Inflation Expectations of Experts and ECB Communication

Katrin Ullrich*

December 21, 2006

Abstract

The communication policy of the European Central Bank (ECB) receives lots of attention from financial markets. This paper analyses the informational content of the monthly introductory statements of the ECB president explaining interest rate decisions with regard to inflation expectations of financial market experts for the euro area from February 1999 to July 2006. We test for the influence of ECB communication on expectations formation besides other macroeconomic variables. As the results indicate, the indicator measuring the informational content of ECB rhetoric contributes to the explanation of inflation expectations formation.

JEL Classification: E52, E58, D83, D84

Key Words: inflation expectations formation, central bank communication, Carlson-Parkin method, survey expectations

*Centre for European Economic Research (ZEW) Mannheim, 'WIN-Kolleg' of the Heidelberg Academy of Sciences; address: P.O. Box 10 34 43, D-68034 Mannheim, Germany; ullrich@zew.de. I thank Carin van der Cruijsen, Michael Ehrmann, Andrew Filardo, Christina Gerberding, and Thorsten Polleit for helpful comments and suggestions.

1 Introduction

The transparency of monetary policy and the communication policy of central banks are gaining weight in discussions about good monetary policy because both measures affect the effectiveness of monetary policy by providing information to the public. The assumption is that more transparency increases monetary policy effectiveness. If interest rates are close to zero, e.g., the leeway for actual policy decisions will be limited and communication would play an important role to influence expectations. Also, in normal times, transparency helps to improve the transmission of monetary policy impulses. More transparency enables financial markets to interpret the monetary signals of the central bank properly, because it provides markets with the necessary information and the possibility to learn the strategy of the central bank, the interpretation of a changing economic environment by the bank, and the respective policy reactions. In this way, the central bank influences expectations formation by private agents. Moreover, the ability to influence expectations provides the link between the short-term interest rate, which the central bank can influence more or less directly, and the long-term interest rates, asset prices, and exchange rates. Furthermore, inflation expectations play a crucial role in determining wage and price setting.

We investigate the influence of the ECB communication on the inflation expectations of experts. To measure the informational content of communication, we concentrate on the ECB press conferences following the Governing Council meetings where decisions about the interest rate are taken. These statements are completed by analysing the editorial of the ECB *Monthly Bulletins* in months where no statement was given. To measure the information content of ECB statements, a variant of the wording indicator of Heinemann and Ullrich (2005) is used. We assume that the statements and the *Monthly Bulletins* are sources of information that are meant for the informed public – central bank watchers in the broader sense. Because financial market experts watch the central bank very closely, we would expect that an influence on their expectations formation is more likely than an influence on expectations of, e.g., consumers. If an effect takes place, we could reason that ECB communication influences at least the informed public and ECB wording differs from noise.

For the measurement of expert inflation expectations, we use data from the ZEW Financial Markets Test. The qualitative answers of experts with regard to the development of inflation in the next six months are transformed into quantitative inflation expectations

using the standard Carlson-Parkin method with asymmetric thresholds that also come from the survey. To investigate the influence of the wording indicator we rely on two approaches. First, we estimate the influence of the indicator on the difference between inflation and inflation expectations. The estimation equation is based on a theoretical setup that relies on a model by Svensson (2003) explaining why communication should have an impact on the gap between the two variables. In a second approach, we explicitly model expectations formation as partly forward-looking and partly backward-looking. For the forward-looking part, we use a set of explanatory variables including the wording indicator to capture the influence of different macroeconomic variables on inflation expectations.

The estimation results allow for the conclusion that the ECB statements given at the press conferences following the interest rate decisions influence inflation expectations of experts. If the rhetoric is rather hawkish, communicating concern about inflation risks, this induces financial market experts to adjust inflation expectations upwards. At the same time, the decisions of the ECB do not seem to have an impact on expectations formation. Most probably the time horizon of six months is to short to capture effects of interest rate decisions on inflation and therefore inflation expectations.

We proceed as follows: First, we give a short motivation arising from gaps in the existing literature regarding communication of the ECB. Next, the two crucial time series, inflation expectations and the wording indicator to measure the informational content of ECB rhetoric are introduced. There is a broad theoretical literature taking into account transparency, but a common model to include communication seems to be missing to our knowledge. Therefore, we use the model of Svensson (2003) to develop a rationale for the effects of communication on inflation expectations in the fourth section. The theoretical results built the basis for the estimation approach. The fifth sections deals with the explicit expectations formation and the respective estimation results. The last section concludes.

2 Motivation

The literature concerned with economic transparency does not provide a unambiguous answer to the question regarding the advantages of economic transparency. Depending on the target of transparency and the modelling framework, especially the assumed transmission mechanism, proposals for more or less transparency have emerged from the

literature (Geraats 2002a). However, there is a fast growing amount of empirical literature investigating the influence of communication in different areas of financial markets.

One strand of the literature deals with the influence on the exchange rate (e.g. Jansen and de Haan 2003 and the papers cited therein, Jansen and de Haan 2005), and, more generally, on financial markets and the predictability of monetary policy decisions (Bernoth and von Hagen 2004, Hartmann et al. 2001, Gaspar et al. 2001). Ross (2002) concludes that the Fed and the Bank of England are more predictable than the ECB whereas Connolly and Kohler (2004) come to the conclusion that the predictability of monetary policy of the Fed, the Bank of England, and the ECB is similar. Furthermore, there are some investigations concerned directly with the communication policy of the ECB (e.g. Jansen and de Haan 2004, Ehrmann and Fratzscher 2005, Gerlach 2004, and Heinemann and Ullrich 2005).

Transparency and communication of central banks will not only influence the expectations of agents in financial markets regarding the next interest rate decision. Sellon (2004) describes the impact of central bank behaviour and communication on the term structure of interest rates, on the link between short-term and long-term rates and the different reactions of the rates on policy rate changes depending on the maturity of the rates. In addition to that, inflation expectations are also influenced.

The monetary strategy of inflation targeting is also connected with the provision of extensive information and with transparency. Kuttner and Posen (1999) investigate the link between inflation expectations and inflation targeting coupled with more communication in UK, Canada, and New Zealand. However, the analysis does not rely on direct measures of inflation expectations but rather employs indirect approaches as the Taylor rule and the time series properties of inflation rates. Czogała et al. (2005) investigate the influence of the communication policy of the Polish central bank on corporate inflation expectations without explicitly incorporating a measure for communication into the estimations but relate the econometric findings with regard to the rationality of expectations formation to the communication policy of the National Bank of Poland. Kliesen and Schmid (2004) analyse the influence of macroeconomic data releases of the Federal Reserve on inflation expectations. The inflation expectations are produced from concepts of inflation compensation included in nominal Treasury securities. Kohn and Sack (2003) find that, at the longer horizon, communication matters as much as policy actions for the Federal Reserve. The longer horizon works by altering the perceptions of the central bank's economic outlook. Although private agents may have the same information available with regard to the future development of economic variables, central bank forecasts seem to

be better than these of the private sector (Romer and Romer 2000). Van der Cruijsen and Demertzis (2005) investigate the influence of central bank transparency on inflation expectations.

