Inflation Expectations – Role and Measurement for Monetary Policy

Ernest Gnan, Johann Scharler, Maria Antoinette Silgoner[1]

Inflation expectations play a crucial role in modern monetary policy, given their capacity to influence actual inflation and given their informative value on the central bank's credibility with regard to safeguarding price stability. The risk of a de-anchoring of inflation expectations in the wake of soaring energy and commodity prices figured among the key motivations for international hikes in official interest rates between 2007 and mid-2008. But also the recent abrupt decline in headline inflation – driven by the collapse in energy and commodity prices as well as the sharp global recession – may bear the risk of affecting inflation expectations, this time downward. An appropriate conceptualization and measurement – in real time – of inflation expectations is therefore essential for successful monetary policy.

Building on the current state of economic theory and central bank practice, this study addresses four questions: First, which agents' or sectors' inflation expectations should be considered? Second, what time horizon of inflation expectations is relevant for monetary policy decisions? Third, what are the relative merits and drawbacks of the various available measures of inflation expectations in the light of the answers to the first two questions? Finally, how do shocks to inflation expectations affect actual inflation in the euro area?

The study finds, first, that to gauge future risks for inflation and to assess central bank credibility comprehensively across various constituencies, it would be desirable to capture wage and price setters' inflation expectations better than so far. Second, besides the much-quoted long-term inflation expectations, also medium-term inflation expectations (beyond one and below five years) should be given due consideration. Third, the available empirical measures of inflation expectations only partly fit these conceptual requirements. Given the important limitations of the proxy measures currently available in the euro area, we recommend further research and improving data coverage.

Finally, the study confirms empirically that shocks to expected inflation account for a considerable part of actual inflation dynamics. The influence is stronger for financial market-based measures and for forecasters' inflation expectations than for measures based on consumer expectations. This may also reflect the longer time-horizon of these indicators. Thus, expectation shocks may represent a serious risk for price stability.

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Inflation Expectations Are Central to Monetary Policy Decisions and Communication

Inflation expectations have moved center stage in recent central bank policy thinking and communication. This reflects, *first*, the current theoretical understanding of inflation formation embodied in the New-Keynesian Phillips curve, which sees a key role for inflation expectations in the shaping of current inflation and which is also confirmed by empirical studies for the U.S.A. and the euro area. Accordingly, inflation expectations are also embodied in state-of-the-art macroeconomic forecasting models used by central banks and other economic think tanks. *Second*, well-anchored low inflation expectations are widely regarded as an important indicator of a central bank's credibility regarding its price stability commitment.

Inflation expectations gain special prominence in periods of sharp swings in inflation and economic activity. The

[1] *ernest.gnan@oenb.at; johann.scharler@jku.at (Johannes Kepler University Linz); maria.silgoner@oenb.at.*
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energy and commodity price shock between 2005 and mid-2008 caused a marked rise in actual inflation. Since the inflationary impact was drawn out over an extended period due to a sequence of price shocks, it was widely feared that this would trigger a rise in inflation expectations. As a result, central banks worldwide raised official rates to keep inflation expectations anchored at a low and stable level.

A similar line of argument applies also to an undershooting of headline inflation resulting, for instance, from a sharp fall in commodity and energy prices, or from a deep, protracted recession. If actual inflation is below target over a protracted period, expectations may adjust to this lower level. In the extreme, deflation can become self-reinforcing via expectations of falling aggregate demand, rising unemployment, falling asset prices and persistent positive real interest rates (Gnan, 2009).

Importantly, inflation expectations may overreact to shocks. "Exaggerated" or "unreasonable" inflation – or deflation – expectations, which may result e.g. from misperceptions or forecasting errors, may become an independent source of macroeconomic shocks and instability. Poor expectations management by central banks can therefore entail macroeconomic instability (ECB, 2009b).

While the importance of well-anchored inflation expectations and professional management of inflation expectations over the cycle is generally acknowledged and well documented by both economic theory and central bank practitioners, much less thought has been invested in questions related to the appropriate measurement of inflation expectations.

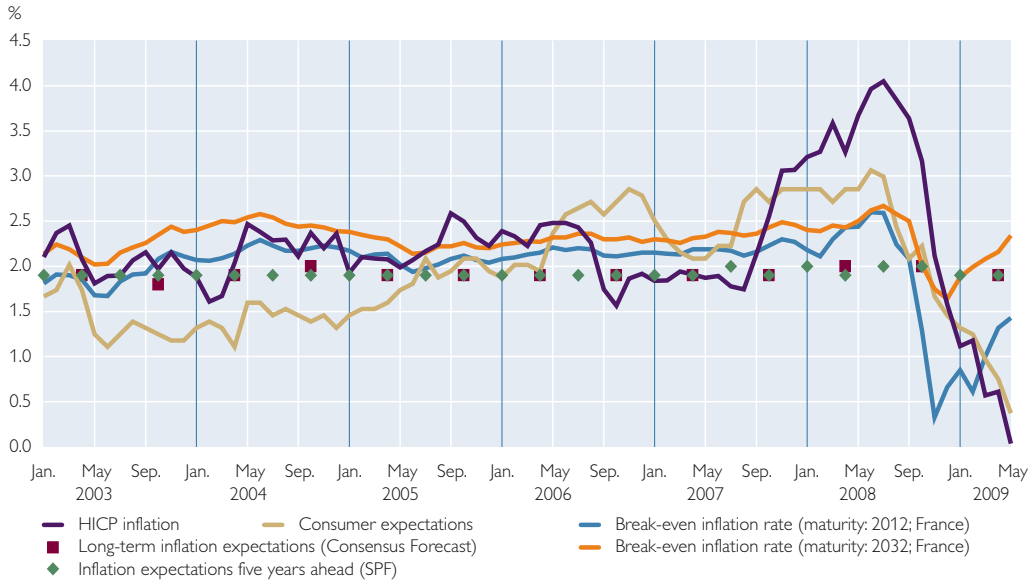
Chart 1 presents a typical collection of inflation expectations indicators used by policy makers, central bank watchers and economic and financial analysts. The chart highlights a number of issues: First, there are many indicators of inflation expectations (in fact, only a fraction of all available indicators is shown in the chart). Second, measures are based on three broad sources of information: surveys among economic agents (consumers or businesses); surveys among professional forecasters; and price data on financial products linked to inflation. Third, the various indicators yield strongly diverging results regarding the level, the trend and the volatility of inflation expectations: Some indicators seem to follow actual headline HICP inflation rather closely, others tend to follow longer-term non-stationary trends, while a third group appears to be stationary, moving hardly at all. Fourth, the divergence among the various indicators appears to have increased since mid-2007, together with the sharp swings in HICP headline inflation.

Several questions arise from the divergent development of the various indicators: Is this divergence an indication of expectations differences across types of economic agents and/or the different expectations horizons covered; or do differences reflect measurement errors related to the data collection or processing methodology or the source of information? In the former case, which sectors, agents and time horizons should monetary policy makers monitor particularly closely, and which are less relevant? Would other, additional indicators be desirable, and if so, which ones?

This article takes the many open issues in the measurement and interpretation of inflation expectations as a starting point and focuses on three interrelated questions, the first two of a more conceptual and the third of a more statistical nature: (1) *Whose infla-*

Chart 1

Inflation Expectations in the Euro Area



Source: ECB, European Commission, Consensus Economics.

tion expectations should be monitored? To answer this question, we need to have a clear view of the transmission through which inflation expectations might feed through to actual inflation, and of what the central banks' relevant constituencies are when it comes to credibility of the commitment to maintain price stability. (2) What is the most relevant *time horizon* for inflation expectations from the central banks' perspective? (3) How should we measure inflation expectations *in practice?* What are the strengths and weaknesses of the various measures available in the economic literature? What measures seem most suitable in the light of the answers to the first two questions? Is the range of available measures satisfactory?

The structure of the article follows the above logic: *Section 1* summarizes the relevant theoretical literature on the role of inflation expectations in price formation and for monetary policy making. Building on this review, *section 2* discusses the first two research questions, namely which agents' inflation expectations should be monitored by central banks in the conduct of monetary policy; and the appropriate time horizon(s) of inflation expectations to be considered. *Section 3* provides an overview of available measures of inflation expectations as used by central banks in practice and discusses and evaluates their usefulness in guiding monetary policy decisions. *Section 4* offers a policy application, by empirically investigating how (various measures of) inflation expectations affect actual inflation. *Section 5* concludes.

1 Role of Inflation Expectations in Monetary Policy: What Do We Know from Theory?

The traditional Keynesian model assumes that inflation is either due to demand pull or cost push factors. Demand pull shocks raise inflation through excessive demand, which monetary policy can dampen (or stimulate in case of negative demand gaps). By contrast, counteracting cost push shocks may involve

a tradeoff, as restrictive monetary policy pushes output below potential. While these issues are also emphasized in the New Keynesian model[2], the latter goes beyond the previous analysis by suggesting that also *expectations about future inflation* may pose a risk to price stability.

