Central Bank Communication and the Perception of Monetary Policy by Financial Market Experts

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Abstract

This paper investigates how financial market experts perceive the interest rate policy of the European Central Bank (ECB). Assuming a Taylor–rule–type reaction function of the ECB, we use qualitative survey data on expectations about the future interest rate, inflation, and output to discover the sources of individual interest rate forecast errors. Based on a panel random coefficient model, we show that financial experts have systematically misperceived the ECB's interest rate rule. While the perception of monetary policy regarding inflation has become more accurate since the clarification of the ECB's monetary policy strategy in May 2003, the experts' misperception regarding the ECB's reaction to output has increased in the financial crisis.

Keywords: Central bank communication, Interest rate forecasts, Survey expectations, Panel random coefficient model
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1 Introduction

Central bank communication is increasingly important to both central banks and financial market participants, see Blinder, Ehrmann, Fratzscher, DeHaan, and Jansen (2008). Effective communication should ensure that financial markets understand the central bank's interest rate policy, i.e., how interest rate decisions are linked to future inflation and output. However, central bank communication is not always effective and interest rate forecast errors can, and do, occur for two reasons. First, forecasters may indeed *understand* monetary policy but misperceive future interest rate decisions simply because they are wrong about future inflation and output. Second, the forecasters actually *do not understand* monetary policy and the interest rate rule applied by the central bank. In this case, communication should be improved because markets will misperceive interest rate decisions even under perfect information about the economic outlook. This paper employs survey data on financial market expectations about future interest rates, inflation, and output in the Euro area to shed more light on communication by the European Central Bank (ECB), disagreement among financial experts over future interest rate decisions, and the sources of policy misperception.

Our analysis employs individual interest rate forecasts by financial market experts taken from the Financial Market Survey conducted by the Centre for European Economic Research (ZEW). It is a monthly survey and comprises a rich set of qualitative expectations on short–term interest rates, inflation, and output. Assuming that experts use Taylor–rule–type forecast equations for short–term interest rates, we explore whether interest rate forecast errors are driven by uncertainty about the future course of inflation and output or whether experts are confused about monetary policy rules. In particular, we assess the consequences of a major change in ECB communication that occurred in May 2003. At this time, the ECB provided a more precise definition of price stability (inflation should be below but close to 2%) and deemphasized the role of monetary aggregates for short–term policy decisions. Since then, the ECB's monetary analysis has put more emphasis on the long–term relationship between money supply and inflation. We also investigate whether the market's understanding of monetary policy has been affected by the recent economic crisis.

Survey data on expectations are increasingly used in the literature to evaluate the effects of central bank communication. For example, Capistrán and Ramos-Francia (2010) and Ehrmann, Eijffinger, and Fratzscher (2010) explore how the introduction of inflation targeting affects the dispersion of inflation expectations in surveys. Lange, Sack, and Whitesell (2003), Swanson (2006), Ehrmann and Fratzscher (2007), and Sturm and de Haan (2009) derive from survey data that more transparent communication generally improves market participants' predictions of the central bank's interest rate decisions.

All these contributions focus on the size and other statistical properties of individual forecast errors; no attempt is made to explain why interest rate forecast errors are made. A work by Berger, Ehrmann, and Fratzscher (2009) is closest in spirit to the approach we undertake here. The authors investigate the role of geography, i.e. the forecaster's location, in interest rate forecast errors. By estimating Taylor–rule–type relationships for each forecaster separately, they decompose forecast errors as being either systematic or unsystematic. The present paper extends this approach in two ways. First, our analysis of experts' interest rate forecast errors includes information of the individual forecasts about inflation and output. Second, we analyze the determinants of the individual interest rate forecast errors by a panel random coefficient model which accounts for both the panel structure of the survey data and the heterogeneity of forecasters. In order to disentangle the sources of individual forecast errors, we estimate how heterogenous financial experts perceive the interest rate rule of the central bank. Recently, Hamilton, Pruitt, and Borger (2011) used a similar Taylor–rule–type model to investigate the perception of U.S. monetary policy. Based on the response of Fed funds rate futures to macroeconomic news, they estimate a market–perceived monetary policy rule and, thus, abstract from forecaster heterogeneity. In contrast, our empirical approach accounts for the disagreement between financial experts over the monetary policy rule and the economic outlook.

Our empirical results show that financial market experts tend to overestimate the ECB's interest rate reaction to inflation in the early years of the euro. However, the clarification of the ECB's monetary policy strategy in 2003 actually improved communication regarding the role of inflation. Following a counterfactual analysis, the major source of experts' interest rate forecast errors have been their own mistaken inflation forecasts and not the misperception of the ECB's response to actual inflation. In contrast, the assessment of experts about the central bank's reaction to output growth has become less accurate over time. Since the beginning of the financial crisis, the misperception of the role of output for the ECB's interest rate decisions has explained a significant part of the experts' interest rate forecast errors.

The paper is structured as follows. Section 2 introduces the ZEW financial market survey data and briefly discusses how recent work has used the aggregate survey balance statistics versus the individual survey expectations. Section 3 derives and decomposes interest rate forecast errors from a standard Taylor rule. Section 4 presents the econometric model. Section 5 sets out the empirical results on misperception of the ECB interest rate policy and Section 6 concludes.

2 The ZEW Financial Market Survey

2.1 The Data Set

Since December 1991, the ZEW has regularly asked approximately 350 financial sector professionals about their expectations regarding a large set of macroeconomic variables, such as inflation, output, and interest rates. These professionals, or "financial market experts", usually have an academic background in economics and are also engaged in observing economic developments. Hence, they should be highly qualified for forecasting economic developments. Around half of them work at banks (60%); the rest are employed by the insurance industry (10%), financial departments of industrial companies (11%), or by other financial service providers. A majority (88%) of these financial market experts are employed in Germany, 10% are located within the European region, and 2% are from non-European countries.