As this short overview shows, there are a number of empirical studies investigating the influence communication has on financial markets and the predictability of interest rate decisions. However, the link is not well investigated with regard to inflation expectations formation, especially for the ECB. Whereas the empirical investigation seem to have a clear understanding about the concept of communication, the theoretical meaning is not equally clear and cannot easily be distinguished from transparency. Theoretical modelling is dominated by transparency issues (Geraats 2002, Neumann 2002). Transparency is a multidimensional concept which includes the presentation and explanation of the objectives, methods, forecasts, models, tactics, and decisions of a central bank (Blinder et al. 2001). Winkler (2000) treats communication as an integral part of transparency. Because transparency means openness and clarity, the mere presentation of data is not enough to reach a common understanding as ultimate objective of genuine transparency. Communication does not only provide quantitative information. The more articulated information plays a crucial role (Di Bartolomeo and Marchetti 2004, p. 17). An analysis that comes close to provide a rational for communication in monetary policy is Svensson (2003). He introduces a judgment factor of the central bank with regard to possibly unobservable components of the economy into a model to analyse reaction functions of monetary policy. We take this analysis to develop a basis for the empirical investigation.

3 Inflation Expectations of Experts

Because the analysis of inflation expectations is the concern of this paper, we describe the expectations series in more detail. The series is generated on the basis of the ZEW Financial Market Survey. This monthly survey among German financial market experts asks for inflation expectations of the euro area since February 1999. The surveyed experts (regularly 300-350 participants) come from banks, insurance, investment, and industrial companies. Within their companies, the respondents mostly hold positions in the financial, research, and economic departments or the investment and securities departments. The experts are asked for a qualitative assessment of their inflation expectations. The forecast horizon is six months. With regard to inflation expectations respondents have

the choice between 'The annual inflation rate in the general economy in the medium term (6 months) will increase/not change/decrease/don't know'.

For quantifying these qualitative assessments we follow a standard variant of the probability approach pioneered by Carlson and Parkin (1975). The starting point of the approach is the assumption that every individual bases her answers on a subjective probability distribution for inflation rates given her information set. The expected inflation rate is then identical with the conditional expected value of the distribution. If the expected inflation rate exceeds a certain threshold the answer is 'increase' and if the expected inflation falls below a threshold 'decrease' and in between is the indifference interval resulting in a 'no change'-answer. There are different possibilities for the treatment of the 'don't know category' (Marnet 1995). Since the category is minimally occupied in the ZEW survey, we simply ignore them. The next assumption of Carlson-Parkin is that the thresholds are identical across individuals even if they do not have to be symmetric and constant over time. The relevant thresholds come from the ZEW panel itself which were polled in January 2006. The answer categories allow for asymmetric thresholds. For the calculation of the inflation expectations series the mean value of the answers is used and is given by -0.24 for the lower threshold and 0.22 for the upper threshold.

The final assumption of the Carlson-Parkin approach is that the subjective probability distributions are independent of one another and have the same known form across individuals. If the assumptions are satisfied we can conclude that the proportion of 'rise' answers is identical to the probability that inflation in 6 months exceeds the upper threshold and the proportion of the 'decrease' answers is the same as the probability that the future inflation rate will be lower than the lower threshold given the information at the time expectations are formed. The expected inflation rate corresponds to the expected value of the distribution given the information set. The quantification depends on the chosen form of the aggregate distribution function. For the calculation we use a standard normal distribution following most of the literature on transforming qualitative survey

data.[1] From the survey results we get the expected change of inflation regarding the next 6 months,

$$\Delta^e \pi_{t+6|t} = \frac{-a r_{t+6|t} + b f_{t+6|t}}{f_{t+6|t} - r_{t+6|t}} \tag{1}$$

where a denotes the lower threshold and b the upper threshold (Smith and McAleer 1995). The variables $r_{t+6|t} = \phi^{-1}(1 - R_{t+6|t})$ and $f_{t+6|t} = \phi^{-1}(F_{t+6|t})$ are the inverse of the cumulative standard normal distribution of the share of experts expecting a fall ($F_{t+6|t}$) or a rise ($R_{t+6|t}$) in inflation.

Because this gives the absolute expected change, $\Delta^e \pi_{t+6|t} = \pi_{t+6|t} - \pi_t$, we assume that inflation expectations can be gathered from the following equation:

$$\pi_{t+6|t} = \tilde{\pi} + \Delta^e \pi_{t+6|t} \tag{2}$$

where $\tilde{\pi}$ denotes the last publicly known inflation rate. We use the inflation rate published in the latest ECB Monthly Bulletin. This induces a publication lag of two months. The resulting expectations series is very similar to actual inflation (see Figure 2). The experts do not expect that inflation six months ahead will deviate from actual inflation much. This is reasonable given that the inflation rate moves around two percent, the definition of price level stability of the ECB. In this respect, ECB monetary policy seems to be credible.

3.1 Measurement of ECB Communication

For investigating empirically the influence of communication on expectations formation, the informational content of the statements has to be measured. There are a number of indices that capture the meaning of the ECB rhetoric. We rely on a variant of the wording indicator of Heinemann and Ullrich (2005). The construction period of the indicator covers the period January 1999 to December 2001 ($wd10$) so that the first interest rate cycle for

[1] The normal distribution of inflation expectations is criticized by different authors, e.g. Batchelor and Orr (1988). But Balcombe (1996) does not find a hint for skewness or curtosis in QSBO survey data and Mitchell (2002) analyses the class of stable distributions and finds no advantaged with regard to the normal distribution using data of the Industrial Trends Survey in the UK manufacturing industry. Using the Dutch consumer survey Berk (1999)(Berk 1999) compares the transformation of qualitative data into inflation expectations using the normal, central and non-central t-distribution. He finds that the accuracy of the inflation expectations is not improved although the effect of the non-normal asymmetry is substantial.

the euro area is included. Because the indicator is crucial for the analysis we describe the calculation in the following.

The quantification starts with identifying possible signal words in the introductory statement of the monthly ECB press conferences. The lengths of the statements is also tested. In order to determine the words' informational content, we count their use in the introductory statements in each monthly ECB press conferences. In those months where no press conference took place we take the editorials of the monthly ECB reports as substitute which are very similar in contents, length, and terminology to the press conferences' initial statements. Then, observations are grouped into periods of neutrality, tightening, and easing bias. The grouping criterion is the observed interest rate policy of the two months following the press conference. On the basis of a 10 percent significance level, potential signal words that do not show significant differences in mean frequencies are excluded from the calculation of the indicator. If the five percent level is used for calculation, the indicators are very similar and display a correlation of 98 percent.

Then, pair-wise tests are used to decide the sign of the specific code word in the indicator. A positive sign is attributed to those words for which tests show significantly larger frequencies in tightening compared to easing periods, tightening compared to neutral periods, or in neutral compared to easing periods. A negative sign is assigned to words where the significant relative frequencies are opposite. Thus, the resulting indicator is, by construction, positively associated with an increasing 'hawkishness' of ECB rhetoric. The informational content of a word is measured by the η^2 statistic. The statistic measures the share of the total variance attributable to differences in means between the three different kinds of periods.

Summing up, the wording indicator WI is constructed using frequency of code words x_i as follows:

$$wi_t = \sum_{i=1}^{k} \frac{nobs(x_{i,t}) - meanobs(x_i)}{stdv(x_i)} sign(x_i)\eta^2(x_i) \tag{3}$$

The index adds for each period the standardised number of observations. These numbers are weighted by the η^2 statistic in order to account for the differences in the informational content of code words. The sign of each individual code word is determined on the basis of significant pair-wise tests as described. Figure 1 in the appendix shows the indicators for the two significance levels.

Although the indicator is constructed with regard to the next interest rate decision of the ECB, it is also applicable for the analysis of inflation expectations. Because the mandate of the ECB is to guarantee price stability in the euro area, the central bank will react to inflationary pressure with rising interest rates. A deflation would also be a violation of the inflation target of lower but near the two percent ceiling for the inflation rate of the Harmonised Consumer Price Index. A higher hawkishness in the rhetoric of the ECB would hint to inflationary pressure identified by the central bank and would also lead to reactions of the ECB. If the expectations rise with higher hawkishness but would not react to decisions, this would indicate that the economic agents too see danger for inflation as the central bank but are not confident that the ECB would bring inflation back to target.