Within the New Keynesian framework, the economy consists essentially of three sectors: a household sector, a monopolistically competitive firm sector and a central bank that conducts monetary policy by setting the interest rate depending on movements in inflation and the output gap. Since firms operate in an environment of monopolistic competition, they have some market power, and therefore their price setting behavior determines inflation dynamics. Basically, prices are set as a markup over marginal cost. Moreover, prices are to some extent sticky, in the sense that not all prices are adjusted in every period.

An important feature of this class of models is that agents are assumed to be forward-looking, so that decisions are not only influenced by current but also – and maybe predominantly – by expected future developments. This gives expectations about future inflation a prominent role.

How can revisions in inflation expectations influence output and inflation dynamics in this framework? As a starting point, consider the demand side of the economy. Suppose that the household sector revises its forecast of future inflation upward. Everything else equal, this results in a lower expected real interest rate, which reduces the return on savings and therefore raises the current demand for consumption goods. Similarly, the lower expected real interest rate increases firms' investment. Thus, aggregate demand rises due to the upward revision of inflation expectations.

So essentially, such a shock to expected inflation has similar consequences as a standard demand shock hitting the economy: Firms face higher demand and therefore produce higher output, which leads to an increase in the marginal cost of production. Higher production costs, in turn, lead to higher prices and inflationary pressure. Thus, we observe both an increase in output and in inflation (Clarida et al., 1999). By adjusting the nominal interest rate, the central bank can stabilize the economy.

Next, consider a situation where the shock to expected inflation first affects price setting. Suppose that firms' inflation expectations increase. Due to the assumption of price stickiness, the firms may not be able to adjust prices for a considerable period of time. Therefore, they will already raise prices today, and we end up with an instantaneous increase in inflation. Essentially, this type of situation closely resembles a supply shock. Stabilization policy is more complicated in this case, because to counteract inflationary pressures, the central bank needs to tighten monetary policy, which has a dampening effect on output.

In short, the implications of expectation shocks (i.e., revisions in expectation) are similar to the implications of demand and supply shocks in the New Keynesian model. So far, in our discussion we implicitly made the assumption that revisions in expectations do not become self-fulfilling. That is, we assumed that over time the economy stabilizes and the impact of the expec-

[2] *For detailed descriptions of this type of model, see e.g. Clarida et al. (1999); Woodford (2003) or Galí and Gertler (2007).*

tations shock disappears. However, this need not be the case. In fact, this is only the case if monetary policy reacts appropriately and does not accommodate these revisions of expectations.

Consider again the case where households expect higher inflation. As discussed above, this expectations shock translates into lower expected real interest rates. In addition, suppose that the central bank tightens monetary policy but not by enough to stabilize the real interest rate. As a result, the nominal interest rate increases but not sufficiently to compensate the rise in expected inflation. The resulting lower real interest rate reduces savings and pushes up aggregate demand. The higher demand induces firms to step up production. However, this is only possible at higher marginal cost. Therefore firms will raise prices and inflation will rise. In other words, the initial expectation is confirmed and the revision of expectations becomes self-fulfilling. In order to avoid such effects and guarantee a unique and stable equilibrium, central banks therefore need to raise nominal interest rates sufficiently, i.e. at least one-for-one to changes in the expected inflation rate.

This result is called the Taylor principle (Woodford, 2003). Several studies argue that the success of monetary policy in reducing and containing inflation since the early 1980s is primarily due to the implementation of monetary policies observing the Taylor principle (e.g. Judd and Rudebush, 1998; Taylor, 1999; Clarida et al., 1998, 2000).[3] These studies typically estimate interest rate rules with U.S. data for pre-1979 and post-1979 and document that the reaction to expected inflation increased substantially in the post-1979 period. More recently, Leduc et al. (2007) analyze survey data for the U.S.A. and reach a similar conclusion.

To summarize, as long as the monetary policy response to revisions in inflation expectations is sufficiently strong, the macroeconomic consequences of such revisions closely resemble those of standard demand and supply shocks. By doing so, the central bank is able to avoid the macroeconomic instability associated with self-fulfilling expectations. If monetary policy is considered credible in pursuing such a strategy, inflation expectations will not deviate from the central bank's price stability objective in the first place, and inflation expectations are considered to be well-anchored.

2 Two Conceptual Issues: Whose Inflation Expectations, and for what Time Horizon(s)?

A discussion on the measurement of inflation expectations should start from the purpose for which this information is sought. As indicated in the introduction, the aim of monitoring inflation expectations is basically twofold: first, to obtain indications about the credibility of the central bank's commitment to safeguarding price stability; and second, to collect information about future price dynamics over time. Depending on the purpose, the time horizon of inflation expectations as well as the type of agents whose expectations are monitored may differ.

2.1 Which Agents' Inflation Expectations Should Be Monitored?

Very simple models incorporating inflation expectations assume expecta-

[3] *Similarly, in a series of papers, Orphanides (2002, 2003, 2004) argues that the instability observed in the 1970s was the consequence of too ambitious goals for output stabilization and too pessimistic real-time estimates of the output gap.*

tions to be homogeneous across economic agents, including policy makers. A first refinement is to assume that private agents' expectations may differ from the central bank's expectations, e.g. due to information asymmetries resulting from private information on economic indicators which the central bank does not disseminate. A further refinement is to relax the assumption of homogenous inflation expectations among private agents.

A number of empirical studies confirm that e.g. consumer inflation expectations are heterogeneous (Mankiw et al., 2003; Curtin, 2005; for the euro area, see Forsells and Kenny, 2004). In the theoretical economic literature, two main reasons are given to account for heterogeneity of inflation expectations: inattention and learning. Thus, heterogeneity may arise from differences in the scope of information available or used by agents and from differences in the speed of information processing and expectations adjustment (Brayton et al., 1997). In the case of *rational inattention* (Sims, 2009), agents do not process all available information due to their finite information processing capacity that arises e.g. from the limited time available for or devoted to specific decisions.[4] Furthermore, different agents may assume different probability distributions over uncertain states of the economy, yielding different probability distributions for inflation expectations. The interesting aspect here is that the differences in agents' information processing likely lead to persistent differences in inflation expectations. This argument applies *a forteriori* in periods of new, unprecedented situations, in which no long history of repeated observations has led to a convergence of views among agents.

In the case of *learning*, agents have imperfect knowledge on the structure of the economy or on policy makers' reaction functions, and rely on perpetual learning to form and update their expectations. It can be shown that the assumption of learning increases the sensitivity of inflation expectations to economic shocks, thus creating the possibility of endogenous "inflation scares." Furthermore, under learning, inflation expectations may follow a time-varying process and contain useful information for monetary policy (contrary to a situation of rational expectations with full credibility, where they merely reflect the central bank's price stability target) (Orphanides and Williams, 2005; Orphanides, 2009).

To sum up, agents or sectors may differ in the way they form inflation expectations, which may result in persistent differences in inflation expectations. Inflation expectations heterogeneity varies over time, moving with inflation, the variability of inflation and the variability of relative prices (Mankiw et al., 2003). It is useful for a central bank to explicitly monitor different agents' or sectors' inflation expectations, taking into account how these expectations may ultimately feed into current and future consumer price inflation. Section 2 shows that, depending on the sector where a shock to inflation expectations originates, its impact on the economy and the appropriate policy response may differ. Blanchflower (2008), for instance, argues that

[4] *The concept is similar to the one of economically rational expectations (Feige and Pearce, 1976), according to which people should collect and process information until the cost of an additional piece of information outweighs the benefits of an improved forecast. Theoretical skepticism on the accuracy of households' inflation expectations is confirmed by surveys, which often reveal a lack of knowledge about the very concept of inflation, its recent and current rate as well as its future development (Blanchflower and Kelly, 2008).*

the expectations of price and wage setters matter most for inflation prospects (see also Landau, 2009). But also a shock to financial markets' inflation expectations may be very relevant, since it may affect financing conditions and thus aggregate demand and public and private sector debt developments.

