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Why do financial market experts misperceive future monetary policy decisions?

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Abstract

This paper investigates why financial market experts misperceive 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 unfold the sources of individual interest rate forecast errors. Our results based on a panel random coefficient model show that financial experts have systematically misperceived the ECB's interest rate rule. While experts tend to overestimate the impact of inflation on future interest rates, the perception of monetary policy has become more accurate since the clarification of the ECB's monetary policy strategy in May 2003. Reflecting the improved communication, we find that the disagreement about the ECB's response to expected inflation has remained low during the financial crisis.

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

JEL classification: E47, E52, E58, C23

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1 Introduction

Central bank communication has become increasingly important for both, central banks and financial market participants, see Blinder, Ehrmann, Fratzscher, DeHaan, and Jansen (2008). Communication should ensure that financial markets understand the interest rate policy of the central bank, i.e. how interest rate decisions depend on future inflation and output. Depending on the way monetary policy is communicated, interest rate forecast errors can occur for two reasons. First, forecasters *understand* monetary policy but misperceive future interest rate decisions simply because they err on future inflation and output. Second, markets *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 the communication of the European Central Bank (ECB), the disagreement among financial experts upon 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" by the Centre for European Economic Research (ZEW). This survey is conducted on a monthly basis 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 the uncertainty about the future course of inflation and output or whether experts are confused about the rules of monetary policy. In particular, we assess the consequences of a major change in ECB communication in May 2003. Here, the ECB gave a more precise definition of price stability (inflation should be below but close to two percent) and

deemphasized the role of monetary aggregates for short-term policy decisions. Since then, the ECB's monetary analysis puts more emphasis on the long-term relation between money supply and inflation. Finally, we investigate whether the market's understanding of monetary policy has been affected by the recent economic crisis.

Many contributions confirmed the predictive content of survey data for macroeconomic variables, see e.g. Mitchell and Pearce (2007) and Dreger and Stadtmann (2008) who study the forecasting performance of the Wall Street Journal's panel of economists. In the same vein, Nolte and Pohlmeier (2007) find a good forecast quality of aggregate economic indicators derived from the ZEW survey. As a consequence, survey data on expectations are increasingly used in the literature to evaluate 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) show that more transparent communication generally improves the predictability of the central bank's interest rate decisions by market participants.

All these contributions focus on the size and further statistical properties of individual forecast errors. They do not attempt to decompose the forecast error to explain why interest rate forecast errors are made. In this sense, the closest reference to our work is Berger, Ehrmann, and Fratzscher (2009) who investigate the role of geography, i.e. the forecaster's location, for the determinants of the interest rate forecast error. Estimating Taylor rule-type relationships for each forecaster separately, they decompose forecast errors in a systematic and unsystematic component. Advancing on Berger, Ehrmann, and Fratzscher (2009), our analysis of financial market experts' interest rate forecast errors includes the information contained in the individual forecasts for inflation and output. Moreover, estimating a panel random coefficient model that allows for a dispersion of the estimated coefficients, our empirical approach is designed

to estimate the disagreement of financial experts upon the monetary policy strategy, see Swamy (1970) and Rangvid, Schmeling, and Schrimpf (2009).

Our empirical results confirm that both the ECB and the financial market experts use inflation as a Taylor rule argument. However, financial experts tend to overestimate the ECB's interest rate reaction to inflation. The ECB's attempt to clarify its monetary strategy in 2003 has actually contributed to improve the communication regarding the role of inflation. In contrast, the disagreement among experts about the central bank's reaction towards output growth has increased since the beginning of the financial crisis suggesting that the financial market experts had difficulties assessing the ECB's strategy with respect to output fluctuations.

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 shows the empirical results about the misperception of the ECB interest rate policy and Section 6 concludes.

2 Survey data on expectations

2.1 The ZEW financial market survey

2.1.1 The data set

Since December 1991, the ZEW has been asking about 350 professionals from the financial sector for their expectations about a large set of macroeconomic variables such as inflation, output or interest rates. These professionals, or "financial market experts", usually have an academic background in economics and, at the same time, observe economic developments. So they should be highly qualified for forecasting economic developments. Most of them work at banks (60 percent), furthermore are

employed at insurances (10 percent), financial departments of industrial companies (11 percent) or other financial service providers. A majority of 88 percent of these financial market experts are employed in Germany, further 10 percent are located within the European region and 2 percent are from non-European countries.

Usually during the first two weeks of a month, the financial market experts are asked whether they expect e.g. short-term interest rates to decrease (-1), stay constant (0) or to increase (1) within the next six months. The experts are asked for the 3-month interbank rate, i.e. the 3-month Euribor in the euro zone. Furthermore, the surveyed changes in the annual inflation rate and the economic situation in the euro zone are relevant in our context. We approximate them by the six-month change in HICP inflation and by the six-month growth rate of industrial production. We prefer industrial production to GDP data because the former is available at monthly frequency and the latter only at quarterly frequency. Table 4 in the Appendix gives some descriptive statistics, Table 5 the detailed survey questions, and Figure 1 in the Appendix a graphical illustration. The ZEW publishes aggregate balance statistics defined as the difference between the relative share of answers falling into the categories "increase" and "decrease". In contrast, our analysis uses the individual, qualitative assessments of experts. Out of the 350 experts, who are questioned each month, about 300 persons indeed answer on average. Thus, we base the estimation on an unbalanced panel of around 300 observations each month. For a sample period from January 2000 to March 2009, this gives us 32,072 observations.

