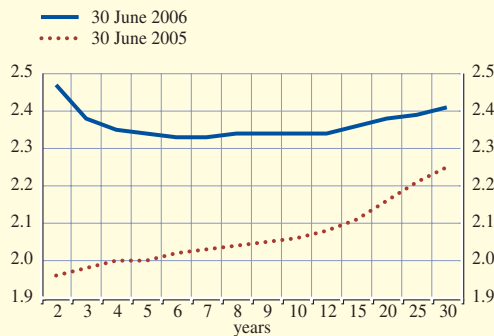
(percentages per annum)



Sources: Consensus Economics, ECB, Reuters and ECB calculations.

Chart 6 Euro area inflation curve derived from inflation-linked swap rates

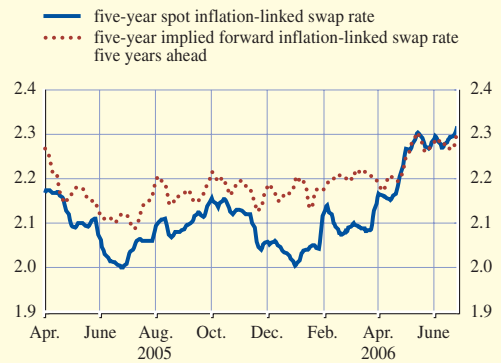
(percentages per annum)



Sources: Reuters, ICAP and ECB calculations.

Chart 7 Euro area five-year spot and implied forward inflation-linked swap rates

(daily data; five-day moving averages; percentages per annum)



Sources: Reuters, ICAP and ECB calculations.

premium for this shorter horizon has stood at between 15 and 40 basis points since 2005 (see also Chart 5).

INFLATION-LINKED SWAP RATES

Inflation-linked swap quotations are an additional source of information about market participants' inflation expectations (see the box entitled "Deriving euro area inflation expectations from inflation-linked swaps" in the September 2003 issue of the Monthly Bulletin). In an inflation-linked swap agreement, an investor commits to a single payment (zero coupon) on the basis of a fixed rate agreed at the outset and, in return, receives payments based on realised inflation over the life of the contract. The euro area inflation-linked swap market has grown significantly since 2002, probably helped by the increasing demand for inflation-linked instruments. Institutional investors have used this market to hedge against the risk of high inflation, given that their liabilities are linked to inflation, while corporations with revenues linked to inflation, such as utilities and retailers, have used it to hedge against the risk of low inflation.

Inflation-linked swaps offer a wide range of maturities, particularly for medium-term horizons, making it possible to observe a clear term structure for inflation-linked swap rates

(see Chart 6). The slope of the inflation-linked swap rate curve tends to point upwards, probably owing to term premia and inflation uncertainty rising as maturities lengthen. In addition to this inflation risk premium, these rates can also be distorted by a counterparty risk. The latter risk, however, is usually mitigated through collateral. The exact magnitude of these distortions is not known. The resulting inflation-linked swap rates should, therefore, not be interpreted as direct market expectations of future inflation rates. Nevertheless, the inflation-linked swap rate curves suggest that inflation expectations among financial market participants across all horizons were higher in June 2006 than they had been one year previously.

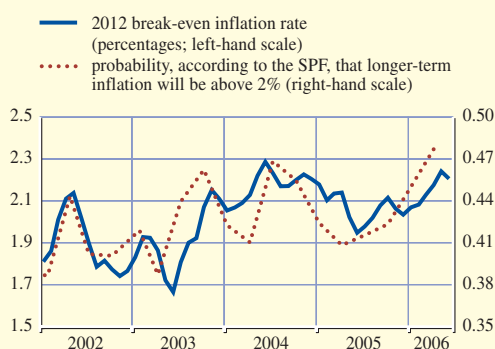
As in the case of break-even inflation rates, it is also possible to calculate corresponding long-term implied forward inflation-linked swap rates. However, inflation-linked swap rates display comparatively pronounced day-to-day fluctuations, which tend to distort the implied forward rates particularly strongly. It is therefore advisable to assess developments in inflation-linked swap rates and implied forward inflation-linked swap rates over time. Chart 7 plots time series for the five-year spot inflation-linked swap rate and the five-year implied forward inflation-linked swap rate five years ahead, starting in April 2005. The five-year

implied forward inflation-linked swap rate five years ahead has fluctuated within a narrow range of between 2.1% and 2.3%, whereas the five-year spot inflation-linked swap rate has varied a little more and has typically been lower than the five-year implied forward inflation-linked swap rate five years ahead owing to the fact that inflation risk premia tend to increase as maturities lengthen. Inflation risk and other premia imply that inflation-linked swap rates cannot be interpreted as a direct measure of inflation expectations among market participants.

4 CONCLUSIONS

The ECB uses measures of inflation expectations to gain insight into the expectations of the private sector, to cross-check its own assessment of the outlook for future inflation and as part of a set of indicators used to evaluate the credibility of its monetary policy. However, both types of measure described in Sections 2 and 3 are only an imperfect gauge of inflation expectations. While survey-based measures provide direct measures of inflation expectations that are not distorted by unobservable risk premia, these expectations are not necessarily directly linked to actual economic behaviour. Moreover, these measures of inflation expectations may in part be “backward-looking”, i.e. inflation expectations may to some extent be shaped by past inflation developments or may not be fully “rational”. On the other hand, inflation expectations derived from financial instruments, which are based on market trades and basically available in real time for a wide range of maturities, are distorted by unobservable time-varying premia. A comprehensive assessment of these limitations and of the comparative strengths and weaknesses of both kinds of measure strongly argues in favour of a combined analysis, the cross-checking of both types of source and the use of several measures of inflation expectations involving different horizons and different agents.

Chart 8 Selected indicators for cross-checking the inflation outlook



Sources: ECB, Reuters and ECB calculations.

Chart 8 shows an example of the cross-checking of different measures. It plots the probability that longer-term inflation may eventually be equal to or above 2% according to the SPF and the 2012 spot break-even inflation rate. Both measures can be seen as an indicator of the private sector’s perception of the risk of the ECB failing to meet its price stability objective, bearing in mind that the latter measure is particularly influenced by an inflation risk premium. It is therefore not surprising that there appears to be some co-movement between the two measures.

All in all, the main message derived from the cross-checking of the various sources of inflation expectations in the euro area is that euro area longer-term inflation expectations have in recent years been well-anchored at levels consistent with price stability. Survey-based measures of longer-term inflation expectations have been below but close to 2%. A broadly similar picture emerges from longer-term inflation expectations derived from financial market instruments, at least when one takes into account the fact that break-even inflation rates and inflation-linked swap rates include a sizeable inflation risk premium that overstates inflation expectations among market participants. These findings, in turn, suggest that the ECB’s commitment to promoting price stability is viewed as credible,

while this is no reason for complacency. The indicators available point to the continued existence of non-negligible inflation risk premia in financial markets. This is why it is so important that the ECB's monetary policy delivers price stability and remains credible in ensuring price stability over time, in the medium and long run. Ultimately, if investors and other economic agents can be sure that prices will remain stable in the future as a result of that credible monetary policy, inflation expectations will not only remain anchored, but investors and agents will also tend to demand low inflation risk premia, which will help to provide a more favourable environment for growth in the euro area.