In principle, the different agents' or sectors' inflation expectations should eventually converge. However, this may take rather long (ECB, 2009b). It has been shown theoretically and empirically that a clear monetary policy strategy can help reduce heterogeneity and support convergence of inflation expectations (Orphanides, 2009; Capistrán and Ramos-Francia, 2007). Linked to this, heterogeneity regarding the expectations formation by various agents or sectors may also have implications for effective central bank *communication*. Different constituencies require different types, and different detail, of information on the economic and inflation outlook and the central bank's reaction function. Central banks should aim to reach out to all groups of society and provide information that is relevant for the various decision-making horizons. Given the diversity of the various agents' ability or willingness to process information, Sims (2009), proposes a multi-tiered communication strategy, ranging from very detailed and analytical explanations for sophisticated constituencies such as financial markets to simplified – but not misleading – policy descriptions.[5]

In this context, it is also relevant to note that inflation expectations of various sectors or constituencies may influence each other. For instance, Carroll (2003) shows empirically that households' inflation expectations are influenced by news reports on the views of professional forecasters. Since households pay only occasional attention to such news reports, this inattention in the aggregate generates sticky inflation expectations. Lamla and Lein (2008) shed some light on the propagation mechanisms of inflation expectations, by investigating the influence of the media on consumers' inflation expectations. They find that both the intensity of news coverage of inflation (volume channel) as well as the content of such media reports (tone channel) exerts an influence. A related question raised in particular for consumers' and workers' inflation expectations is whether they are influenced more by actual (headline) inflation (biased downward by hedonic pricing and other factors) or by perceived inflation (biased upward by daily purchases) (White, 2009). In the latter case, inflation expectations would be subject to the various and complex psychological mechanisms which drive inflation perceptions (for the latter, see e. g. Fluch and Stix, 2005, 2007; Stix, 2006). Thus, to guide inflation expectations effectively, the central bank's communication strategy should also take into account the special role of opinion leaders and the media, as well as the importance of creating awareness of actual inflation as opposed to perceived inflation.

To sum up, it follows from the above considerations that monetary policy should simultaneously monitor inflation expectations of various sectors and constituencies – households, wage setters, price setters, financial markets and opinion leaders (such as professional forecasters and the media) –

[5] *Note that the aim of such differentiated communication policy is to shape the simplified views that the public would form in any case so as to reach a common, less heterogeneous view of the future course of economic variables and policy.*

for the following reasons. First, the appropriate monetary policy response may differ depending on the sector from which an expectations shock originates. Second, the central bank should monitor its credibility across a broad range of constituencies of society. Finally, inflation expectations across various sectors may influence each other; therefore, it is worthwhile to pay particular attention to opinion leaders such as professional forecasters and the media, given their potential influence on other sectors' inflation expectations. Financial markets' inflation expectations play an important role insofar as they may exert a direct influence on the transmission of monetary policy and thus macroeconomic financing conditions.

2.2 What Is the Appropriate Time Horizon for Inflation Expectations for Monetary Policy Purposes?

An analysis of the development of inflation expectations is now a standard part of central banks' decision-making and communication. Mostly, reference is made to long-term inflation expectations.[6] For instance, long-term inflation expectations were (virtually) unaffected by the rise in inflation during 2007 and 2008 (chart 1) – a fact that the Eurosystem interpreted as a comforting sign for the credibility of its commitment to price stability. Rising short-term inflation expectations as indicated by survey indicators were, by contrast, regarded as less relevant, inter alia due to their short-time nature. Is this emphasis on rather long horizons of five years and beyond justified?

A first counterargument could be that stable long-term inflation expectations might reflect a lack of meaningful information and the impossibility to prepare forecasts for such long time horizons rather than a conscious vote on a central bank's credibility.[7] Skepticism about the information content of longer-term inflation expectations may also be motivated by agents' myopic behavior in the sense that long-term inflation expectations might simply be ignored for some economic decisions.

Second, in many economic models, monetary policy shows its most powerful effects on inflation over time horizons of two to three years. This is also the usual horizon covered by macroeconomic forecasts – which are an important input factor for central banks' monetary policy decisions – and it may be deemed relevant for a central bank's medium-term price stability objective. It should thus be interesting for monetary policy makers to understand whether economic agents trust the central bank's commitment to safeguard price stability over those medium time horizons.

Special caution is called for with respect to very short-term inflation expectations of up to one year. Since inflation is usually measured on a monthly basis as the increase in the price level compared to 12 months ago, it takes a full year until the mechanical effect of a one-off shift in the price level disappears from the statistically measured inflation rate. Thus, it is reason-

[6] *The term "long-term inflation expectations" can have different meanings: It can refer to inflation in, for instance, 10 years, or to average inflation over the coming, say, 10 years, or else to average future inflation over a period of, say, 5 years in 5 years' time. For further details of these various concepts in the different measures of long-term inflation expectations, see section 3.*

[7] *A similar point is made by Kelly (2008), who argues that – provided the monetary policy target is credible – anchoring expectations to the target is clearly more economically rational in the sense of Feige and Pearce (1976) than any other means of expectations formation.*

able and correct for inflation expectations up to 12 months to be affected by current and very recent price level shocks. Therefore, inflation expectations for horizons up to 12 months likely say more about price level effects than about monetary policy credibility.

All in all, it emerges that monetary policy and the related communication should simultaneously consider inflation expectations over various time horizons and not be content with anchoring very long-term inflation expectations alone (Landau, 2009). It is desirable to have term structure information on the expected dynamic development of inflation expectations rather than just an average value for inflation expectations over the long term.

This is especially highlighted by the current economic situation. Inflation in many euro area countries has turned negative around mid-2009, mostly as a result of the collapse of international energy and commodity prices. The strong downward price level effects will keep inflation below zero for several months but should be temporary. Very low inflation expectations over these very short horizons reflecting this development in actual inflation should thus not be a cause for worry.

As the recession unfolds and output gaps and unemployment increase, domestic and international inflation-dampening effects are mounting. This should keep inflation quite low until demand recovers and output returns toward potential (which may take some years). Given the time lags of monetary policy and the severity of the downturn, central banks worldwide will in many cases not be able to prevent a temporary undershooting of their inflation targets or definitions of price stability. Provided agents understand this, inflation expectations for horizons up to two years or even beyond should be quite low, too.

At the same time, worries about the medium- to long-term inflationary consequences of expansionary and exceptional monetary and fiscal policies to fight the global crisis have been mounting recently and have gained considerable media attention. Should they be taken seriously by a sufficiently large number of agents, they may result in an increase in long-term inflation expectations. If, by contrast, central banks manage to credibly communicate to the public their ability and commitment to quickly and fully withdraw the current ample liquidity once the economy recovers, then long-term inflation expectations might remain stable around central banks' price stability objectives.

An interesting question is how inflation expectations across various time horizons might influence each other. If phenomena such as inflation persistence are a factor in agents' expectations formation, inflation expectations across horizons would be correlated. Furthermore, inflation expectations for various horizons might be linked through "expectations spillovers", which may arise from psychological phenomena governing perceptions (e.g. simplified expectations formation ignoring time horizons etc.).

Finally, it is noteworthy that the relevant time horizon for the various agents' inflation expectations may depend, among other things, on the different typical decisions they take. While rather short-term expectations of price fluctuations (e.g. regular sales periods, expected beginning and end of government subsidies for certain purchases) may be relevant for certain consumption decisions, the longer-term perspective might also play a role for other decisions involving e.g. durable

consumption goods. Companies' price setting may be influenced by expectations regarding the horizon for which a price list is valid. For wage negotiations, which usually cover the next one or two years, prospective inflation developments over this period may be particularly relevant. By contrast, for businesses' and savers' longer-term investment decisions, long-term inflation expectations extending over the life of the investment project and its financing may influence the expected real financing costs and profitability.

3 Measuring Inflation Expectations: Available Data

Inflation expectations are not directly observable but need to be estimated. There are three main sources of information that can help derive an indicator for inflation expectations. The first source is surveys among consumers or businesses about their expectations regarding future price developments. A second option is to ask professional forecasters about their most recent inflation projections. The third option is to gain information from financial market data. The following sections describe these data sources and their advantages and drawbacks in more detail in the light of the discussion of the previous section.

3.1 Surveys Among Consumers and Businesses

A straightforward way to measure inflation expectations would be to directly ask people about their views on future inflation. A few surveys follow this approach, e.g. the Swedish Household Survey or the University of Michigan survey of consumer attitudes. On an experimental basis, the European Commission's monthly business and consumer surveys also include an explicit question on respondents' inflation expectations. The problem is that economic agents do not even have a realistic view on current inflation. Several studies (Jonung, 1981; Palmqvist and Strömberg, 2004; Lindén, 2006) show that consumers asked about the current inflation rate come up with figures that deviate substantially from reality. The lower the household income and the lower the education level, the more inflation perceptions and expectations deviate from measured values. The reason for this gap between measured and perceived data is that inflation is in general a variable that is difficult to assess or even understand. Respondents' consumption baskets do not necessarily correspond to the one used for calculating consumer price indices.