To make a judgement in this respect, however, the time horizon of expectations formation and the length of the transmission mechanism have to be taken into account. If the central bank communicates inflation risks that have an impact on inflation at a shorter time than the effect of an interest decision would take place, expectations formed with regard to the short time horizon would react to communication but not to interest rate decisions. This is one reason why central banks are responsible to keep inflation on target in the middle and long run and do not react to short-term developments that might influence short-run inflation expectations.

4 Influence of Communication on Inflation Expectations

4.1 Theoretical Approach

We investigate the possible link between central bank communication and inflation expectations based on one version of the Svensson model (Svensson 2003). Thereby, we have to take into account that a theoretical model has a time structure that is not necessarily compatible with real time. The empirical investigation will be based on monthly time series. Because it is unrealistic to assume that monetary policy affects the inflation rate two months ahead as proposed by the model structure[2], we assume that a monetary policy decision has a first impact on the output gap five months ahead and the output gap

[2]Svensson gives the length of a period with three quarters.

influences the inflation rate the following month. This choice is affected by the available data for the inflation expectations with a six month time horizon.

Taking these assumptions into account and using the notation of Svensson, the supply function is given by

$$\pi_{t+5} = \pi_{t+4} + \alpha_x x_{t+4} + \alpha_z z_{t+5} + \epsilon_{t+5} \tag{4}$$

where π denotes the inflation rate, and x the output gap. In z, all other exogenous influences that affect the inflation rate are collected. Demand is described by

$$x_{t+5} = \beta_x x_{t+4} + \beta_z z_{t+5} - \beta_r(i_t - \pi_{t+5|t} - \overline{r}) + \eta_{t+5} \tag{5}$$

where i denotes the policy rate, $\overline{r}$ the average real interest rate, and $\pi_{t+1|t}$ are private sector inflation expectations formed in t with regard to inflation in $t+1$. In the backward-looking model of the transmission mechanism, the central bank employs a reaction function based on a linear-quadratic loss function (Svensson 2003, p. 437) as follows

$$i_t = \overline{r} + \pi^* + \left(1 + \frac{1-c}{\alpha_x \beta_r}\right)(\pi_{t+5,t} - \pi^*) + \frac{\beta_x}{\beta_r} x_{t+4,t} + \frac{\beta_z}{\beta_r} z_{t+5,t} + \frac{1-c}{\alpha_x \beta_r} \tilde{z}_{t+6,t} \tag{6}$$

where π^* denotes the inflation target, and $z_{t+1,t}$ and $\tilde{z}_{t+6,t} = \sum_{s=0}^{\infty} (\delta c)^s z_{t+\tau+s,t}$ are valuations of the central bank about the exogenous variables influencing inflation and output gap. The parameter c is the appropriate solution of the characteristic equation for the determination of the interest rate rule (for a detailed description see Svensson 2003).

The variable z plays a crucial role for the following results. In z, exogenous variables are collected that influence supply and demand but are nor necessarily observable. The central bank assesses the future development of these variables for monetary policy decisions and, therefore, the information set of the central bank is expanded by these 'judgement factors'. E.g., judgement is necessary because the true model of the economy is not known. As Lomax (2005) describes the role of the Bank of England forecasts, formal economic models are always accompanied by judgement even if the framework of the judgement is based on models. Svensson assumes that the central bank and the private agents possess the same information set and, therefore, private sector and central bank judgement are the same. We change this assumption by allowing a difference between the judgement of private agents and central bank.

Because we are not interested in the solution of the model but in the estimation of the relationship between inflation rate and inflation expectations, we concentrate on the

derivation of equations for both variables that allow a translation into an estimation equation. We determine private sector inflation expectations in t for $t+6$, $\pi_{t+6|t}$, where monetary policy decisions about the interest rate in t have a first impact on the inflation rate. Correspondingly, the inflation rate π_{t+6} is determined. The inflation rate in $t+6$ is then given by

$$\begin{aligned}\pi_{t+6} &= \pi_{t+5} + \alpha_x\beta_r\pi_{t+5|t} - (\alpha_x\beta_r + (1-c))\pi_{t+5,t} + (1-c)\pi^* + \alpha_z z_{t+6} - (1-c)\alpha_z\tilde{z}_{t+6,t} \\ &\quad +\alpha_x\beta_z(z_{t+5} - z_{t+5,t}) + \alpha_x\beta_x(x_{t+4} - x_{t+4,t}) + \alpha_x\eta_{t+5} + \eta_{t+6} \end{aligned} \tag{7}$$

and inflation expectations in t for $t+6$ are determined as follows

$$\begin{aligned}\pi_{t+6|t} &= \pi_{t+5|t} + \alpha_x\beta_r\pi_{t+5|t} - (\alpha_x\beta_r + (1-c))\pi_{t+5,t|t} + (1-c)\pi^* + \alpha_z z_{t+6|t} \\ &\quad -(1-c)\alpha_z\tilde{z}_{t+6,t|t} + \alpha_x\beta_z(z_{t+5|t} - z_{t+5,t|t}) + \alpha_x\beta_x(x_{t+4|t} - x_{t+4,t|t}) \end{aligned} \tag{8}$$

The difference between inflation expectations of private agents and the inflation rate is calculated as

$$\begin{aligned}\pi_{t+6|t} &= \pi_{t+6} + \pi_{t+5|t} - \pi_{t+5} - (\alpha_x\beta_r + (1-c))\left(\pi_{t+5,t|t} - \pi_{t+5,t}\right) \\ &\quad -\alpha_z(1-c)\left(\tilde{z}_{t+6,t|t} - \tilde{z}_{t+6,t}\right) - \alpha_z(z_{t+6} - z_{t+6|t}) \\ &\quad -\alpha_x\beta_x(z_{t+5} - z_{t+5,t} - z_{t+5|t} + z_{t+5,t|t}) \\ &\quad -\alpha_x\beta_x(x_{t+4} - x_{t+4,t} - x_{t+4|t} + x_{t+4,t|t}) - \alpha_x\eta_{t+5} - \epsilon_{t+6} \end{aligned} \tag{9}$$

where $z_{t+s,t|t}$ gives the expectations of private agents about the judgement of the central bank on the exogenous influences on inflation and output. If the central bank and the private agents would possess the same information set and form expectations in the same way based on the underlying model, the difference would reduce to

$$\begin{aligned}\pi_{t+6|t} - \pi_{t+6} &= \pi_{t+5|t} - \pi_{t+5} - \alpha_z(z_{t+6} - z_{t+6|t}) - \alpha_x\beta_x(z_{t+5} - z_{t+5|t}) \\ &\quad -\alpha_x\beta_x(x_{t+4} - x_{t+4|t}) - \alpha_x\eta_{t+5} - \epsilon_{t+6} \end{aligned} \tag{10}$$

If the information set of private agents differs from that of the central bank, the evaluation of central bank expectations by private agents with regard to the deviations has an impact on the difference between inflation and expectations.

If the central bank could communicate its judgement about the model of the economy and be economically transparent in the classification of Geraats (2002), inflation and inflation expectations of private agents would be more in line. Economic transparency would be enhanced, e.g., if the central bank communicates its models and forecasts. Presuming

that the information sets of the central bank and private agents coincide, inflation and inflation expectations would only differ because of the purely random shocks to output and inflation. However, one part of the private sector expectations error with regard to the judgement factor, $z_{t+s} - z_{t+s|t}$, could not be influenced by the central bank. What could be influenced by communication of the central bank is the gap between the private and the central bank assessment of the exogenous factors influencing inflation and output, $z_{t+s,t|t} - z_{t+s,t}$.