Usually during the first two weeks of a month, the financial market experts are asked whether they expect short–term interest rates to decrease (-1), stay constant (0), or to increase (1) within the next six months. Specifically, the experts are asked for their predictions of the three–month interbank rate, i.e., the three–month Euribor in the euro zone, which is very closely related to the ECB's policy rate. In particular, assuming equal *qualitative* changes of the Euribor and the ECB's policy rate is empirically well established, see e.g. Nautz and Offermanns (2007). Further survey questions relevant to this study concern changes in the annual inflation rate and the economic situation in the Euro zone. We evaluate the experts' answers to these questions with respect to the six–month changes in HICP inflation and in the yearly growth rate of industrial production, respectively. Table 1 presents a descriptive summary of these survey expectations. Of the 350 experts surveyed each month, about 300 answer on average. Accordingly, our estimations will be based on an unbalanced panel of around 300 observations each month. For the entire sample from January 2000 to March

2009, this gives us 32,073 observations.

Table 1: Survey expectations for short–term interest rates, inflation and output in the Euro area: Descriptive statistics

	Jan 00 - Oct 03	Nov 03 - Jul 07	Aug 07 - Mar 09
Expected 6–month change in short–term interest rates			
$\mu(i^e_{jt})$	-0.10	0.52	-0.30
$\sigma(i^e_{jt})$	0.81	0.55	0.73
$\text{freq}(i^e_{jt}) = -1$	38%	3%	46%
$\text{freq}(i^e_{jt}) = 0$	34%	43%	38%
$\text{freq}(i^e_{jt}) = 1$	28%	55%	16%
Expected 6–month change in inflation			
$\mu(\pi^e_{jt})$	-0.12	0.21	-0.08
$\sigma(\pi^e_{jt})$	0.74	0.65	0.83
$\text{freq}(\pi^e_{jt}) = -1$	34%	13%	39%
$\text{freq}(\pi^e_{jt}) = 0$	43%	54%	30%
$\text{freq}(\pi^e_{jt}) = 1$	22%	34%	31%
Expected 6–month change in output			
$\mu(y^e_{jt})$	0.40	0.34	-0.39
$\sigma(y^e_{jt})$	0.65	0.61	0.63
$\text{freq}(y^e_{jt}) = -1$	9%	7%	47%
$\text{freq}(y^e_{jt}) = 0$	43%	52%	45%
$\text{freq}(y^e_{jt}) = 1$	48%	41%	8%

Notes: The table shows descriptive statistics of the individual survey expectations for the Euro zone. The data are qualitative with possible discrete values {-1,0,1}. $\text{freq}(x^e_{jt})$ gives the relative frequency of the corresponding variable taking the value given.

2.2 Balance Statistics and Forecaster Heterogeneity

The ZEW publishes aggregate balance statistics, defined as the difference between the relative share of answers falling into the categories "increase" and "decrease". Balance statistics of the ZEW survey are typically found to have reasonable forecasting properties, compare Nolte and Pohlmeier (2007). The analysis of aggregate balance statistics already indicates that financial market experts keep a sharp eye on central bank communication. Ullrich (2008) showed that the balance statistics of ZEW inflation expectations respond significantly to ECB announcements.

Restricting the attention to the behavior of aggregate balance statistics does not fully exploit the information contained in the distribution of individual forecasts. In particular, forecaster heterogeneity should not be ignored when exploring how central bank communication affects the perception of monetary policy. In order to account for different views on the central bank's monetary policy rule, our empirical analysis will be based on the individual forecasts of experts rather than on aggregate balance statistics. The empirical literature typically models forecaster heterogeneity by defining subgroups according to e.g. location or experience of the forecaster. A more sophisticated way to model forecaster heterogeneity is proposed by Rangvid, Schmeling, and Schrimpf (2009). They estimate a panel random coefficient model for the stock market expectations of participants in the ZEW financial market survey. In the following, we adopt the random coefficient approach. This approach captures the disagreement among experts over the central bank's monetary policy rule in the estimated distribution of random coefficients.

3 Sources of Interest Rate Forecast Errors

3.1 Interest Rate Forecasts and Taylor Rules

Most of the relevant studies on the accuracy of forecasts make no attempt to explain the sources of interest rate forecast errors. In an exception to this trend, Berger, Ehrmann, and Fratzscher (2009) employ a Taylor rule model to investigate interest rate forecast errors of professional ECB policy forecasters. They use quantitative survey data from a Reuters poll in which financial institutions were asked for the expected policy rate. The authors decompose the interest rate forecast errors $(r^e_{jt} - r_t)$ of forecaster j into a systematic (s_j) and an unsystematic (u_j) component. The systematic part depends on the individual Taylor–rule–type forecast equation

$$r^e_{jt} - r_t = \hat{\beta}_{jr} r_{t-1} + \sum \hat{\beta}_{jk} x_{kt} + \hat{\beta}_{j\pi} \tilde{\pi}_{jt} - r_t + \hat{u}_{jt} = \hat{s}_{jt} + \hat{u}_{jt}.$$

where x_{kt} are macroeconomic variables and $\tilde{\pi}_{jt}$ is the inflation differential of the country in which the forecaster is located, relative to the euro zone average. Their empirical results indicate that the systematic component matters for forecast accuracy. In particular, descriptive statistics on average errors suggest that forecasters from financial centers such as Frankfurt or London provide more accurate forecasts.[1]

This paper extends Berger, Ehrmann, and Fratzscher (2009) in two important respects. First, since the ZEW financial market survey not only asks for expected interest rates, but also for expected inflation and output, we can include these expectations in each individual interest rate forecast equation. Second, our econometric framework uses a random coefficient model to explicitly model the forecasters' disagreement about appropriate Taylor rule parameters, see Section 4.