An alternative approach is to indirectly ask about relative price changes over time and convert this information into an index of inflation expectations. This is what the European Commission does as part of its monthly business and consumer surveys. Consumers are asked about the development of consumer prices over the next 12 months compared with the past 12 months: Will they increase more rapidly (PP), increase at the same rate (P), increase at a slower rate, stay about the same (N) or fall (NN)? We can calculate a balance index as a weighted difference between the positive and negative responses using the formula $I = (pp + 0.5p) - (0.5n + nn)$, where p, pp, n and nn represent the respective share of respondents in the corresponding response category. An index value close to zero would thus in normal times indicate that prices are expected to increase at a small positive rate. In a similar way, businesses in the manufacturing and construction industry as well as in the retail and services industries are asked about their expectations of

selling price changes over the next three months (increase (P)/remain unchanged/decrease (N), in this case the index formula is I = p – n). As expectations may be affected by seasonal effects, the balances are seasonally adjusted. While the data derived from the consumer survey can be interpreted as CPI inflation expectations, the business surveys should rather be interpreted as information about very near-term price setting plans in that specific industry. They are thus not considered further in this article.

The advantage of the EU survey data is that they are available for a large set of countries (all EU countries) on a standardized basis and at monthly frequency. Around 20,000 consumers throughout the EU take part in these monthly surveys on inflation expectations.

The drawback is that the index figures cannot be directly interpreted as inflation expectations. There are various approaches to converting the index data into figures that are broadly in line with inflation figures (Carlson and Parkin, 1975; Batchelor and Orr, 1988; Berk, 1999, or Millet, 2006). The consumer expectation measure in chart 1, for instance, follows the method of Berk (1999). However, these approaches generally rely on a set of restrictive assumptions such as the unbiasedness of expectations. A further problem may be that the given set of answers allows for only a rather rough quantification of expected price changes. Respondents may also have difficulties differentiating between price level changes and changes in the rate of inflation.

A final drawback is the rather short horizon of the questions that ask for price trends over the next year. As explained in section 2.2, inflation expectations for horizons up to 12 months are likely to be affected strongly by current and recent price level shifts, given that inflation is usually measured in annual comparison. Chart 1 illustrates the close co-movement of the euro area inflation rate with the index of inflation expectations derived from consumer surveys. As argued in section 2.2, the horizon that is most relevant for monetary policy considerations clearly extends beyond one year.

3.2 Professional Forecasters

Given that nonprofessional economic agents find it difficult to even correctly judge current inflation, another survey type targets agents that can be expected to be better informed: professional economists or forecasters, who have the resources for, and a professional interest in, more sophisticated economic forecasting. The idea behind conducting surveys among professional forecasters, which is also supported by the literature (Batchelor, 2001; Blix et al., 2001; Zarnowitz, 1984), is that individual forecasters rarely outperform average forecasts systematically. Consensus, or average, forecasts should thus minimize forecast errors and provide a more reliable indicator of inflation expectations.

For two decades, *Consensus Economics*, a private British survey company, has conducted a monthly survey among financial and economic forecasters worldwide on a range of variables including also consumer price inflation. The euro area panel is made up of 34 forecasters. The monthly publication provides inflation forecasts for the current and the next year. Twice a year (April and October), Consensus Economics also undertakes special surveys on long-term forecasts which extends as much as 10 years into the future (the number of respondents is only around 10, though). The major advantage is the

long historical data availability (since 1989 for individual euro area countries) and the large global set of countries covered.

The *Euro Zone Barometer* is a comparable monthly survey, although with a much shorter history. Since mid 2002, 28 forecasters associated with financial institutions have been surveyed on a monthly basis. It is focused primarily on the euro area. Longer-term inflation expectations (up to five years ahead) are surveyed four times a year (number of respondents: only 10). There is a sizeable overlap of 23 respondents in the Euro Zone Barometer panel and the Consensus Economics panel.

Since early 1999, the ECB has been conducting the *Survey of Professional Forecasters (SPF)*, which asks a panel of nearly 90 EU-based participants from financial institutions, research institutes, as well as employers' associations and trade unions about their forecasts for the euro area at quarterly intervals (Garcia, 2003), including predictions on inflation. Almost two-thirds of the forecasters in the panel respond to the questionnaire. SPF forecasters are free to use a forecasting method of their choice; in practice, time series models are most common, and most participants use several approaches. Nevertheless, judgment plays an important role: on average, respondents consider 45% of their forecast to be judgmental (ECB, 2009a). Data on long-term forecasts (five years ahead) are also collected, and the number of respondents is considerably larger than for the other two surveys of forecasters (first quarter 2009: 48 respondents). The main results are regularly published in the ECB's Monthly Bulletin.

A distinctive feature of the SPF is that it does not only ask for point estimates but also for complete probability distributions. Accordingly, forecasters are to allocate subjective probabilities to intervals with a width of 0.5 percentage points. This sheds light on the risk distribution around the most probable forecast value. Chart 2a shows the results of the SPF in the second quarter of 2009. It gives the probability distributions for the years 2009, 2010 and 2013. While experts expect HICP inflation to be around 0.5% on average in 2009, the probability distribution gradually shifts toward inflation levels in line with the Eurosystem's definition of price stability as the forecast horizon extends more into the future. Chart 2b gives information on how the distribution of expectations for the year 2010 has shifted over time. We can see from the chart that the distribution has both shifted to the left and become flatter, i.e. inflation forecasts for 2010 have been revised downward and have become more heterogeneous among forecasters over the past three quarters.

Chart 3 compares the results of the three surveys among professionals since 2003. Generally they lead to the same conclusion that longer-term inflation expectations in the euro area are firmly anchored. Most of the time, the point estimate was 1.9%, a number that is in line with the Eurosystem's definition of price stability of "below but close to 2%." Only during 2008, when HICP inflation in the euro area reached levels of up to 4%, expectations increased to or above 2.0%. This trend can be expected to have reversed during the financial crisis and the sharp decline in inflation.

The advantage of surveys among professional economists is that they provide direct information about inflation expectations at various time horizons. Furthermore, they provide more detailed information on how economists form their inflation forecasts. The drawback is that inflation forecasts

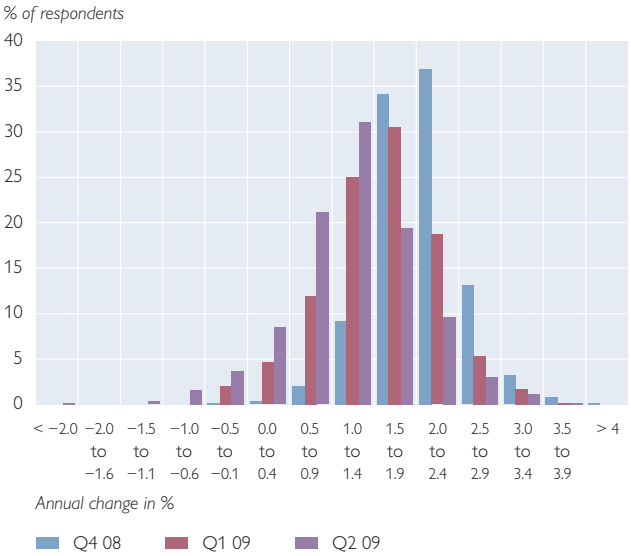
Chart 2a

SPF Results in Q2 09

Source: ECB.

Chart 2b

SPF Estimates for Headline HICP for 2010: Changes Over Time



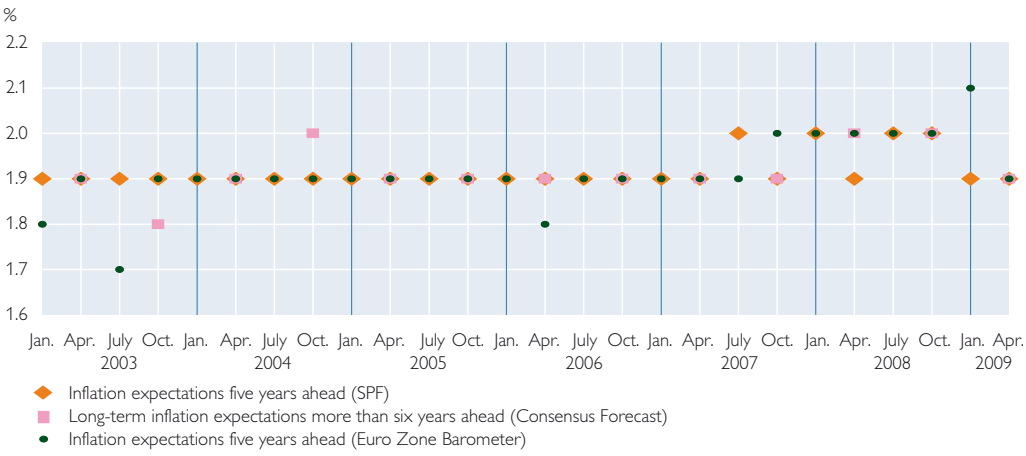
Source: ECB (survey dates: Q4 08, Q1 09 and Q2 09).

cannot necessarily be interpreted as measures of inflation expectations. Inflation forecasts are the results of econometric models based on a set of assumptions on future commodity prices and exchange rates as well as the economic development in other countries. This approach can substantially deviate from the way consumers, workers or businesses form their inflation expectations.