In the outline above, the central bank is assumed to know private expectations perfectly well. On the other hand, private agents do not know the judgement of the central bank but have to form expectations of the knowledge and assessment of the central bank. In contrast to this assumption, Eijffinger et al. (2004) have analysed the effects of central bank communication about the model that is employed by the central bank to assess private sector expectations.

4.2 Estimation Approach

As the preceding analysis shows, inflation and inflation expectations should only differ because of expectations errors and because the expectations of the central bank are not well understood by private agents. To translate equation (9) into an estimation equation, we lag all variables by six months. Moreover, we assume that we can approximate expectations for inflation five months ahead by inflation expectations formed one period before, $\pi_{t+5|t} \approx \pi_{t+5|t-1}$ (see Döpke et al. 2005).

The gap between expectations of the central bank and expectations of the private sector about expectations of the central bank with regard to the exogenous and presumably unobservable component, z, is assumed to be influenced by communication efforts of the central bank. Because we do not posses a communication measure for different time horizons and contents, we approximate all differences by a wording indicator known at the time of expectations formation, wd_{t-6} and wd_{t-7}. We use wd_{t-6} because the decision about the interest rate is done at the beginning of the month most of the time. To be sure that the wording indicator reflects communication policy and does not capture the effects of interest rate decisions, we include die first difference of the policy rate, Δi, as well. The difference between the realisation of the respective variable and the expectations of the private sector is assumed to be purely random and included into the error term of the estimation equation, ε. The observable error terms of the theoretical model are

approximated by a collection of other variables, v_i, that could influence inflation and inflation expectations. These variables could also help to model the expectations errors, at least partially. The estimation equation results in

$$\begin{aligned}\pi_t &= a_1\pi_{t|t-6} + a_2(\pi_{t-1} - \pi_{t-1|t-7}) + a_3 wd10_{t-6} + a_4 wd10_{t-7} + a_5\Delta i_{t-6} + a_6\Delta i_{t-7} \\ &\quad + \sum_{i=1}^{5}\sum_{s=0} a_{6+i} v_{i,t-s} + \varepsilon_t \end{aligned} \tag{11}$$

The additional explanatory variables, v_i, have to be determined. Here, we follow the literature that uses explicit quantities to model inflation expectations. E.g., Pesaran (1987) uses cost and output factor and general economic conditions to explain adaptive inflation expectations formation in British Manufacturing. The additional explanatory variables are the rate of change of raw materials and fuel prices, wages, and the effective exchange rate, as well as the change of manufacturing output, overall rate of unemployment, and the change of money supply. Besides this, policy variables like the exchange rate regime and different periods of price policy are considered. Gramlich (1983) also extends a model of adaptive expectations formation and includes money growth, unemployment or capacity utilisation, budget deficit, and supply shocks. For rational expectations, he considers expected money growth and lagged output gap where the derivation is based on the quantity equation of money. In the end the list of explanatory variables contains the inflation rate, rate of change of wages, a fiscal impact variable, and shock dummies, as well as money growth. Johnson (1997) uses lagged inflation, the recent forecast difference, an average of the bank rates over the last twelve months, 12-month percentage change of the exchange rate, the average difference between home and foreign interest rate over the last twelve months, the average slope of the term structure, the unemployment rate and an announcement dummy of monetary policy. In an monetary policy context, Ball and Croushore (2003) estimate the effect of changes in the federal funds rate as policy variable on inflation expectations.

For a more systematic approach to determine the explanatory variables, we rest our considerations on models explaining the behaviour of the inflation rate. In this case, two approaches can be considered. The first is the mark-up approach that attributes price changes to demand and cost factors (Bronfenbrenner and Holzman 1963). Because the traditional separation between cost push and demand pull is controversial, we take both aspects into account (Laidler and Parkin 1975). This approach results in determining a measure of capacity utilisation to capture the demand situation, and the import price index and unit labour costs to depict cost components as explanatory variables for inflation.

The second approach of the P-Star model relies on the quantity theory of money and contains a simple monetary model as well as an expectations-augmented Phillips curve as special cases (Lee 1999). The generalised form of the model contains the price gap that can be reduced to its component parts that are the liquidity and the output gap (Svensson 2000). This approach ultimately results in money growth and some measure of potential output as explanatory variables.

Because we are not interested in discriminating between different models to explain inflation but in the determination of potential influences on the short-term difference between inflation and inflation expectations, we extract the following variables as candidates for influencing the inflation formation process:[3] Both approaches contain a measure of capacity utilisation. We use three different measures, that are the unemployment rate measured as percent of labour force, u, the economic sentiment indicator published by the European Commission, esi, in the form $100[indicator - mean(indicator)]/mean(indicator)$, and the annual growth rate of industrial production, Δip. For the cost push, we use the annual percentage price change of raw materials including as well as excluding energy, π^{raw} and $\pi^{rawexcl}$, and the oil price, oil. Additionally, the annual growth rate of the real effective exchange rate, Δe^{real}, gives a hint for the competitiveness of the European economy. Furthermore, we contain annual money growth M3, $\Delta m3$, in form of the three month moving average.

One problem for the use of time series in estimation where the behaviour of economic agents and their information set matter is the revision of the series. Because expectations are based on the knowledge at the time when expectations are formed, the used of revised data to uncover the relationship between the macro variables and expectations formation seems to be problematic. Therefore, we use data collected from the Monthly Bulletins of the ECB to get time series that reflect as closely as possible the knowledge of the financial market experts at the time of expectations formation.[4] For further description of the data, see appendix.

[3]For an alternative approach determining influences on inflation expectations formation see Gerberding (2001).

[4]Because the estimation equation contains lags of the explanatory variables, vintage data would be needed.

With regard to the time series characteristics, we test the time series for a unit root. The choice of the maximal lag length is done as the integer part of (see Hayashi 2000, p. 594)

$$12\left(\frac{T}{100}\right)^{1/4}$$

This gives maximal 12 lag for all analysed time series. Because of the improved finite-sample properties compared to the original ADF test, we use the ADF-GLS test of Elliott, Rothenberg and Stock (1996). One question to be addressed is the inclusion of deterministic terms in the test equation. To get an impression whether to incorporate a constant and a trend, we rely on graphical inspection of the GLS detrended series compared to the actual series used. We would not expect a trend in either of the series. However, because the matter is not unambiguously clear, we tested the series with and without a trend. For test results, see Table 3 in the appendix. Only for the wording indicator and the annual growth rate of industrial production we can reject the unit root unambiguously.

The exchange rate variable shows an ambiguous result. However, for the time series the assumption of a time trend is not reasonable. In this case, we reject the hypotheses of a unit root for the annual percentage change of the real effective exchange rate. For all other time series, the unit root could not be rejected.

The theoretical model gives the estimation equation in level form. We assume that the inflation rate and inflation expectations are cointegrated. If we transform the respective equation so that the dependent variables is given by the stationary difference between inflation and inflation expectations, the estimation results would not change. For all other time series, we take first differences where the unit root could not be rejected.