3.2 The Interest Rate Policy of the Central Bank

Ever since Taylor's (1993) seminal work, reaction functions specified as Taylor rules, where the central bank determines the key policy rate in response to inflation and output, have been the predominant way of modeling interest rate setting by central banks. Starting with Clarida, Galí, and Gertler (1998), much empirical work confirms that Taylor rules are remarkably adept at describing central bank interest rate decisions (for recent examples, see Jansen and de Haan (2009); Grammig and Kehrle (2008)). In accordance with Berger, Ehrmann, and Fratzscher (2009) and Hamilton, Pruitt, and Borger (2011), we assume that the central bank sets the short–term interest rate

[1] In a related work, Berger, Ehrmann, and Fratzscher (2011) show that regional differences within the United States play a significant role for forecasting monetary policy decisions. In our sample, the effects of location on the perception of the ECB's monetary policy are only weak. In particular, the results obtained for experts from Frankfurt are very similar to those obtained for all experts, see also Footnote 6.

in response to contemporaneous inflation and output:

$$\Delta_6 i_t = \alpha \Delta_6 \pi_t + \beta \Delta_6 y_t. \tag{1}$$

The Taylor rule is defined in terms of semi-annual differences ($\Delta_6 i_t = i_t - i_{t-6}$) because the survey data refer to interest rate changes over six months. From a theoretical point of view, the output gap should be part of the Taylor rule. However, by taking differences, potential output drops out of the equation.

3.3 Decomposing Individual Forecast Errors

If the central bank follows a Taylor rule, financial market experts may also use a Taylor rule in formulating their expectations of the central bank decision. Given the survey horizon of six months, an expert j is expected to form his interest rate expectations in $t-6$ for period t according to the following Taylor–rule–type forecast equation

$$\Delta_6 i^e_{jt} = \alpha_j \Delta_6 \pi^e_{jt} + \beta_j \Delta_6 y^e_{jt}. \tag{2}$$

According to Equation (2), the interest rate change expected by expert j depends on his expected change in inflation $\Delta_6 \pi^e_{jt}$ and output $\Delta_6 y^e_{jt}$.[2]

The interest rate forecast errors e^{i*}_{jt} are obtained by subtracting the financial market expert's forecast (Equation (2)) from the actually observed interest rate set by the central bank (Equation (1))

$$\begin{aligned} e^{i*}_{jt} &= \Delta_6 i_t - \Delta_6 i^e_{jt} \\ &= \alpha \Delta_6 \pi_t + \beta \Delta_6 y_t - \left(\alpha_j \Delta_6 \pi^e_{jt} + \beta_j \Delta_6 y^e_{jt}\right), \end{aligned} \tag{3}$$

where the asterisk in e^{i*}_{jt} is used to be consistent with the latent variable formulation of the econometric model in Section 4. To derive the financial market experts'

[2]Contemporaneous Taylor rules can be viewed as problematic because reliable data for current inflation and output is typically not available in that month and therefore the interest rate decision cannot depend on them. In our application, however, this is less of an issue because the expert's interest rate forecast depends on its own expectations about inflation and output.

misperception regarding central bank parameters, Equation (3) is rewritten as:

$$e_{jt}^{i*} = \alpha_j e_{jt}^{\pi*} + \beta_j e_{jt}^{y*} + (\alpha - \alpha_j)\Delta_6\pi_t + (\beta - \beta_j)\Delta_6 y_t, \quad (4)$$

with $e_{jt}^{\pi*} = \Delta_6\pi_t - \Delta_6\pi_{jt}^e$ and $e_{jt}^{y*} = \Delta_6 y_t - \Delta_6 y_{jt}^e$. Equation (4) shows that the overall individual interest rate forecast error can be decomposed into two parts. The first part $(\alpha_j e_{jt}^{\pi*} + \beta_j e_{jt}^{y*})$ follows from the error a financial market expert makes in forecasting inflation and output. The second component $((\alpha - \alpha_j)\Delta_6\pi_t + (\beta - \beta_j)\Delta_6 y_t)$ is due to the analyst's misperception of how the central bank will react to changes in inflation and output. The central bank can influence both sources of error. First, it can provide the public with macroeconomic projections and, second, it can explain how it reacts to changes in these variables.

3.4 Qualitative Forecast Errors

The answers of the surveyed experts are qualitative, whereas the actual, observed data series is continuous. One way of making the two comparable is to transform the aggregate shares of responses into a quantitative series. Nardo (2003) critically reviews the prevailing quantification methods and concludes that they do not prove superior to the original, qualitative data. In order to ensure that our results will not depend on the applied quantification method, we decided to transform the quantitative interest rate data into a qualitative variable. For $x = i, y, \pi$, we therefore transform the semi-annual differences of the actual time series ($\Delta_6 x_t$) into the corresponding qualitative variable $\Delta_6 x_{jt}^q$ as follows:

$$\Delta_6 x_{jt}^q = \begin{cases} 1 & \text{if } \overline{\Delta_6 x_j} < \Delta_6 x_t \\ 0 & \text{if } \underline{\Delta_6 x_j} \leq \Delta_6 x_t \leq \overline{\Delta_6 x_j} \\ -1 & \text{if } \Delta_6 x_t < \underline{\Delta_6 x_j}, \end{cases} \quad (5)$$

where $\underline{\Delta_6 x_j}$ and $\overline{\Delta_6 x_j}$ denote individual lower and upper thresholds, which have been surveyed within a special question in the ZEW survey.[3] Within these – partly asym-

[3] We use the individual threshold values when they are available and the average thresholds when the individual threshold is not available.

metrical – thresholds, a financial market analyst would continue to say that the underlying macroeconomic variable will not change. It is worth noting that due to different individual thresholds the qualitative variable $\Delta_6 x^q_{jt}$ may actually depend on the expert. For example, some experts will interpret a small increase in inflation ($\Delta_6\pi_t > 0$) as significant ($\Delta_6\pi^q_{jt} = 1$) while others with higher thresholds may find the same increase to be negligible ($\Delta_6\pi^q_{jt} = 0$).