A further problem with surveys of forecasters is that the expense and time involved to make the forecasts cannot be verified in practice. Model forecasts are likely made only at rather large intervals of time and updated on a purely judgmental basis in the mean-

Chart 3

Long-Term Inflation Expectations in the Euro Area



Source: ECB, Consensus Economics, MJEconomics.

time. In the case of the SPF, a special investigation (ECB, 2009a) showed that 35% of participants update their forecasts on a monthly basis, while more than one-half of the participants do so on a quarterly basis. In addition, around one-quarter partially update their forecasts when responding to the SPF. Overall, this suggests that the survey responses are based on rather timely assessments.

Finally, professional forecasters might respond strategically. Bewley and Fiebig (2002) show that forecasters tend to indicate values in the safe consensus range so as not to stick their neck out with forecasts that deviate dramatically from the mean. Lamont (1995) comes up with the opposite hypothesis that professional forecasters have a tendency to reveal extreme forecasts – even if they deviate from their true expectations – in order to gain attention; he maintains that this tendency increases with the forecaster's age. Both factors may lead to a bias in the distribution of submitted inflation expectations. The Deutsche Bundesbank (2001) compares surveys among households with those among professional experts and finds that the latter do not systematically outperform businesses' or consumers' inflation expectations. Both do not make efficient use of all available information when making their forecasts. Batchelor and Dua (1989) even show that U.S. households' inflation expectations are more accurate than those of professional forecasters. By contrast, Gerberding (2006) and Mestre (2007) find that expert forecasts are substantially more precise and rational than household expectations.

3.3 Financial Market-Based Indicators

A third approach to derive inflation expectations is to draw information from financial market data. The most common approach uses information from inflation-linked bonds: Like conventional bonds, inflation-linked bonds combine regular coupon payments and principal payment at maturity. The distinct feature is that either the coupon rate or the underlying principal is adjusted to keep pace with inflation, thus preserving the real value of both income and capital. They are thus attractive to investors who wish to hedge against inflation variability.[8]

The so-called *break-even inflation rate (BEIR)* is calculated as the yield differential between conventional nominal bonds and index-linked bonds that – apart from the indexation – have comparable characteristics (maturity, creditworthiness).[9] The BEIR is thus a measure for inflation expectations of financial market investors. In the euro area, the first bond with coupon payments indexed to euro area inflation (HICP excluding tobacco) was issued by the French Treasury in 2001 based on experience with similar bonds indexed to the French CPI that have been issued since 1998. Today, Greece, Italy and Germany also issue similar index-linked bonds that are linked to the euro

[8] *The first market of inflation-indexed government bonds was launched in New Zealand in 1977. Motivations for launching inflation-linked bonds can be financial innovation and diversification, an attempt to reinforce the credibility of inflation fighting policies or the desire to lower the inflation risk premium in nominal rates.*

[9] *To be more specific, the BEIR at time t is calculated as* $BEIR_{t,M} = i_{t,M} - r_{t,M}$, *where i is the return on a conventional nominal bond and r denotes the return on an index-linked bond of the same maturity M. This is a linear approximation of the Fisher identity linking the ex ante nominal and real (zero coupon) interest rates with the average expected inflation rate* $(1+r) = (1+i)/(1+\pi^e)$.

area HICP (excluding tobacco, as in the case of the French bonds).[10] The market for inflation-linked bonds in the euro area is by now the second-largest after the U.S. market.

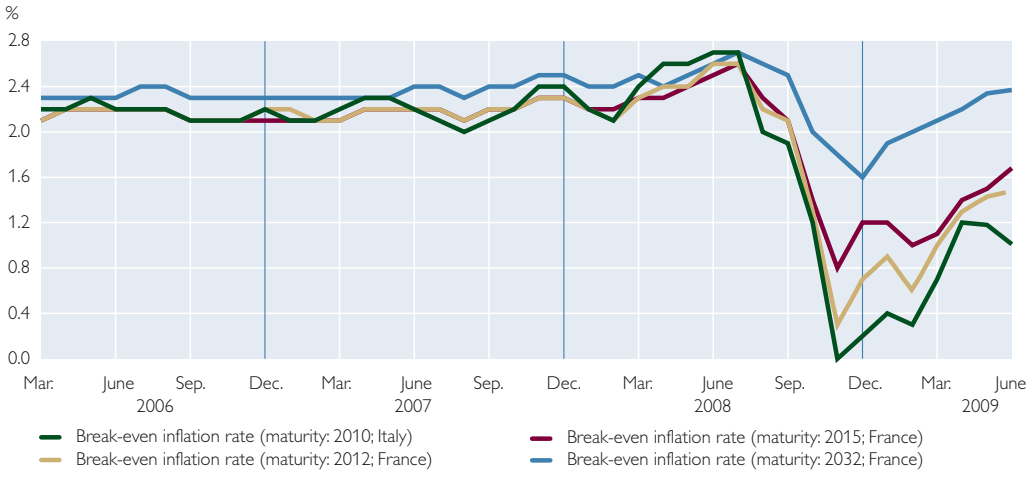
The main advantage of the BEIR is its timeliness and high (daily) frequency. Furthermore, it does not rely on statements of interview respondents but on inflation expectations that form the basis for actual market trading. Finally, BEIR measures also cover various time horizons that extend long into the future and therefore complement the shorter horizon information gained from consumer surveys.

The major drawback is that the BEIR level can in general not be interpreted directly, because it is influenced by a number of interest rate premiums related to liquidity[11], inflation uncertainty, risk aversion of market participants or differences in tax treatment as well as by seasonality effects.[12] The distinction between movements in inflation expectations and movements in the various premiums is difficult. Recent studies (Ang and Bekaert, 2003, or Buraschi and Jiltsov, 2005) estimate the inflation risk premium embodied in U.S. long-term bond yields between 20 and 140 basis points.

This drawback is further aggravated by the time-varying nature of some of these premiums. For example, investors tend to become more risk averse during recessions, so that risk premiums rise. The time dependency of premiums has been highlighted in the current financial crisis and aggravated by investors' portfolio shifts. As can be read from chart 4, the BEIR increased markedly in the first half of 2008. This pattern can be interpreted as an in-

Chart 4

Break-Even Inflation Expectations for the Euro Area



Source: ECB.

[10] *If the headline HICP is persistenly higher than the HICP excluding tobacco – as was the case during the last decade – inflation expectations derived from index-linked bonds would imply a negative bias.*

[11] *The liquidity of indexed bonds tends to be lower than the liquidity of corresponding nominal bonds.*

[12] *BEIR seasonality is a direct consequence of seasonality in inflation rates. This stems from the fact that the remaining maturity of bonds shortens over time and is therefore usually not a multiple of a full year, so that some months of the year are overrepresented in overall inflation over residual maturity. This phenomenon gains importance with the shortening of the remaining maturity of the bond.*

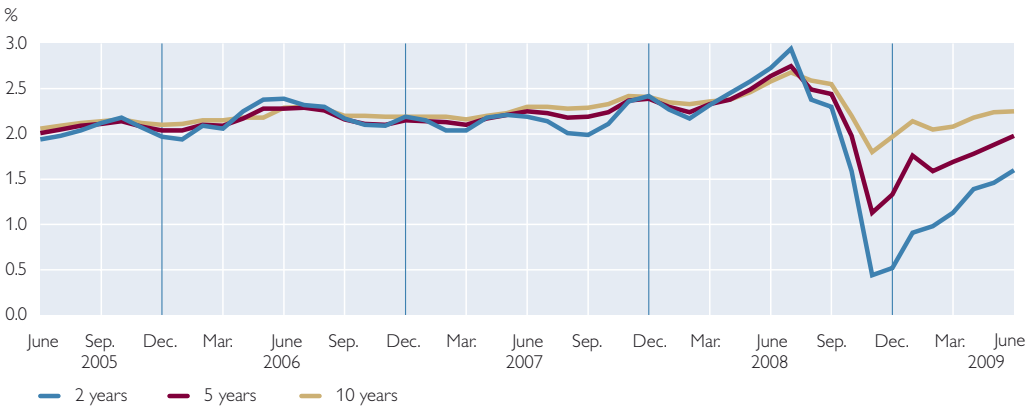
crease in inflation expectations against the background of increasing oil and food prices. From July onward, the turnaround in oil prices and the increasing likelihood of an upcoming recession changed inflation expectations. However, the pronounced downward trend observed in the BEIR cannot be interpreted solely as declining inflation expectations: Some of the BEIR measures with shorter maturity dropped to almost zero in late 2008.