2.1.2 The forecasting performance of aggregate balance statistics

The forecasting performance of the ZEW survey expectations has already been examined in the literature. Breitung and Jagodzinski (2001) and Hüfner and Schröder (2002) find a good forecasting quality of the ZEW Economic Sentiment Indicator, i.e. the survey's aggregate balance statistic of output growth expectations for Germany.

For inflation and short term interest rate balances, the forecasting power is tested by Nolte and Pohlmeier (2007). To this end, Nolte and Pohlmeier (2007) discuss a VAR-based forecasting approach and quantification methods, which transform the shares of positive and negative assessments from the survey into a quantitative variable, see Carlson and Parkin (1975) and Pesaran's (1984) regression approach. Nolte and Pohlmeier (2007) find that the survey forecasts are unbiased and that their predictive power is comparable to the random walk. Furthermore, they cannot support the hypothesis that the expert's forecasting quality depends on subgroups. Ullrich (2008) quantifies the aggregate shares of inflation expectations by means of the Carlson-Parkin method and shows that they are significantly influenced by ECB rhetoric. Her findings suggest that the financial market experts closely follow ECB communication. These papers have in common that they work with the aggregate balances statistics and do not consider individual heterogeneity.

2.1.3 Heterogeneous forecasters

For the exploration of the expectation formation process, one should account for the heterogeneity of forecasters. This can be done in several ways. For the Wall Street Journal's panel of economists, Mitchell and Pearce (2007) classify the participants according to subgroups depending on industry or experience. For the same survey panel, Dreger and Stadtmann (2008) show that the heterogeneity in exchange rate forecasts cannot be explained by the individual forecasts of macroeconomic variables in the survey context. A more sophisticated way to model forecasters' heterogeneity is proposed by Rangvid, Schmeling, and Schrimpf (2009). They estimate a panel random coefficient model for stock market expectations' of the participants of the ZEW financial market survey. In the following, we will adopt the random coefficient approach where forecasters' heterogeneity is reflected in the distribution of estimated coefficients.

2.2 Individual interest rate forecasts and Taylor rules

The largest part of the literature evaluates forecasts and does not attempt to explain the sources of interest rate forecast errors. In contrast, Berger, Ehrmann, and Fratzscher (2009) assume a Taylor rule model to investigate interest rate forecast errors of professional ECB policy forecasters. They employ quantitative survey data from a Reuters poll where financial institutions are asked for the expected policy rate. Berger, Ehrmann, and Fratzscher (2009) decompose the interest rate forecast errors ($r_{jt}^e - r_t$) 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

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

x_{kt} are macroeconomic variables, $\tilde{\pi}_{jt}$ is the inflation differential of the country, where 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 advances on 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 forward-looking Taylor rule arguments in each individual interest rate forecast equation, see Section 3. Second, using a random coefficient model our econometric framework explicitly models the forecasters' disagreement about the appropriate Taylor rule parameters, see Section 4.

¹In a related work, Berger, Ehrmann, and Fratzscher (2006) show that also for the anticipation of Fed monetary policy decisions, regional differences within the U.S. play a significant role.

3 Forecasting interest rates with Taylor rules

3.1 The interest rate policy of the central bank

Following the seminal work by Taylor (1993), reaction functions specified as Taylor rules, where the central bank determines the key policy rate in response to inflation and output, have become the predominant way to model the interest rate setting by central banks. Since Clarida, Galí, and Gertler (1998), many empirical contributions have confirmed that Taylor rules provide a remarkably good fit to describe central bank interest rate decisions, see e.g. Jansen and de Haan (2009) and Grammig and Kehrlé (2008) for recent examples. In accordance with Berger, Ehrmann, and Fratzscher (2009), we assume that the central bank sets the short-term interest rate in response to contemporaneous output and inflation:

$$\Delta_6 i_t = \alpha \Delta_6 \pi_t + \beta \Delta_6 y_t. \quad (1)$$

The Taylor rule is defined in terms of sixth differences (Δ_6) because the qualitative 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.

3.2 Decomposing individual forecast errors

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

$$\Delta_6 i_{jt}^e = \alpha_j \Delta_6 \pi_{jt}^e + \beta_j \Delta_6 y_{jt}^e. \quad (2)$$

Equation (2) states that the interest rate change expected by expert j depends on his expected change in inflation $\Delta_6 \pi_{jt}^e$ and output $\Delta_6 y_{jt}^e$. Note that the experts' expect-

tations for inflation and output should be interpreted as a proxy for the forecasts the experts assume the central bank to have. Unfortunately, the latter are not surveyed. However, it is likely that the experts' inflation and output expectations are influenced by the central bank forecasts, which are regularly published.