After these preliminaries, the qualitative forecast errors e^x_{jt} of expert j are derived as:

$$e^x_{jt} = \Delta_6 x^q_{jt} - \Delta_6 x^e_{jt}; \quad e^x_{jt} \in \{-2, -1, 0, 1, 2\} \tag{6}$$

Note that the qualitative forecast errors can assume integer values from -2 to $+2$. For example, $e^x_{jt} = +2$ occurs if the actual value of x significantly increased (+1) while the expert expected it to decrease (-1). Accordingly, $|e^x_{jt}| = 2$ describes the worst case that even the directional forecast of expert j has been incorrect.

Table 2: Qualitative Euro area interest rate forecast errors of experts: Descriptive statistics

	Jan 00 - Oct 03	Nov 03 - Jul 07	Aug 07 - Mar 09
Interest rate forecast errors			
$\mu(e^i_{jt})$	-0.01	-0.38	-0.23
$\sigma(e^i_{jt})$	0.83	0.60	0.77
$\text{Min}(e^i_{jt})$	-1	-1	-1
$\text{Max}(e^i_{jt})$	1	1	1
Relative frequencies of forecast errors			
$\text{freq}(e^i_{jt}) = -2$	-	-	-
$\text{freq}(e^i_{jt}) = -1$	35%	44%	44%
$\text{freq}(e^i_{jt}) = 0$	31%	49%	35%
$\text{freq}(e^i_{jt}) = 1$	34%	7%	21%
$\text{freq}(e^i_{jt}) = 2$	-	-	-

Notes: Qualitative interest rate forecast errors of the surveyed interest rate expectations versus the 3–month Euribor as constructed in Equation (6). $\text{freq}(e^i_{jt})$ gives the relative frequency of the forecast error taking the respective value.

The descriptive statistics on the resulting qualitative interest rate forecast errors, provided in Table 2, show that the mean value of the forecast error e^i is close to zero. Moreover, they always range between -1 and +1. Therefore, at least the directional interest rate forecasts of experts have always been correct.

4 The Econometric Model

4.1 Panel Random Coefficient Ordered Logit Model

Table 2 shows that the interest rate forecast errors of experts as derived from the ZEW survey are qualitative variables with three ordered outcomes. To explore the determinants of the errors, estimating an ordered logit model is a natural choice. In line with the decomposition of an expert's interest rate forecast error derived in Equation (4), we estimate the following econometric model for the latent variable e^{i*}_{jt} for expert j, $j = 1, ..., N$, in month t, $t = 0, ..., T_j$:

$$e^{i*}_{jt} = \alpha_j e^{\pi}_{jt} + \beta_j e^{y}_{jt} + \gamma^{\pi}_j \Delta_6 \pi_t + \gamma^{y}_j \Delta_6 y_t + \varepsilon_{jt}, \tag{7}$$

where $e^{x}_{jt} = \Delta_6 x^q_t - \Delta_6 x^e_{jt}$ measures the expert's forecast error for inflation and output. γ^x_j reflects expert j's misperception of monetary policy. If e.g. $\gamma^{\pi}_j = \alpha - \alpha_j > 0$, then the role of inflation in the central bank's monetary policy rule is larger then expert j expects.

The logit model assumes that ε_{jt} are i.i.d. and follow a logistic distribution Φ. The outcome probabilities P for the observed values e^i of the latent variable conditional on the vector of explanatory variables $z_{jt} = (1, e^{\pi}_{jt}, e^{y}_{jt}, \Delta_6 \pi_t, \Delta_6 y_t)$ are defined as follows, see Wooldridge (2001):

$$\begin{aligned} P(e^i_{jt} = -1|z_{jt}) &= P(e^{i*}_{jt} \leq 0|z_{jt}) = \Phi(-z'_{jt}\delta_j) \\ P(e^i_{jt} = 0|z_{jt}) &= P(0 < e^{i*}_{jt} \leq \varsigma_1|z_{jt}) = \Phi(\varsigma_1 - z'_{jt}\delta_j) - \Phi(-z'_{jt}\delta_j) \\ P(e^i_{jt} = 1|z_{jt}) &= P(\varsigma_1 < e^{i*}_{jt}) = 1 - \Phi(\varsigma_1 - z'_{jt}\delta_j) \end{aligned} \tag{8}$$

where ς_1 is a threshold parameter for the probability categories.