4.3 Estimation Results for the Relation between Inflation Rate and Inflation Expectations

Before presenting the estimation results, we address a problem that arises for modern central banks following an inflation targeting strategy or a similar monetary strategy that tries to anchor inflation expectations. The inflation target replaces inflation expectations in the long-run if expectations are firmly anchored at the aimed level of inflation and the prices of the economy normally aggregating private information about market conditions

cannot provide its role of information aggregation anymore (Morris and Shin 2005).[5] However, the ECB stresses that it does not follow direct inflation targeting but a two pillar strategy taking into account a broad range of signals about the economic stance. Nevertheless, the ECB announces a definition of price stability that includes a numerical value for inflation that is considered appropriate. This value of below but near two percent is not least to anchor inflation expectations. With the anchoring of inflation expectations, they should not respond to changes in the economic condition in the middle to long run because a credible monetary policy would bring inflation back to target.

In this case, a hypothesis of inflation expectations formation seems to be useless, because inflation expectations equal the numerical target of monetary policy. However, this should only be applicable over a mid- to long-term horizon because the central bank will not react to every (expected) change in inflation. Temporary violation of the inflation target should not be counteracted by interest rate decisions. In this case, short-term inflation expectations could deviate from target inflation even if middle- and long-term expectations are well anchored at the level of the inflation target. We would expect that inflation expectations over a six month horizon are affected by the short-term behaviour of the inflation rate.

Estimating equation (11) includes a large number of explanatory variables. To built a parsimonious equation, equation (11) is estimated with OLS including all explanatory variables v_i with lag zero to five at the first stage. At the second stage, we include only lags of one explanatory variable at a time besides the lagged inflation expectations, the lagged difference between inflation rate and inflation expectations, the wording indicator and the change of the policy rate. Only if the respective lags of the explanatory variable are still significant, they are included into the final estimation equation.

Because we are mostly interested in the influence of wording and interest rate decisions on the gap between inflation and expectations, but both variables are are not significant in the encompassing estimation equation, we test the parsimonious equation of omitted variables. It turns out that the wording indicator adds to the explanation of the difference between inflation and inflation expectations. Therefore, we include both lags into the estimation equation.

[5] In contrast to these concerns, Orphanides and Williams (2003) find that the announcement of an inflation target helps to focus inflation expectations and reduces costs of imperfect knowledge that could otherwise lead to detoriations in stabilisation policies.

The estimation results are displayed in Table 11. First, there is a one to one relationship between the inflation rate and inflation expectations as expected. Next, the lagged difference between inflation and expectations is significant as well but the coefficient is below unity as it would be specified by the theoretical model. From the additional explanatory variables, the oil price has a positive influence on the gap between inflation and inflation expectations. Also, an increase in the annual growth rate of prices of raw materials without energy as well as money growth M3 widens the difference between inflation and expectations. The coefficient of the monthly change of the unemployment rate displays a negative sign as predicted by a short-run Phillips curve.

After controlling for influences from macroeconomic variables, the net effect of the wording indicator is zero even if the two lags included are significant. This leads to the inclusion of the first difference of the wording indicator. Not the absolute level of the indicator but the change from one statement to the next would have an impact. The negative sign of the coefficient implies that an increasing hawkishness of the rhetoric compared to the last months leads to a smaller difference between inflation rate and inflation expectations. One interpretation would be that inflation expectations are higher the higher the risks to price stability communicated by the central bank. This results is confirmed by the estimations of explicit expectations formation, where a higher wording indicator increases leads to increased expectations.

5 Explicit Modelling of Inflation Expectations

A large part of the literature concerning inflation expectations investigates the question of rationality of expectations. If economic agents do not form expectations rationally, different forms of adaptive expectations formation can be assumed. A combination of both approaches implies that inflation expectations are solely explained depending on lagged values of inflation and inflation expectations and leaded values of the inflation rate. In the estimation approach, the expected values of the inflation rate have to be replaced by the realisation of the inflation rate and estimation is done using instrument variables. As instruments, different time series that are expected to influence the inflation rate can be employed. We will use this idea to explicitly model expectations formation.

Table 1: Estimation results for equation (11).

$$\begin{aligned}\pi_t &= a_1\pi_{t|t-6} + a_2(\pi_{t-1} - \pi_{t-1|t-7}) + a_3 wd10_{t-6} + a_4 wd10_{t-7} \\ &\quad + a_5\Delta i_{t-6} + a_6\Delta i_{t-7} + \sum_{i=1}\sum_{s=0}^{5} a_{6+i} v_{i,t-s} + \varepsilon_t\end{aligned}$$

Dependent variable: π_t						
Adj. sample: 1999:09 - 2006:12						
$\pi_{t\|t-6}$	0.98	(69.61)	0.98	(73.39)	0.98	(73.58)
$\pi_{t-1} - \pi_{t-1\|t-7}$	0.68	(10.16)	0.70	(10.83)	0.70	(11.07)
$wd10_{t-6}$			-0.09	(-2.54)		
$wd10_{t-7}$			0.09	(3.12)		
$\Delta wd10_{t-6}$					-0.09	(-3.18)
Δoil_{t-1}	0.04	(3.56)	0.03	(3.65)	0.03	(3.71)
Δoil_{t-2}	0.02	(2.38)	0.03	(3.05)	0.03	(3.08)
$\Delta\pi_{t-2}^{rawexcl}$	0.01	(2.43)	0.01	(2.51)	0.01	(2.56)
Δu_{t-3}	-0.76	(-1.94)	-0.63	(-1.43)	-0.65	(-1.59)
$\Delta m3_{t-1}$	0.15	(1.47)	0.14	(1.41)	0.14	(1.43)
$\overline{R}^2$	0.6054		0.6253		0.6299	
DW statistic	1.91		1.96		1.96	

Newey-West HAC standard errors and covariance

t statistic in parenthesis

More formally, inflation expectations formed in period t for time $t+s$ can be described as

$$\pi_{t+s|t} = E[\pi_{t+s}|\Omega_t] \tag{12}$$

where Ω describes the information set available at time t. This information set includes private as well as public information. If expectations formation is done rationally, private information would play no role and the expectations error would have a zero mean and displays no autocorrelation.

If we assume that part of the individuals form expectations rationally and others employ adaptive expectations formation, the series of inflation expectations could be displayed as the weighted average of both parts

$$\pi_{t+s|t} = \rho E[\pi_{t+s}|\Omega_t] + (1-\rho)E[\pi_{t+s}|S_t] \tag{13}$$

where ρ gives the relative weight of these two formation processes. The information set S_t for forming adaptive expectations is only part of the public information set, $S_t \subseteq \Omega_t$ (Pesaran and Weale 2005, p. 7-15).

Because we are interested in the explicit representation of expectations formation, we have to find a suitable form to express $E[\pi_{t+s}|\Omega_t]$. For the adaptive part, we rely on the usual forms, e.g. the correction of expectations by the expectations error. For the part of rational expectations, we assume that the information set contains a number of time series, v, that give signals with respect to the future inflation rate. In this case, and under the additional assumption of normal distributed random variables, we get the multiple regression equation

$$E[\pi_{t+s}|v] = E[\pi] - \sum_{i=1}^{p} \alpha_i E[v_i] + \sum_{i=1}^{p} \alpha_i v_i + e \tag{14}$$

setting the number of explanatory variables to p (Graybill 1961, p. 62-67).

To include additional explanatory variables in the traditional models explaining expectations formation, we need to test whether there is a part of forward-looking expectations formation. If there are no forward-looking expectations present, we could solely rely on the lagged inflation rate and lagged inflation expectations to determine expectations formation. In a first step we therefore estimate the traditional model of expectations formation (Model I):

$$\begin{aligned} \pi_{t+6|t} &= c_1[\pi_{t|t-6} + c_2(\pi_{t+5|t-1} - \pi_{t-1|t-7}) + c_3(\pi_t - \pi_{t-6}) + c_4(\pi_t - \pi_{t|t-6})] \\ &\quad +(1-c_1)\pi_{t+6} + \epsilon_t \end{aligned} \tag{15}$$

where part of the expectations are allowed to be formed with regard to inflation six months ahead. Other possibilities would be to use the expected change of the inflation rate or the difference between the expectations formed in t and the expectations formed for time t as dependent variables. Because this would incorporate an equivalent transformation of the equation, the estimation results do not change. Therefore, we rely on the traditional equation for explaining expectations formation.