In the course of the financial crisis, investors shifted their portfolios toward the most liquid and secure assets and away from long-term engagements. While investors tended to shift funds from stocks to bonds, thus causing nominal bond yields to shrink, there was an additional effect in the opposite direction in index-linked bond markets as demand for these less liquid bonds dropped.[13] The yield spreads between conventional and index-linked bonds thus contracted markedly. At times, liquidity in the markets for index-linked bonds was so low that single transactions caused BEIR movements. A normalization of the markets has been observed only since end-2008. This illustrates that the BEIR needs to be interpreted against the background of uncertainty and risk aversion in financial markets, duly taking into account possible price distortions for various reasons in these markets (for a comprehensive explanation, see Hördahl, 2009).

In order to abstract from the various premiums that effect the movement of the BEIR, it is useful to take into account evidence from inflation swap markets. An *inflation swap* is a derivative instrument that – similar to regular interest rate swaps – exchanges a fixed payment for a variable payment. In the case of inflation swaps, the variable payment is linked to inflation over the life of the swap. The measures of inflation expectations derived from inflation swaps are unaffected by differential liquidity conditions in nominal and real bond markets or by flight-to-liquidity flows. Chart 5 shows inflation-linked swaps for different maturities. A comparison with chart 4 shows

Chart 5

Inflation Expectations for the Euro Area Based on Inflation-Linked Swaps



Source: ECB.

[13] *Even under normal market conditions, inflation-linked bonds are substantially less liquid than their conventional counterparts. This liquidity disadvantage tends to be aggravated during periods of financial market stress.*

that, until the outbreak of the financial crisis, all financial market-based inflation expectations indicators fluctuated at a similar level slightly above 2%. Toward the end of 2008, the BEIR and inflation swaps-based inflation expectations started to decline, indicating lower inflation expectations. However, the decline in inflation swaps was far less pronounced, which suggests that liquidity effects played a significant role in the bond spot markets.

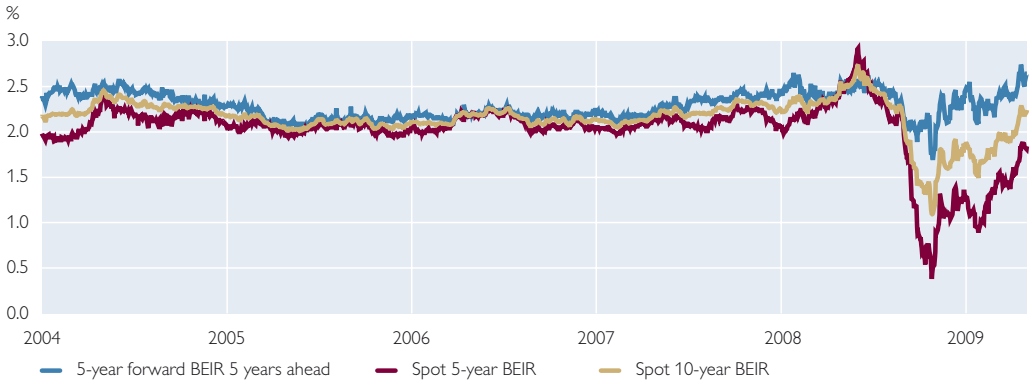
A drawback of inflation swaps is that they may incorporate a premium for counterparty risk. In addition, they have only been available since 2005 and are thus not considered further in this article.

There are two further drawbacks of conventional BEIR measures. The first is that 10-year spot BEIR measures gauge average inflation over the entire 10-year holding period. It may, however, also be interesting to abstract from the near-term inflation outlook and focus on longer-term inflation expectations. A way to achieve this is the *implied forward BEIR* measures, calculated from a decomposition of the spot BEIR over various time horizons. If an implied forward BEIR is for example derived from two index-linked bonds maturing in 2012 and 2015, the resulting measure of inflation expectations can be interpreted as investors' future average inflation expectations between 2012 and 2015. Implied forward BEIR measures have become widely used recently in the context of the current financial crisis, since they abstract from near-term inflation expectations which are potentially influenced by short-term uncertainty. Chart 6 shows that while the volatility of the implied forward BEIR five years ahead has increased somewhat since late 2008, there was no marked change in its overall level, suggesting that longer-term inflation expectations have remained broadly stable. This indicates that the credibility of the ECB's commitment to price stability has so far been unaffected by the crisis.

The second drawback associated with the interpretation of conventional BEIR measures over time is that the residual maturity of the bonds declines over time. This is problematic as some of the premiums change with residual maturity. Shifts in the BEIR may thus at least partly be due to changes in the residual maturity of the bonds. This problem can be overcome by using constant maturity BEIR measures such as

Chart 6

Forward Break-Even Inflation Rate Five Years Ahead for the Euro Area

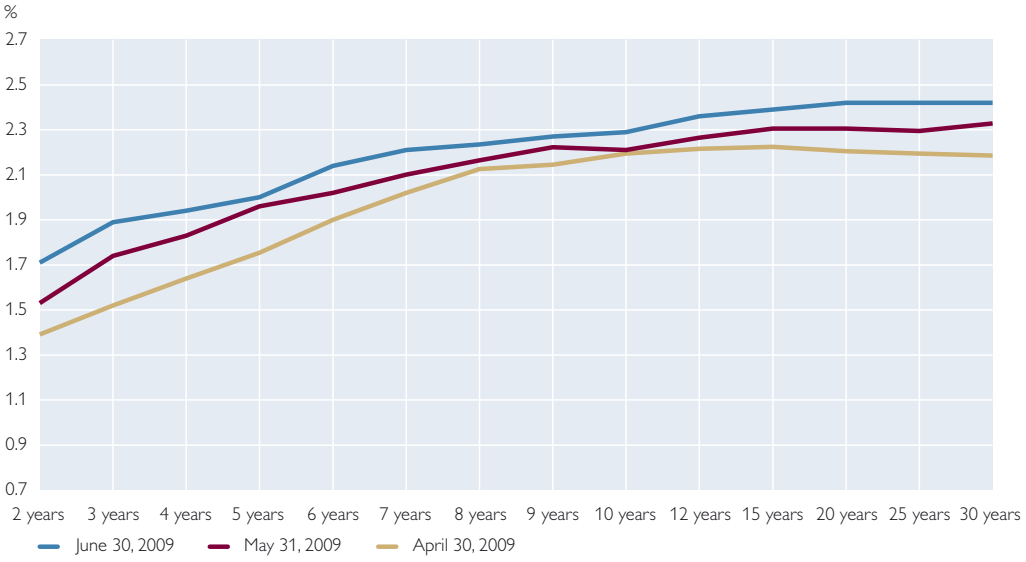


Source: ECB.

Chart 7

Euro Area Inflation Expectation Curve Derived from Inflation-Indexed Swaps

(HICP excluding tobacco)



Source: Bloomberg.

inflation swaps. An alternative is the *zero coupon BEIR*, based on the estimation of comparable zero-coupon yield curves for index-linked and conventional nominal bonds. Their major advantage is that they provide information on a wider spectrum of maturities, especially also covering shorter horizons. Similarly, a term structure for inflation expectations across various maturities can be calculated from inflation swaps (chart 7).

Table 1

A Comparison of Inflation Expectation Indicators

Indicator	Agents	Method	Available since	Publishing institution	Frequency	Time lag to publication	Horizon in years	Sample size
European Commission's Consumer Survey	Consumers	Survey	1985	European Commission	monthly	1 to 2 weeks	t+1	20,000
Consensus Forecast	Professional forecasters	Survey	1989	Consensus Economics	monthly (long-term: biannual)	n.a.	t to t+10	34
Euro Zone Barometer	Professional forecasters	Survey	2002	MJEconomics	monthly	2 days	t to t+5	28
Survey of Professional Forecasters	Professional forecasters	Survey	1999	ECB	quarterly	1 to 2 weeks	t, t+1, t+5	90
Break-even inflation rate	Financial market participants	Yield differential	2001	Thomson Reuters, ECB	daily	Next day	t+4 to t+33	x
Inflation-linked swaps	Financial market participants	Derivative instrument	2005	Thomson Reuters, ECB	daily	Next day	t+2 to t+25	x

Source: OeNB.

Table 1 summarizes some key features of the various inflation expectations measures discussed. It becomes obvious, first, that only measures based on financial market data and input by professional forecasters cover medium- to longer-time horizons that are most relevant for monetary policy purposes. Second, data on consumers' inflation expectations are limited to the very short time horizon of up to one year. For wage or price setters' inflation expectations, no indicators are available for time horizons between two and ten years. Thus, while quite a number of measures for inflation expectations exist, they do not fully satisfy the needs suggested by economic theory, particularly as regards medium- to longer-term expectations of consumers, wage and price setters.

4 Do Shocks to Inflation Expectations Influence Actual Inflation? Some Empirical Evidence

4.1 Does Expected Inflation Affect Actual Inflation, and Are there Differences Across the Inflation Expectations Indicators Used?