To measure dispersion of the forecasting models across the financial market experts, we estimate a random coefficient model according to Swamy (1970). Under this approach, we incorporate cross–sectional heterogeneity of the perceived model coefficients. Cross–sectional heterogeneity in Equation (7) is introduced via the random coefficients α_j, β_j and γ_j^x. Specifically, the random coefficients are specified as follows:

$$\begin{pmatrix} \alpha_j \\ \beta_j \\ \gamma_j^\pi \\ \gamma_j^y \end{pmatrix} = \begin{pmatrix} \bar{\alpha} \\ \bar{\beta} \\ \bar{\gamma}_j^\pi \\ \bar{\gamma}_j^y \end{pmatrix} + \begin{pmatrix} \sigma_\alpha & 0 & 0 & 0 \\ 0 & \sigma_\beta & 0 & 0 \\ 0 & 0 & \sigma_{\gamma^\pi} & 0 \\ 0 & 0 & 0 & \sigma_{\gamma^y} \end{pmatrix} \begin{pmatrix} \xi_j^\alpha \\ \xi_j^\beta \\ \xi_j^{\gamma^\pi} \\ \xi_j^{\gamma^y} \end{pmatrix} \tag{9}$$

with $\xi_j^\alpha, \xi_j^\beta, \xi_j^x \sim i.i.\mathcal{N}(0,1)$. σ_α, σ_β, and σ_{γ^x} measure the dispersion of the estimated model coefficients across the financial market experts. Systematic misperception of monetary policy is present if the mean values of the misperception coefficients $\bar{\gamma}^x$ are significantly different from zero. More details about the estimation of panel random coefficient models by simulated maximum likelihood is provided in Appendix A.2.

4.2 The ECB's Clarification of the Monetary Policy Strategy

Given the economic interpretation of the mean and dispersion parameters of the random coefficient model for the experts' interest rate forecast errors, we are particularly interested in how these parameters respond to ECB communication or to the financial market crisis. To that aim, we estimate our model for three different sub–periods. The first two sample periods are chosen according to changes in the ECB's communication. The ECB made two announcements with respect to monetary policy strategy. In the first, in October 1998,[4] the ECB declared that its strategy would consist of three elements. Price stability, the primary objective, would be achieved with inflation rates of below 2%. Money would play a prominent role in assessing the risks to price stability and the outlook for price stability would be based on a broad assessment. In May

[4]See ECB press release "A stability–oriented monetary policy strategy for the ESCB" on October 13, 1998.

2003,[5] the ECB released the second statement on the monetary policy strategy. It contained two major elements. First, the ECB gave a more precise numerical definition of price stability, i.e. inflation rates should be less than, but close to, 2%. Second, by classifying money as a means for cross–checking the risks to price stability, the role of money in its short–term interest rate policy was de–emphasized.

The ECB has repeatedly emphasized that the May 2003 announcement should be viewed as a clarification of its monetary policy strategy, see, e.g., Berger, de Haan, and Sturm (2011). Accordingly, the experts' understanding of monetary policy should have become clearer due to improved central bank communication and the misperception coefficients should decrease. Due to the six–month forecast horizon of the survey, the clarification of May 2003 is for the first time incorporated in the financial experts' expectations in November 2003. At the same time, in November 2003, Jean–Claude Trichet superseded Wim Duisenberg as ECB president. Due to this observational equivalence, we cannot distinguish between the effects of improved communication and the possible implications of the change in the ECB presidency. Finally, the third sample period accounts for changes in Taylor rule parameters during the financial crisis.

[5]See ECB press release "The ECB's monetary policy" on May 8, 2003.

5 The Perception of the ECB's Monetary Policy Rule by Financial Market Experts

5.1 Evidence from a Panel Random Coefficient Ordered Logit Model

The estimation results for the determinants of the experts' qualitative interest rate forecast errors are summarized in Table 3. We considered three different sample periods in order to explore to what extent the experts' perception of monetary policy is affected by changes in the ECB's communication and the financial crisis.

The upper part of the table presents the estimated means of the Taylor rule coefficients ($\bar{\alpha}$, $\bar{\beta}$) perceived by the experts and the corresponding dispersion measures (σ_α, σ_β). The experts' Taylor rule coefficients are always significant and generally plausibly signed. The positive coefficients indicate that the financial market experts associate higher expected inflation and accelerating output with a probable tightening of monetary policy.

Table 3 shows that the perception of monetary policy has not been constant over time. While the coefficients of inflation have decreased monotonically, the output coefficient is particularly small and even negative (-0.11) in the second sample period. This indicates that the clarification of the ECB's monetary policy in May 2003 contributed to de–emphasizing the role of output for the experts' interest rate forecasts. In fact, experts assume the ECB to put more weight ($\bar{\alpha} > \bar{\beta}$) on price stability compared to output stabilization before the crisis. The relative importance of inflation decreased during the financial crisis when experts attribute to the ECB a higher output weight relative to inflation.

Table 3: The monetary policy rule as perceived by financial experts

	Dependent variable: Interest rate forecast errors e^{i}_{jt}		
	Jan 2000 - Oct 2003	Nov 2003 - Jul 2007	Aug 2007 - Mar 2009
Financial market experts' Taylor rule parameters			
$\bar{\alpha}$	1.54	1.15	0.73
	(0.027)	(0.031)	(0.042)
σ_{α}	0.65	0.97	0.59
	(0.027)	(0.032)	(0.041)
$\bar{\beta}$	1.04	-0.11	0.95
	(0.026)	(0.029)	(0.045)
σ_{β}	0.27	0.38	0.15
	(0.011)	(0.012)	(0.013)
Misperception parameters			
$\bar{\gamma}^{\pi}$	-0.67	0.45	-0.15
	(0.022)	(0.022)	(0.030)
$\sigma_{\gamma^{\pi}}$	0.27	0.05	0.30
	(0.021)	(0.020)	(0.028)
$\bar{\gamma}^{y}$	-0.22	0.38	-0.88
	(0.019)	(0.022)	(0.033)
$\sigma_{\gamma^{y}}$	0.12	0.05	0.31
	(0.019)	(0.019)	(0.030)
Pseudo R^2	0.27	0.16	0.18
N	414	393	339
# obs	13,885	13,056	5,132
Implied ECB Taylor rule parameters			
$\alpha = \bar{\alpha} + \bar{\gamma}^{\pi}$	0.87	1.60	0.58
$\beta = \bar{\beta} + \bar{\gamma}^{y}$	0.82	0.27	0.07