For the backward-looking part of expectations formation, it is possible to allow for three different approaches. First, expectations could be formed regressive. This would mean to include the lagged change of expectations, $(\pi_{t+5|t-1} - \pi_{t-1|t-7})$. Second, expectations formation can be oriented towards the change of actual inflation over the last six months, $(\pi_t - \pi_{t-6})$. The third approach would be an adaptive part that allows for the correction of the last known expectations error, $(\pi_t - \pi_{t|t-6})$. We include all three possibilities into the equation.

If the forward-looking part is significant and cannot be neglected, we can proceed by explicitly modelling expectations formation. Because we assume that the backward-looking part already contains the information of published macroeconomic variables, we keep the lagged inflation rate and inflation expectations as well as the respective hypothesis of expectations formation for this part.

The problem is to identify the set of explanatory variables that should replace the forward-looking part of expectations formation. To determine the respective quantities, we rely on the same thoughts than determining the variables that influence the difference between inflation and inflation expectations. When unit root tests indicate so, the first differences of the variables are taken as before. We employ three different measures of capacity utilisation, that are the unemployment rate measured as percent of labour force, the economic sentiment indicator published by the European Commission, and the growth rate of industrial production. For the cost push, we use the price change of raw materials and oil prices. Additionally, the annual growth rate of the real effective exchange rate gives a hint for the competitiveness of the European economy. Furthermore, we contain money growth, and the change of the policy rate in the euro area. Whereas with the policy rate and money growth, the action of monetary policy makers are included to test their influence on inflation expectations formations, we include the wording indicator to test whether words also matter in this respect. In this case, the original estimation equation transforms into (Model II)

$$\begin{aligned}\pi_{t+6|t} &= c_1[\pi_{t|t-6} + c_2(\pi_{t+5|t-1} - \pi_{t-1|t-7}) + c_3(\pi_t - \pi_{t-6}) + c_4(\pi_t - \pi_{t|t-6})] \\ &\quad +(1-c_1)[c_5 + c_6\Delta i_{t-1} + c_7\Delta m3_t + c_8\Delta\pi_t^{rawexcl} + c_9 oil_t + c_{10} esi_t + c_{11}\Delta ip_t \\ &\quad +c_{12}\Delta u_t + c_{13} wi10_t] + \epsilon_t \qquad (16)\end{aligned}$$

The variables always contain the last known value of the respective explanatory variable and take into account the publication lag.

5.1 Estimation Results for the Explicit Expectations Formation

With regard to the estimation strategy of Model I, TSLS is used because the value of the inflation rate in $t + 6$ is not known in t. Because we follow the errors-in-variables approach to replace expected inflation with realised inflation six months ahead, we need a list of reasonable instruments (Blake 1991). This list does not contain lagged inflation expectations because the survey data may measure inflation expectations with error. The test for over-identifying restrictions shows that the instruments seem to be valid and the specification of the equation is reasonable (see Table 2 for the instrument list and test result). Moreover, the estimation has to deal with the fact that the time horizon for expectations is six months. Therefore, the time period of expectations formations differs from the monthly frequency of the survey. This would generate serial correlation that has to be taken into account by using robust standard errors when estimating the model.

The estimation results show that an important part of expectations formation can be regarded as backward-looking. Depending on the specification, this part reaches up to 81 percent but is still significantly different from unity. In Model I, the adaptive part splits half between the correction of the lost known expectations error and the regressive approach to expectations formation. In Model II, the weight shifts towards correction of the expectations error and the recent development of the inflation rate over the last six months also influences adaptive expectations.

For the influence of macroeconomic variables on expectations formation, monetary policy seems to have no influence. The time horizon of expectations formation is too short for an observable effect of money growth as well as interest rate decisions. Surprisingly, the oil price and prices of other raw materials also do not seem to have an impact if other macroeconomic variables are included. For the measures of capacity utilization, the monthly change of economic sentiment has a positive impact on expectations. With higher capacity utilization, inflation expectations increase because of inflation risks stemming from the real side of the economy. In addition to that, the constant is highly significant. Forward-looking inflation expectations seem to be anchored at 2.20 percent. That is higher than the definition of price stability of the ECB and also somewhat higher than the mean of the inflation rate of 2.10 percent. This might be due to the fact that these inflation expectations are short run whereas the ECB targets inflation over the middle- to long-run.

The wording indicator also display a significantly positive influence on inflation expectations. A higher indicator leads to higher inflation expectations. It shows that financial market experts believe the risks to price stability that are communicated by the central bank. Even if there is no reaction to interest rate decision, this result does not necessarily interfere with the credibility of the central bank. The expectations formation horizon of expert is too short to allow for effects from interest rate decisions at the time expectations are formed.

These results are supported by the answers of financial market experts to a number of special questions asked within the framework of the Financial Market Test in March 2006 (ZEW Finanzmarktreport 2006). A large proportion of experts (62.3 percent) evaluates the communication of the ECB as clear or very clear. Also the statements of the ECB play a role for forecasting macroeconomic variables. If the statements are considered, they mostly influence inflation expectations followed by the exchange rate and long-run interest rates. Around 40 percent of the experts take statements of the ECB into account when forecasting inflation conditional that the rhetoric is regarded when forecasting macroeconomic variables.

6 Conclusion

With the change of monetary policy in direction of more transparency, the communication strategy of central banks comes more and more into focus. Especially for the ECB with a complex two pillar strategy and a definition of price stability, the understanding of monetary policy decisions and strategy by the public is crucial. The literature focuses to a large extend on the short-run effects of communication and comes to the conclusion that the interest rate decisions of the ECB are predictable to a large amount. Whereas the monetary policy of the ECB is well understood in this respect, the influence of communication on inflation expectations is not equally well investigated.

We contribute to the literature by investigating the influence of the information content of the ECB Presidents' statements on inflation expectations. The informational content is captured by a wording indicator and it is analysed whether there is a significant influence on inflation expectations formation and the difference between the inflation rate and inflation expectations. For measuring expectations, we use inflation expectations of financial market experts provided by the ZEW Financial Markets Test.

Table 2: Estimation results for explicit expectations formation.

	Dependent var. $\pi_{t+6\|t}$			
Adj. sample	2000:2 - 2006:06 (n)		1999:09 - 2006:12 (n)	
	Model I		Model II	
c_1	0.81	(7.10)	0.72	(13.19)
c_2	0.60	(2.96)	0.14	(2.50)
c_3	0.07	(0.35)	0.30	(2.21)
c_4	0.52	(2.50)	0.78	(4.47)
constant			2.20	(32.87)
esi_t			0.15	(3.24)
wd_t			0.25	(2.59)
$\overline{R}^2$	0.4496		0.8524	
DW	1.04		0.81	
Test of overid. restrictions	3.45 (p-value 0.75)			
Instruments	constant, π_{t-6}, $\pi_t - \pi_{t-6}$, $\Delta m3_{t-1}$, $\Delta m3_{t-8}$, esi_{t-8}, u_{t-2}, $\Delta\pi^{raw}_{t-7}$, $\Delta\pi^{raw}_{t-8}$, Δe^{real}_{t-2}			

(n) Newey-West HAC standard errors (lag truncation=3)
t-statistic in parenthesis

As the estimations show, there is a significant influence of the wording indicator on inflation expectations. A possible interpretation is that the rhetoric of the ECB communicates risks to price stability in a credible way and financial market experts react to the announcements.