As discussed in section 1, shocks to expected inflation may influence real economic activity and the inflation rate. In this section, we provide some empirical evidence on the link between shocks to expected inflation and actual inflation in the euro area. To do so, we estimate bivariate vector autoregressions (VARs) with inflation and several measures of expected inflation (as described in section 3) as endogenous variables. As discussed in section 2, inflation expectations may be heterogeneous. To take this potential heterogeneity into account, we conduct our analysis with proxies for expected inflation based on surveys among consumers or professional forecasters as well as proxies extracted from financial market data.[14]

We estimate bivariate VAR models containing two lags of the endogenous variables. The results are robust with respect to the inclusion of additional lags. However, due to the rather short time series, we chose to include only two lags in our preferred specification. To identify shocks to expected inflation, we assume that the inflation rate reacts contemporaneously to shocks to expected inflation, whereas expected inflation reacts with a one-period lag to fluctuations in the actual inflation rate. Leduc et al. (2007) use a similar assumption. To explore the dynamic interrelationship between expected and actual inflation, we use impulse response functions and variance decompositions.[15]

Chart 8.1 shows the impulse responses of inflation and expected inflation along with two standard error significance bands. Here, the inflation expectation measure is based on the European Commission's consumer survey. The left panel shows how inflation reacts to a shock to expected inflation, that is, the effect of an unexpected, one-time shock to consumers' inflation

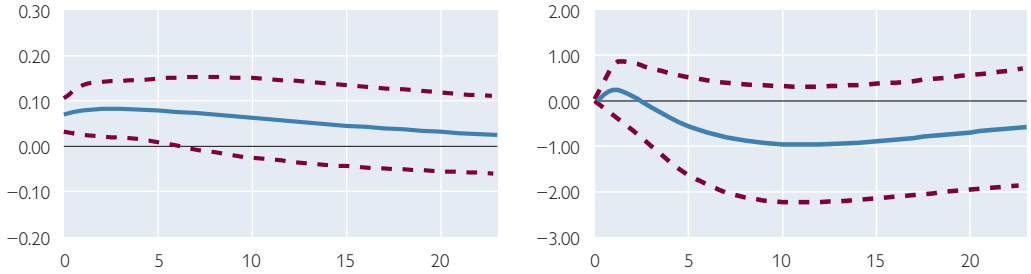
[14] *Our sample for the euro area covers the period from January 1999 to February 2009. Data on CPI inflation are obtained from the OECD. We proxy expected inflation with the results of the European Commission's consumer survey, the Consensus Forecast is obtained from Consensus Economics and the data on index-linked bonds from Thomson Reuters.*

[15] *The latter are based on Cholesky decompositions, where expected inflation is ordered before actual inflation. This ordering captures our identifying assumption that expected inflation is contemporaneously predetermined. As a sensitivity analysis, we also use generalized impulse responses which are independent of the variable ordering. This analysis shows that our main conclusions are robust.*

How Does Inflation React to Shocks to Expected Inflation?

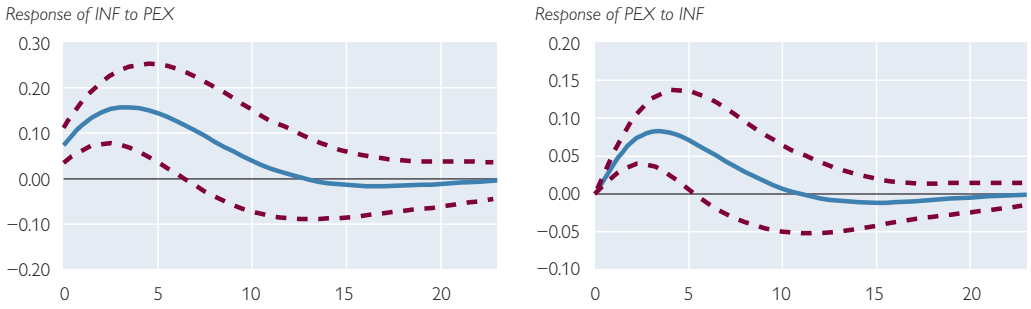
Consumer Survey

Chart 8.1



Consensus Forecast

Chart 8.2



2-Year Index-Linked Bond

Chart 8.3

5-Year Index-Linked Bond

Chart 8.4

Source: Authors' calculations.

Note: The left panel shows the response of inflation (INF) to a shock to expected inflation (PEX) and the right panel shows the response of expected inflation to a shock to the inflation rate.

expectation (one year ahead). We see that actual inflation increases significantly. The response is rather persistent and inflation remains significantly above the pre-shock level for approximately eight months after the shock. The right panel of chart 8.1 shows that expected inflation rises briefly after a shock to the inflation rate and then declines. However, the response is not significant. Hence, our results suggest that expected inflation reacts only to a limited extent to fluctuations in actual inflation.

Next, we re-estimate the VAR using the Consensus Forecast (published by Consensus Economics) instead of the consumer survey as the proxy for expected inflation. Chart 8.2 shows the results. We see that the shock to expected inflation leads to a significant response of actual inflation, similar to the results using consumer expectations. Interestingly, here we find that expected inflation reacts significantly and positively to the shock in the inflation rate, which is in contrast to our results for the consumer survey discussed above.

Third, we explore how shocks to inflation expectations extracted from financial market data affect the dynamics of the actual inflation rate. More specifically, we use inflation expectations extracted from index-linked bonds with maturities of two and five years. Due to data limitations, the sample is slightly shorter for this analysis and covers the period from March 2002 to February 2009.

Charts 8.3 and 8.4 show the results. Shocks to expected inflation derived from index-linked bonds significantly increase actual inflation for around two to seven months after the shock, depending on the maturity of the bond. The impact of shocks to expected inflation turns out to be somewhat more pronounced when expectations are extracted from the five-year maturity bond.[16]

In short, although magnitudes vary across proxies for expected inflation, we find that shocks to the expected inflation rate significantly affect the dynamics of the actual inflation rate.

4.2 How Important Are Shocks to Inflation Expectations for Actual Inflation Dynamics?

Having demonstrated that expected inflation shocks significantly affect inflation, we now turn to the question

Table 2

Variance Decomposition of Inflation

Horizon in months	Consumer Survey	Consensus Forecast	2-year bond	5-year bond
	%			
1	8.31	9.68	15.91	13.02
4	9.90	27.46	44.10	44.64
10	16.61	40.80	60.57	60.40
16	20.59	41.12	56.40	59.29
24	22.39	41.26	56.12	59.28

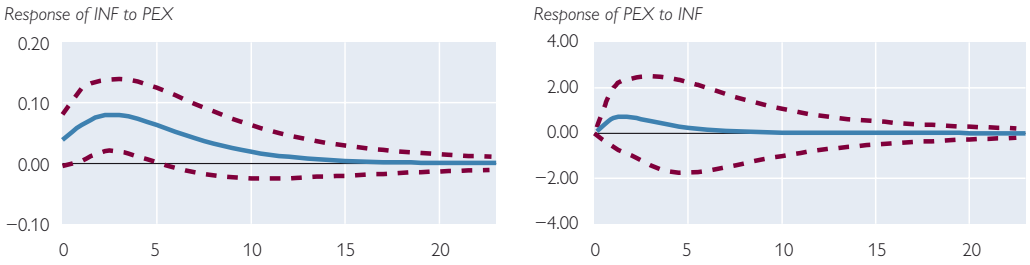
Source: Authors' calculations.

Note: Variance compositions based on bivariate VARs with the inflation rate and one of the proxies of expected inflation are included as endogenous variables.