Notes: In each sample period, $e^{i*}_{jt} = \alpha_j e^{\pi}_{jt} + \beta_j e^{y}_{jt} + \gamma^{\pi}_{j} \Delta_6 \pi_t + \gamma^{y}_{j} \Delta_6 y_t + \varepsilon_{jt}$ (see Equation (7)) is estimated. Standard errors in parentheses. Pseudo $R^2 = 1 - LL1/LL0$ with $LL1$ being the unrestricted log-likelihood obtained in the respective estimation and $LL0$ the log-likelihood of a model restricted to a constant. N denotes the number of individuals. All estimated Taylor rule coefficients and dispersion measures presented are significant at the 5-percent level. Estimation by simulated maximum likelihood with 250 Halton draws, see Section A.2.

The middle part of Table 3 sets forth the average analyst misperception regarding the ECB's reaction to inflation ($\bar{\gamma}^{\pi}$) and output growth ($\bar{\gamma}^{y}$). A positive (negative) misperception coefficient implies that the expert under(over)estimates the weight of the respective variable in the Taylor rule of the ECB. Since $\bar{\gamma}^{\pi}$ and $\bar{\gamma}^{y}$ are always significantly different from zero, the average expert misperceived the Taylor rule parameters of the ECB in each sample period. In the early years of the ECB, experts tended to overestimate the impact of inflation on future interest rates. Since our sample is dominated by German forecasters, this finding may be partly explained by the legacy of the strict anti–inflationary policy of the Bundesbank. Yet, the misperception regarding inflation has declined over time. The ECB's clarification of the monetary policy strategy in 2003, including a more precise definition of the intended inflation rate, apparently contributed to a better understanding of monetary policy.

The effects of the ECB's communication are less clear for the output coefficient. In particular, our results indicate that experts severely overestimate the weight of output for the ECB's interest rate policy during the crisis. Apparently, experts see less need for the ECB to fight inflation given the severe economic environment and expect the ECB to be more supportive of output growth. Indeed, the ECB decreased interest rates from 4% in August 2007 to 1.5% in March 2009. However, even during the crisis, the ECB explained monetary policy easing primarily with declining inflationary risks. This predominant role of price stability for the ECB's monetary policy is reflected in the coefficients of the ECB's Taylor rule derived from the estimated means of the perception and misperception parameters. The resulting Taylor rule coefficients suggest that not only perceived but also actual monetary policy has changed over time.[6]

[6]To check whether experts from Frankfurt profit from their vicinity to the ECB, we furthermore estimated the random coefficient model for interest rate forecast errors using only data of Frankfurt experts. The thus obtained Taylor rule coefficients are close to those of the whole sample. The similarity of the Taylor rule coefficients reveals that location plays no important role for the degree of policy misperception. Also, the estimated disagreement measures indicate that experts from Frankfurt cannot be regarded as a particularly homogenous group. Confirming our results obtained for all

5.2 Monetary Policy Misperception by Financial Market Experts: A Counterfactual Analysis

So far, our empirical results show that interest rate forecast errors did not only occur because financial experts were wrong about the future economic outlook, i.e. because e^{π}_{jt} or $e^{y}_{jt} \neq 0$. According to the estimated average misperception coefficients $\bar{\gamma}^{\pi}, \bar{\gamma}^{y}$, the average expert would have misperceived the ECB's interest rate decisions even under complete information about future inflation and output growth.

In this section, we shed more light on the economic significance and the relative importance of the various sources of interest rate forecast errors. To that aim, we use the estimated panel random coefficient ordered logit model to calculate for each individual expert j how the predicted probability of zero interest rate forecast error

$$\hat{P}(e^{i}_{jt} = 0 | e^{\pi}_{jt}, e^{y}_{jt}, \hat{\gamma}^{\pi}_{j}, \hat{\gamma}^{y}_{j})$$

changes if one of the four sources of policy misperception is assumed to be absent holding all other variables constant.

For example, the quantitative effect of a better inflation forecast on expert's j ability to correctly anticipate the ECB's interest rate policy should be revealed in the difference between the model's predictions $\hat{P}(e^{i}_{jt} = 0 | e^{\pi}_{jt}, e^{y}_{jt}, \hat{\gamma}^{\pi}_{j}, \hat{\gamma}^{y}_{j})$ and $\hat{P}(e^{i}_{jt} = 0 | 0, e^{y}_{jt}, \hat{\gamma}^{\pi}_{j}, \hat{\gamma}^{y}_{j})$, where the latter probability is calculated under the assumption that expert j has perfect foresight on future inflation, i.e. $e^{\pi}_{jt} = 0$.