Appendix: Figures

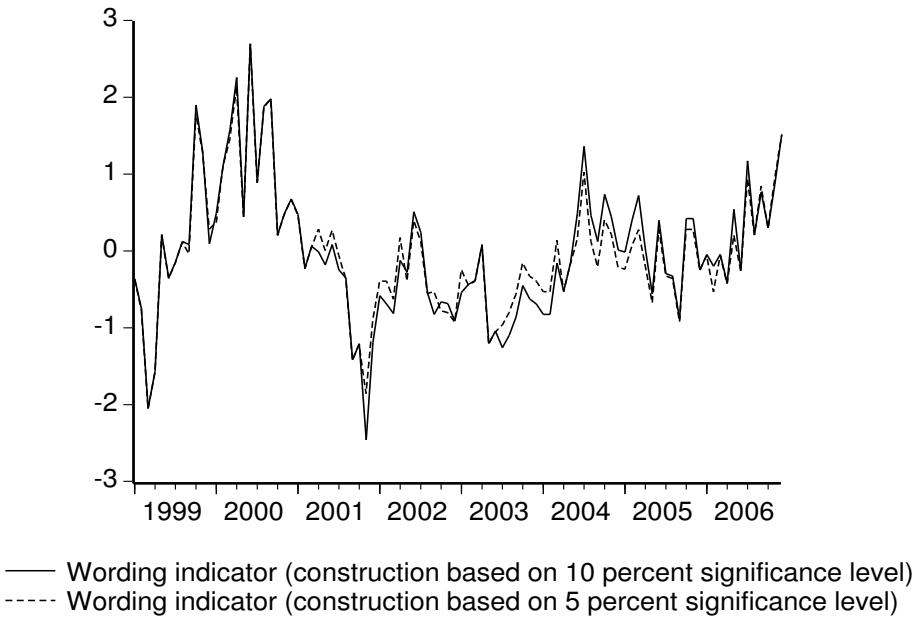

Figure 1: Wording indicators wd10 and wd5.

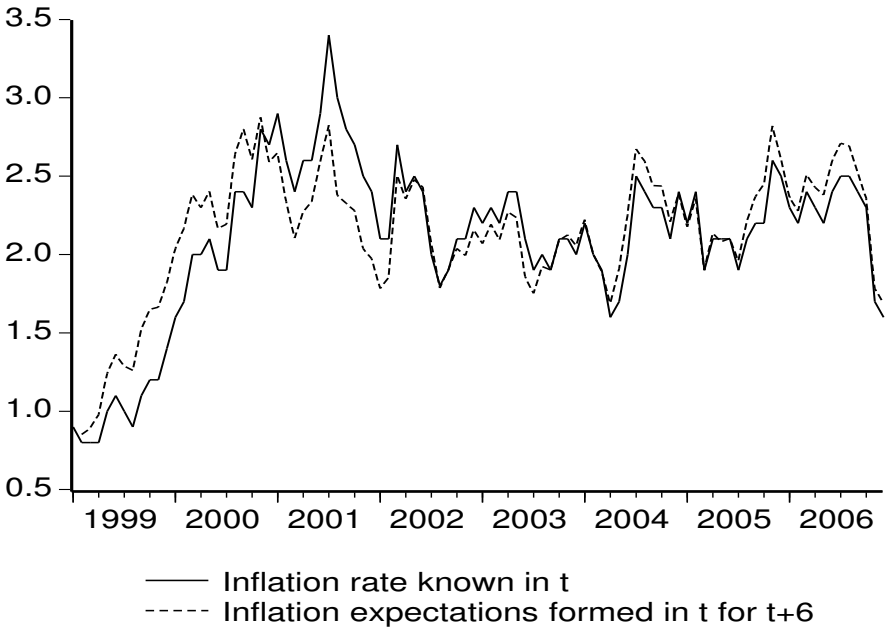

Figure 2: The inflation rate and inflation expectations.

Appendix: Data Description

The unemployment rate measured as percent of labour force is seasonally adjusted. The data are released with a lag of 2 months as a rule, so that e.g. in January the value of November of the previous year is known. However, for the time series form January 1999 to January 2006, it happens 10 times that only the value of the previous month was published in the Monthly Bulletin and that in the following month two new values were published to keep on track with the two month publication lag. We construct the series that captures the knowledge of an observer that displays the latest available unemployment rate at that time.

The annual percentage change of the real effective exchange rate is used in the narrow definition of trading partners of the euro area. It has a publication lag of one month due to adjustment to price changes. There are some special features of this series. For January 1999, the value is calculated from the respective exchange rate indices published in the February 1999 Monthly Bulletin. Before April 2000, the effective exchange rate change is published for the countries also individually displayed in the Monthly Bulletin. Since April 2000 it is a narrow group of 23 trading partners. The values for January 2001 to December 2001 are calculated using the Table 'Past data for selected economic indicators for the euro area plus Greece'.

For money growth M3, the value for the centred three month moving average was first published in August 2001 (Mai 2001 value). For January 1999 to April 2001, the values are calculated from the seasonally adjusted index of M3, firstly published in August 1999 (May 1999 value). For the January 1999 to April 1999, the data are calculated using the index values taken from the August 1999 Monthly Bulletin. The publication lag is four months.

The economic sentiment indicator is published by the European Commission. We use it in the form $100(esi - \overline{esi})/\overline{esi}$.

Table 3: ADF-GLS test for revised/real time series potentially included in the regressions.

	Test statistics	
	without trend	with trend
Money M3 (annual growth rate) $\Delta m3$	-1.31^{A}	-2.74^{B}
Exchange rate (annual growth rate) Δe^{real}	$-2.09^{A,**}$	-2.20^{C}
Economic sentiment esi	-1.36^{A}	-1.33^{D}
Unemployment rate u	1.08^{A}	-0.98^{C}
Oil price oil	0.02^{A}	-1.77^{C}
Prices of raw materials excl. energy (annual growth rate) $\pi^{rawexcl}$	-0.54^{A}	-1.67^{C}
Prices of raw materials (annual growth rate) π^{raw}	-1.25^{A}	-1.63^{C}
Industrial production (annual growth rate) Δip	$-1.66^{A,*}$	$-3.01^{C,*}$
Inflation rate π	-1.20^{A}	-1.76^{C}
Expected inflation rate $\pi_{t\|t-6}$	-1.20^{A}	-1.69^{D}
Wording indicator $wd10$	$-2.74^{A,***}$	$-2.80^{D,*}$

Critical values

A: 10% level: -1.61; 5% level: -1.94; 1% level: -2.59

B: 10% level: -2.77; 5% level: -3.06; 1% level: -3.62

C: 10% level: -2.76; 5% level: -3.05; 1% level: -3.60

D: 10% level: -2.76; 5% level: -3.05; 1% level: -3.61

Critical values for the test including a trend are provided by EViews interpolating the critical values of ERS. For the constant and no deterministic term, McKinnon (1996) critical values are applied.

References

Balcombe, K. (1996): "The Carlson-Parkin Method Applied to NZ Price Expectations Using QSBO Survey Data," *Economics Letters*, 51(1), 51–57.

Ball, L., and D. Croushore (2003): "Expectations and the Effects of Monetary Policy," *Journal of Money, Credit, and Banking*, 35(4), 473–484.

Batchelor, R., and A. Orr (1988): "Inflation Expectations Revisited," *Economica*, 55, 317–331.