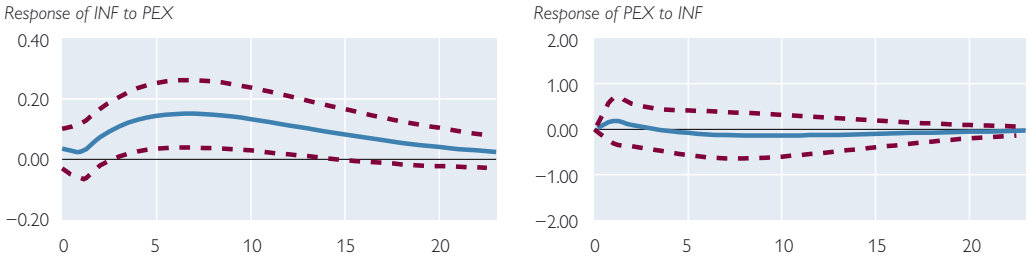
[16] *We repeated the exercise also for 10- and 25-year index-linked bonds. The results were qualitatively similar and are printed in the annex.*

How Does Inflation Respond to Inflation Expectation Shocks? Pre-EMU Period

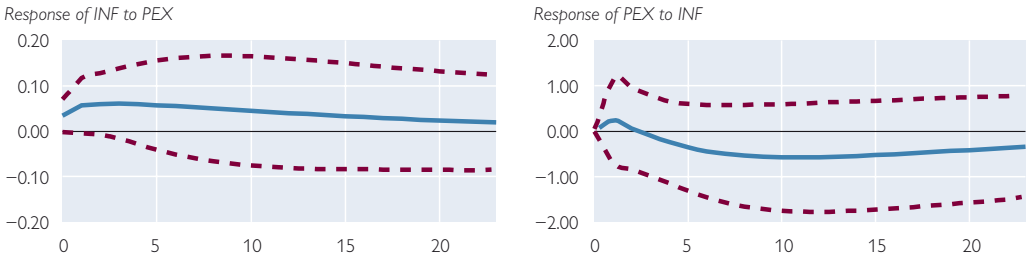
France Chart 9.1



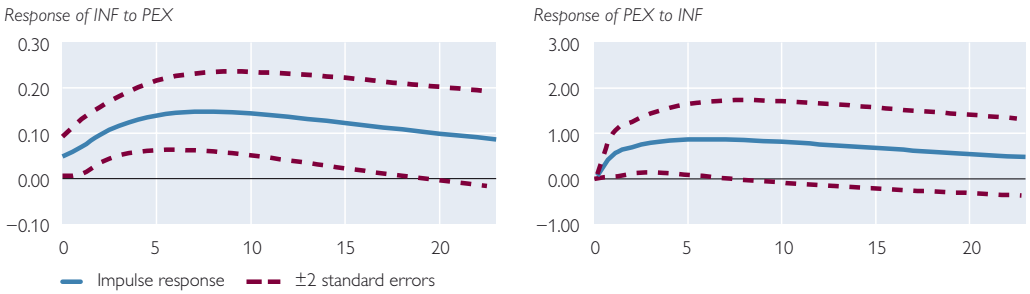
Germany Chart 9.2



Italy Chart 9.3



Spain Chart 9.4



Source: Authors' calculations.

Note: The left panel shows the response of inflation (INF) to a shock to expected inflation (PEX) and the right panel shows the response of expected inflation to a shock to the inflation rate.

how important these shocks are for the dynamics of actual inflation. To do so, we compute the variance decomposition of the inflation rate, which allows us to assess the relative importance of the individual shocks in the VAR (table 2).

We see that, depending on the proxy used for expected inflation, shocks to expected inflation account for

up to 13% of inflation variability at the one-period horizon. At the 24-month horizon, expectation shocks account for substantially higher fractions of inflation variability, especially when we use proxies for expected inflation which are extracted from index-linked bonds.

4.3 Did EMU Change the Influence Expectations Have on Actual Inflation?

As explained in section 1, from a theoretical point of view, the impact of shocks to expected inflation should be closely related to how monetary policy responds to these shocks. Therefore, it appears conceivable that the way expected inflation influences actual inflation has changed with the implementation of EMU. To analyze this issue, we re-estimate the VAR with data from France, Germany, Italy, and Spain for the period from January 1990 to December 1998. Inflation expectations are obtained from the European Commission's consumer survey only because of data limitations of the other indicators. To take into account that inflation declined in several EMU countries during the 1990s as a result of a convergence process, we include a time trend in the VARs.

Charts 9.1 to 9.4 show the results. We see that inflation expectations significantly affect actual inflation in France for about eight months following the shock. Expected inflation also responds to shocks to the inflation rate, although the response is significantly different from zero only between three and ten months after the shock. For Germany, we see that the largest effect of an inflation expectations shock occurs somewhat later, after eight months, and that expected inflation does not significantly react to actual inflation shocks. For pre-EMU Italy, although the signs of the responses are in line with what we find for the other countries, neither inflation nor expected inflation respond significantly to shocks. For Spain, results are similar to those for France. Overall, we find no systematic differences concerning the impact of expected inflation before and after the introduction of the euro.

5 Conclusions

Inflation expectations are important for monetary policy. Particularly in periods of increased inflation volatility, monetary policy needs to pay special attention that inflation expectations remain firmly anchored at a level that is close to the inflation target or definition of price stability. This applies both to periods when inflation rises above the central bank's definition of price stability and to periods when it falls below it. The risk of a de-anchoring of inflation expectations in the wake of soaring energy and commodity prices figured among the key motivations for international hikes in official interest rates between 2007 and mid-2008. But also the recent abrupt decline in headline inflation – driven by the collapse in energy and commodity prices as well as the sharp global recession – may bear the risk of affecting inflation expectations, this time downward. An appropriate conceptualization and real-time measurement of inflation expectations is therefore important for successful monetary policy.

Building on the current state of economic theory and central bank practice, this study addressed four research questions: (1) Which agents' or sectors' inflation expectations should be considered? (2) What time horizon of inflation expectations is relevant for monetary policy decisions? (3) What are the relative merits and drawbacks of the various inflation expectations measures in the light of the answers to

the first two questions? (4) How do shocks to inflation expectations affect actual inflation in the euro area?

The study argues, first, that to gauge future risks for inflation and also to assess central bank credibility comprehensively across various constituencies, it would be desirable to capture wage setters' inflation expectations better than so far. Second, besides the much-quoted long-term inflation expectations, also medium-term inflation expectations (beyond one and below five years) should be given due consideration. Third, the empirical measures available only partly fit these conceptual requirements. Given the important limitations of the proxy measures currently available for the euro area, we recommend further research and better data coverage.

Finally, our empirical estimates show that shocks to expected inflation indeed influence actual inflation. This applies to all four indicators used – short-term consumer expectations, long-term forecasters' expectations, and medium- and long-term financial market expectations. For all measures of inflation expectations, shocks to expected inflation account for a non-negligible part of actual inflation dynamics. The influence is stronger for financial market-based measures and for forecasters' inflation expectations, which may also reflect the longer time-horizon of these indicators. Thus, expectation shocks may represent a serious risk for price stability.

We also find that the effects of shocks to expected inflation prior to EMU were quite similar to what we find using more recent data. We cannot confirm that EMU has significantly changed the transmission from inflation expectations shocks to actual inflation.

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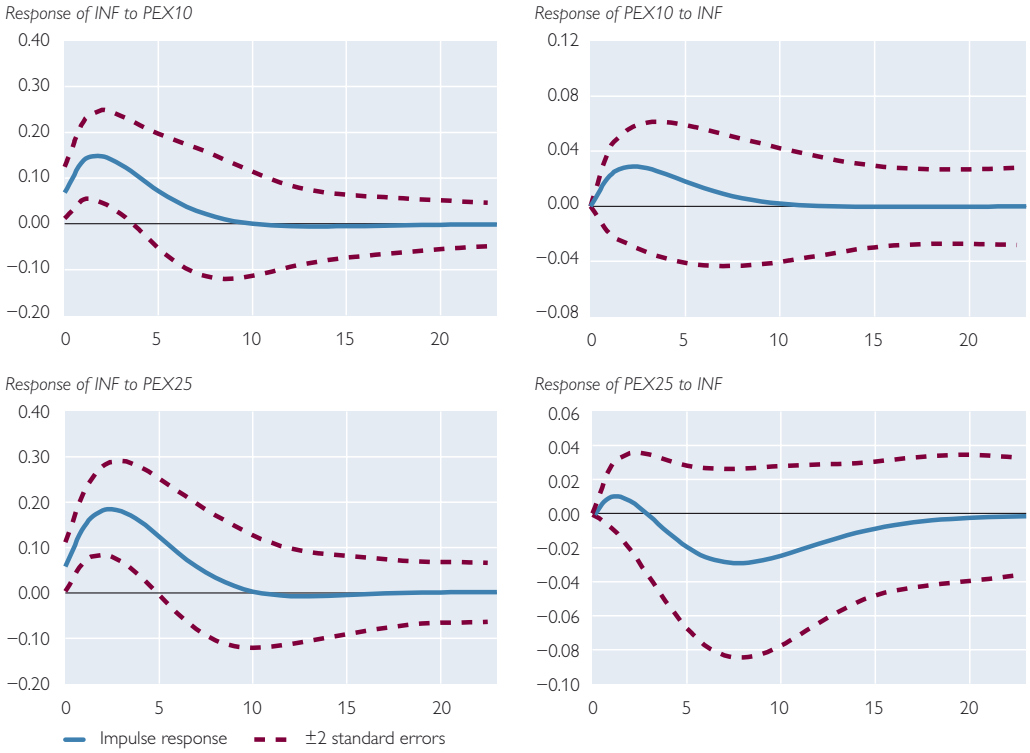
Annex

Impulse Response Functions Based on Index-Linked Bonds with 10- and 25-Year Maturity



Source: Authors' calculations.

Note: The left panel shows the response of inflation (INF) to a shock to expected inflation (PEX) and the right panel shows the response of expected inflation to a shock to the inflation rate.