Analogously, the effect of a correct understanding of the role of inflation for the ECB's interest rate policy ($\gamma^{\pi}_{j} = 0$) is measured by

$$\hat{P}(e^{i}_{jt} = 0 | e^{\pi}_{jt}, e^{y}_{jt}, 0, \hat{\gamma}^{y}_{j}) - \hat{P}(e^{i}_{jt} = 0 | e^{\pi}_{jt}, e^{y}_{jt}, \hat{\gamma}^{\pi}_{j}, \hat{\gamma}^{y}_{j}).$$

For the sake of comparison, we will look at the relative change in probabilities. For

experts, the perception of ECB policy by experts from Frankfurt improves over time with respect to inflation and deteriorates with respect to output during the financial crisis.

example,

$$\Delta\hat{P}(e^i_{jt}=0|\gamma^\pi_j=0) =: \frac{\hat{P}(e^i_{jt}=0|e^\pi_{jt},e^y_{jt},0,\hat{\gamma}^y_j) - \hat{P}(e^i_{jt}=0|e^\pi_{jt},e^y_{jt},\hat{\gamma}^\pi_j,\hat{\gamma}^y_j)}{\hat{P}(e^i_{jt}=0|e^\pi_{jt},e^y_{jt},\hat{\gamma}^\pi_j,\hat{\gamma}^y_j)} \tag{10}$$

measures the relative change in the predicted probability for a correct interest rate forecast if expert j had correctly perceived the ECB's response to inflation. The larger the increase in that probability the larger the effects of a further improvement of central bank communication regarding its attitude towards inflation. We perform this exercise for all experts and for each of the different sources of policy misperception.

Table 4: Predicted probabilities of correct interest rate forecasts from a counterfactual analysis

	Jan 00 - Oct 03	Nov 03 - Jul 07	Aug 07 - Mar 09
Predicted probabilities, sample averages			
$\hat{P}(e^i_{jt}=0)$	31.3%	51.6%	36.7%
Relative changes in predicted probabilities if $\omega_{jt}=0$, $\omega_{jt}=e^\pi_{jt},e^y_{jt},\gamma^\pi_j,\gamma^y_j$, sample averages			
$\Delta\hat{P}(e^i_{jt}=0|e^\pi_{jt}=0)$	4.1%	30.5%	17.1%
$\Delta\hat{P}(e^i_{jt}=0|e^y_{jt}=0)$	9.4%	1.7%	-26.0%
$\Delta\hat{P}(e^i_{jt}=0|\gamma^\pi_j=0)$	10.8%	1.9%	1.5%
$\Delta\hat{P}(e^i_{jt}=0|\gamma^y_j=0)$	2.2%	1.7%	15.4%

Notes: $\Delta\hat{P}(e^i_{jt}=0|e^\pi_{jt}=0)$ denotes the relative change in predicted probability of a correct interest rate forecast if the inflation error is set to zero compared to the actual error. Accordingly, $\Delta\hat{P}(e^i_{jt}=0|\gamma^\pi_j=0)$ gives the relative change in probability if an expert has a perfectly correct perception of the ECB's reaction to inflation compared to the estimated misperception, see Equation (10). The same reasoning applies to the output variables. The table presents the averages of individual predicted probabilities in each sample period.

Table 4 summarizes the results of this counterfactual analysis. For each sub–period, the first column of the table reports the model prediction for the average probability of a correct interest rate forecast, i.e. $\hat{P}(e^i_{jt}=0)$. Note that the predicted probabilities are very close to the actual relative frequencies of the interest rate forecast errors, compare Table 2. Taking the average predicted probability of a zero interest rate forecast error as a benchmark, the remaining columns of the table show the sample averages of the relative changes in the predicted probability if one of the four determinants of policy misperception ($e^{\pi}_{jt}, e^{y}_{jt}, \gamma^{\pi}_{j}, \gamma^{y}_{j}$) is set to zero, compare Equation (10).

In the first sample period, the misperception of the role of inflation in the ECB's Taylor rule is the most important source of experts' interest rate forecast errors. The average probability of a correct interest rate forecast would have increased by 10.8% if the experts had correctly predicted the ECB's reaction to changes in inflation. Assuming perfect foresight about future inflation can only increase the probability of a correct interest rate forecast by 4.1%. While the counterfactual effect of output forecasts is rather important (9.4%), the misperception of the output weight in the ECB's Taylor rule has no severe consequences for the interest rate forecasting ability of experts (2.2%).

The second subperiod shows a clear dominance of inflation expectations as the main source of interest rate forecast errors (30.5%). By contrast, the impact of all other determinants of policy misperception appear to be economically insignificant because their impact on the experts' interest rate forecasts is virtually negligible, i.e. below 2%. This indicates that the clarification of the ECB's monetary policy strategy in May 2003 has actually contributed to a more accurate perception of interest rate decisions. Having clarified the weight of inflation in its Taylor rule, the remaining task of the ECB's communication is to enhance experts' ability to forecast future inflation.

The improved perception of the role of inflation in the ECB's Taylor rule is confirmed for the period of the financial crisis. In fact, the effect of a correct perception of the ECB's inflation coefficient ($\gamma^{\pi}_{j} = 0$) on experts' interest rate forecasts remains small (1.5%). The larger effects of experts' forecasts for inflation (17.1%) and output (-26.0%) may reflect the increased uncertainty about the economic development during the crisis. Note that interest rate forecasts of experts would even have been impaired by correct forecasts for output because experts have strongly misperceived the ECB's response to output during the crisis, compare Table 3. In contrast, a correct perception of the monetary policy reaction to output would have increased the probability of a zero interest rate forecast error by 15.4%.

The counterfactual analysis indicates that the misperception of the ECB's interest rate policy shown in Table 3 is not only statistically but also economically significant. Both the improved communication about the role of inflation in the ECB's Taylor rule and the drastic increase in misperception of the role of output in the financial crisis have considerable effects on experts' interest rate forecasting ability.

6 Conclusions

There is a growing consensus among economists and central bankers that expectations management by the central bank is crucial to effective monetary policy. Because households and firms are forward looking, central banks affect the economy as much through their influence on expectations as through any direct effect of their policy instruments. Therefore, central banks are increasingly interested in how markets form expectations about future interest rate decisions. If market participants are confused about the goals and rules of monetary policy, analyzing expectations data should reveal that individual forecasters systematically misunderstand future interest rate decisions.