Berk, J. M. (1999): "Measuring Inflation Expectations: A Survey Data Approach," *Applied Economics*, 31(11), 1467–1480.

Bernoth, K. u. J. v. H. (2004): "The Euribor Futures Market: Efficiency and the Impact of ECB Policy Announcements," *International Finance*, 7(1), 1–24.

Blake, D. (1991): "The Estimation of Rational Expectations Models: A Survey," *Journal of Economic Studies*, 18(3), 31–70.

Blinder, A., C. Goodhart, P. Hildebrand, D. Lipton, and C. Wyplosz (2001): *How Do Central Banks Talk?* CEPR.

Bronfenbrenner, M., and F. D. Holzman (1963): "Survey of Inflation Theory," *American Economic Review*, 53(4), 593–661.

Connolly, E., and M. Kohler (2004): "News and Interest Rate Expectations: A Study of Six Central Banks," *Reserve Bank of Australia Research Discussion Paper*, No. 10.

Cruijsen, C. v. d., and M. Demertzis (2005): "The Impact of Central Bank Transparency on Inflation Expectations," *DNB Working Papers*, No. 031.

Czogała, A., A. Kot, and A. Sawicka (2005): "Inflation Expectations of Polish Entrepreneurs. Does the Central Bank Communication Matter?," *Working Paper*.

Di Bartolomeo, G., and E. Marchetti (2004): "Central banks and information provided to the private sector," *Economics Working Paper Archive at WUSTL*, No. 0504025.

Döpke, J., J. Dovern, U. Fritsche, and J. Slacalek (2005): "European Inflation Expectations Dynamics," *Deutsche Bundesbank Discussion Paper Series 1: Economic Studies*, No. 37.

Ehrmann, M., and M. Fratzscher (2005): "Communication and Decision-Making by Central Bank Committees. Different Strategies, Same Effectiveness?," *ECB Working Paper*, No. 488.

Eijffinger, S. C., M. M. Hoeberichts, and M. F. Tesfaselassie (2004): "Central Bank Communication and Output Stabilization," *CEPR Discussion Paper*, No. 4408.

Elliott, G., T. J. Rothenberg, and J. H. Stock (1996): "Efficient Tests for an Autoregressive Unit Root," *Econometrica*, 64(4), 813–836.

Gaspar, V., G. P. Quiros, and J. Sicilia (2001): "The ECB Monetary Policy Strategy and the Money Market," *ECB Working Paper*, No. 69.

Geraats, P. M. (2002a): "Central Bank Transparency," *Economic Journal*, 112(483), F532–F565.

Gerberding, C. (2001): "The information content of survey data on expected price developments for monetary policy," *Economic Research Centre of the Deutsche Bundesbank Discussion Paper*, No. 09.

Gerlach, S. (2004): "Interest Rate Setting by the ECB: Words and Deeds," *CEPR Discussion Paper*, No. 4775.

Gramlich, E. M. (1983): "Models of Inflation Expectations Formation," *Journal of Money, Credit & Banking*, 15(2), 155–173.

Graybill, F. A. (1961): *An Introduction to Linear Statistical Models*, vol. I. McGraw-Hill, New York.

Hartmann, P., M. Manna, and A. Manzanares (2001): "The Microstructure of the Euro Money Market," *CEPR Discussion Paper*, No. 3081.

Hayashi, F. (2000): *Econometrics*. Princeton University Press, Princeton.

Heinemann, F., and K. Ullrich (2005): "Does it Pay to Watch Central Bankers' Lips? The Information Content of ECB Wording," *ZEW Discussion Paper*, No. 05-70.

Jansen, D.-J., and J. de Haan (2003): "Statements of ECB Officials and Their Effect on the Level and Volatility of the Euro-Dollar Exchange Rate," *CESifo Working Paper*, No. 927.

——— (2004): "Look Who's Talking: ECB Communications During the First Years of EMU," *CESifo Working Paper*, No. 1263.

——— (2005): "Were Verbal Efforts to Support the Euro Effective? A High-Frequency Analysis of the ECB Statements," *DNB Working Paper*, No. 33-2005.

Johnson, D. R. (1997): "Expected Inflation in Canada 1988-1995: An Evaluation of Bank of Canada Credibility and the Effect of Inflation Targets," *Canadian Public Policy - Analyse de Politiques*, 23(3), 233–258.

Kliesen, K. L., and F. A. Schmid (2004): "Monetary Policy Actions, Macroeconomic Data Releases, and Inflation Expectations," *Federal Reserve Bank of St Louis Review*, 86(3), 9–21.

Kohn, D. L., and B. P. Sack (2003): "Central Bank Talk: Does It Matter and Why," *Federal Reserve Board Finance and Economics Discussion Series*, No. 55.

Kuttner, K. N., and A. S. Posen (1999): "Does Talk Matter After All? Inflation Targeting and Central Bank Behavior," *CFS Working Paper*, No. 04.

Laidler, D. E. W., and J. M. Parkin (1975): "Inflation: A Survey," *Economic Journal*, 85(340), 741–809.

Lee, J. (1999): "Alternative P* Models of Inflation Forecasts," *Economic Inquiry*, 37(2), 312–25.

Lomax, R. (2005): "Inflation Targeting in Practice: Models, Forecasts and Hunches," *Bank of England Quarterly Bulletin*, Summer, 237–246.

Marnet, V. (1995): *Eigenschaften und Bestimmungsfaktoren Von Finanzmarkttesterwartungen. Eine Theoretische und Empirische Analyse unter Verwendung der ZEW-Finanzmarkttestdaten*. Nomos, Baden-Baden.

Mitchell, J. (2002): "The Use of Non-Normal Distributions in Quantifying Qualitative Survey Data on Expectations," *Economics Letters*, 76(1), 101–107.

Morris, S., and H. S. Shin (2005): "Central Bank Transparency and The Signal Value of Prices," *Brookings Papers on Economic Activity*, 2, 1–43.

Neumann, M. J. (2002): "Transparency in Monetary Policy," *Atlantic Economic Journal*, 30(4), 353–365.

Orphanides, A., and J. C. Williams (2003): "Imperfect Knowledge, Inflation Expectations, and Monetary Policy," *NBER Working Paper Series*, No. 9884.

Pesaran, M. H. (1987): *The Limits to Rational Expectations*. Basil Blackwell, Oxford.

Pesaran, M. H., and M. Weale (2005): "Survey Expectations," *CESifo Working Paper*, No. 1599.

Romer, C. D., and D. H. Romer (2000): "Federal Reserve Information and the Behavior of Interest Rates," *American Economic Review*, 90(3), 429–457.

Ross, K. (2002): "Market Predictability of ECB Monetary Policy Decisions: A Comparative Examination," *IMF Working Paper*, No. 233.

Sellon Jr., G. H. (2004): "Expectations and the Monetary Policy Transmission Mechanism," *Federal Reserve Bank of Kansas City Economic Review*, 89(4), 5–41.

Smith, J., and M. McAleer (1995): "Alternative Procedures for Converting Qualitative Response Data to Quantitative Expectations: An Application to Australian Manufacturing," *Journal of Applied Econometrics*, 10, 165–185.

Svensson, L. E. (2003): "What Is Wrong with Taylor Rules? Using Judgment in Monetary Policy Through Targeting Rules," *Journal of Economic Literature*, 41(2), 426–477.

Svensson, L. E. O. (2000): "Does the P* Model Provide Any Rationale for Monetary Targeting?," *German Economic Review*, 1(1), 69–81.

Winkler, B. (2000): "Which Kind of Transparency? On the Need for Clarity in Monetary Policy-Making," *ECB Working Paper*, No. 26.