This paper investigated how financial market experts perceive the interest rate policy of the European Central Bank (ECB). Assuming a Taylor–rule–type reaction function of the ECB, we employed qualitative survey data on expectations about the future interest rate, inflation, and output to account for the different sources of forecast errors. To that end, we decomposed the individual interest rate forecast errors of financial experts into two components. The first part of the error occurs because forecasters are wrong about future inflation and output, even if they correctly assess the monetary policy strategy. The second part of the error, however, occurs because markets are confused about monetary policy, i.e., there is a lack of understanding as to how the central bank sets interest rates in response to inflation and output. In the case of this second type of error, communication ought to be improved because markets will misperceive future monetary policy decisions even under perfect information about the economic outlook. We estimated the empirical relevance of both components for interest rate forecast errors using a panel random coefficient model in order to explicitly account for heterogeneity and disagreement among forecasters.

Our results confirm that central bank communication has a significant impact on the perception of monetary policy. The ECB's clarification of its monetary policy strategy in May 2003 may explain why the experts' perception of the role of inflation in the ECB's Taylor rule has become more and more accurate. In fact, since 2003 a major source of experts' interest rate forecast errors has been their own inflation forecasts. This suggests that central bank communication should also contribute to improve the predictability of future inflation. While the ECB has been very successful in explaining its attitude towards inflation, the role of output seems to be less clear, particulary during the recent crisis. Our results indicate that experts would have forecasted the ECB's interest rate decisions more accurately if they had had a better understanding of the role of output in the ECB's Taylor rule.

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A Appendix

A.1 Description of Variables

Survey expectations of expert j	Survey questions
$\Delta_6 i^e_{jt}$	”In the medium–term (6 months) the short–term interest rates (3–month–Interbank rate) will ... increase / no change / decrease”
$\Delta_6 \pi^e_{jt}$	”In the medium–term (6 months) the macroeconomic annual inflation rate will ... increase / no change / decrease”
$\Delta_6 y^e_{jt}$	”In the medium–term (6 months) the overall macroeconomic situation will ... improve / no change / worsen”
Original time series	Definitions
$\Delta_6 i_t$	Change in 3–month Euribor from $t-6$ to t
$\Delta_6 \pi_t$	Change in annual HICP inflation from $t-6$ to t
$\Delta_6 y_t$	Change in annual industrial production growth from $t-6$ to t
Transformed variables	
e^{x*}_{jt}	Quantitative forecast error $e^{x*}_{jt} = \Delta_6 x_{jt} - \Delta_6 x^e_{jt}$ of $x = i, y, \pi$
$\Delta_6 x^q_{jt}$	Directional change of $x = i, y, \pi$ from $t-6$ to t
e^x_{jt}	Qualitative forecast error $e^x_{jt} = \Delta_6 x^q_{jt} - \Delta_6 x^e_{jt}$
Taylor rule parameters	
α	The ECB's inflation parameter
β	The ECB's output parameter
α_j	Inflation parameter of expert j
β_j	Output parameter of expert j
$\gamma^\pi_j = \alpha - \alpha_j$	Misperception of expert j with respect to inflation
$\gamma^y_j = \beta - \beta_j$	Misperception of expert j with respect to inflation

Notes: All data refer to the euro zone. Data sources: ECB, Thomson Financial Datastream, ZEW. $\Delta_6 \pi_t$ and $\Delta_6 y_t$ are standardized in the estimations.

A.2 Estimation by Simulated Maximum Likelihood

The econometric model presented in Section 4.1 is estimated by simulated maximum likelihood. In the following, we sketch the estimation method and explain why the standard maximum likelihood procedure is not possible in the case of random parameters. For convenience, we first rewrite the random parameters of Equation (9) in vector notation as $\delta_j = \bar{\delta} + \Lambda\xi_j$. The individual likelihood contribution $L_j|z_j, \delta_j$ of an expert j is conditioned on the explanatory variables z_j and on the random parameter vector δ_j. Substituting δ_j by $\bar{\delta} + \Lambda\xi_j$ gives us the individual likelihood contribution conditional on the random vector ξ_j as $L_j|z_j, \xi_j$. The log likelihood for all experts then follows as the sum of all individual log likelihood contributions

$$\ln L|(z_j, \xi_j, j = 1, ..., N) = \sum_{j=1}^{N} \ln L_j|z_j, \xi_j. \tag{A1}$$

Since ξ_j is unobserved, it has to be integrated out of the conditional log likelihood

$$\ln L|(z_j, j = 1, ..., N) = \sum_{j=1}^{N} \int_{\xi_j} \ln L_j|z_j, \xi_j f(\xi_j) d\xi_j, \tag{A2}$$

with $f(\xi_j)$ being the joint density, in our case the standard normal, of the elements in ξ_j. However, the log likelihood in Equation (A2) has no closed form solution. Consequently, we approximate the expected value of the log likelihood by a simulation–based integration, which replaces the unobserved vector ξ_j by a simulated vector $\xi_{j,r}$. The simulated log likelihood for a number of R draws is computed as

$$\ln L_S|(z_j, j = 1, ..., N) = \sum_{j=1}^{N} \frac{1}{R} \sum_{r=1}^{R} \ln L_j|z_j, \xi_{j,r}. \tag{A3}$$

Advancing on the standard approach of using random draws from the specified distribution, simulations based on Halton draws considerably speed up the estimation. Halton draws are drawn from a deterministic sequence which is efficiently spread over the unit interval. Therefore, the simulation error associated with a given number of draws is reduced considerably and a smaller number of draws is needed compared to random draws. In line with previous literature, e.g. Rangvid, Schmeling, and Schrimpf (2009), we choose a number of 250 Halton draws.