The interest rate forecast errors e_{jt}^{i*} 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))

$$\begin{aligned} e_{jt}^{i*} &= \Delta_6 i_t - \Delta_6 i_{jt}^e \\ &= \alpha \Delta_6 \pi_t + \beta \Delta_6 y_t - (\alpha_j \Delta_6 \pi_{jt}^e + \beta_j \Delta_6 y_{jt}^e), \end{aligned} \quad (3)$$

where the asterisk in e_{jt}^{i*} is used to be consistent with the latent variable formulation of the econometric model in Section 4. In Section 5, Equation (3) will be estimated. To derive the misperception of the financial market experts with respect to the central bank parameters, rewrite Equation (3) 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 the reaction of the central bank to the changes in inflation and output. The central bank can influence both parts of the overall error. First, it can provide the public with macroeconomic projections and second, it can inform them how it reacts to changes in these variables.

3.3 Qualitative interest rate forecast errors

The answers of the surveyed experts are qualitative whereas the actual, observed data series is continuous. To make the two series comparable, one possibility is to transform

the aggregate shares of responses into a quantitative series.² In our application, where the focus is on the individual level, it is more appropriate to transform the realized, quantitative interest rate data into a qualitative variable. To that aim, we transform the sixth differences of the actual interest rate series ($\Delta_6 i_t$) into the corresponding qualitative variable $\Delta_6 i_{jt}^q$ as follows:

$$\Delta_6 i_{jt}^q = \begin{cases} 1 & \text{if } \overline{\Delta_6 i_j} < \Delta_6 i_t \\ 0 & \text{if } \underline{\Delta_6 i_j} \leq \Delta_6 i_t \leq \overline{\Delta_6 i_j} \\ -1 & \text{if } \Delta_6 i_t < \underline{\Delta_6 i_j}. \end{cases} \quad (5)$$

where $\underline{\Delta_6 i_j}$ and $\overline{\Delta_6 i_j}$ denote individual lower and upper thresholds, which have been surveyed in form of a special question by the ZEW. Within these — partly asymmetrical — thresholds, a financial market analyst would still answer that the underlying macroeconomic variable will not change. Note that individual thresholds imply that the qualitative interest rate variable $\Delta_6 i_{jt}^q$ also depends on the expert.³ The qualitative interest rate forecast errors e_{jt}^i of expert j are defined as the difference between the qualitative change of the interest rate $\Delta_6 i_{jt}^q$ and the expert's forecast made in period $t - 6$ for the change of i six months ahead $\Delta_6 i_{jt}^e$:

$$e_{jt}^i = \Delta_6 i_{jt}^q - \Delta_6 i_{jt}^e; \quad e_{jt}^i \in \{-2, -1, 0, 1, 2\} \quad (6)$$

The descriptive statistics on the resulting qualitative interest rate forecast errors in Table 1 show that the mean value of the forecast error e^i is close to zero. Moreover, the forecast errors are always between -1 and +1 which implies that the directional forecast has always been correct.

²Nardo (2003) critically reviews the prevailing quantification methods. She concludes that they do not prove superior to the original, qualitative data.

³We use the individual threshold values as far as available and the average thresholds if the individual threshold is not available.

Table 1: Qualitative interest rate forecast errors of experts: Descriptive statistics

	Jan 00 - Oct 03	Nov 03 - Jul 07	Aug 07 - Mar 09
Interest rate forecast errors			
$\mu(e^i)$	-0.01	-0.38	-0.23
$\sigma(e^i)$	0.83	0.60	0.77
$\text{Min}(e^i)$	-1	-1	-1
$\text{Max}(e^i)$	1	1	1
# obs	14,183	12,758	5,132

Notes: Qualitative interest rate forecast errors of the surveyed interest rate expectations versus the 3-month Euribor as constructed in Equation (6).

4 The econometric model

4.1 Panel random coefficient ordered logit model

Table 1 shows that the interest rate forecast errors of experts derived from the ZEW survey are qualitative variables with three ordered outcomes. To explore the determinants of the errors, the estimation of an ordered logit model is a natural choice. Departing from Equation (3), we will estimate the following econometric model for the latent variable e_{jt}^{i*} for expert j , $j = 1, \dots, N$, in month t , $t = 0, \dots, T_j$:

$$e_{jt}^{i*} = \alpha \Delta_6 \pi_t + \beta \Delta_6 y_t - (\alpha_j \Delta_6 \pi_{jt}^e + \beta_j \Delta_6 y_{jt}^e) + \varepsilon_{jt}. \quad (7)$$

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 $z_{jt} = (1, \Delta_6 \pi_t, \Delta_6 y_t, \Delta_6 \pi_{jt}^e, \Delta_6 y_{jt}^e)$ are defined as follows, see Wooldridge (2001):

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

where ς_1 is a threshold parameter for the probability categories.

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

$$\begin{pmatrix} \alpha_j \\ \beta_j \end{pmatrix} = \begin{pmatrix} \bar{\alpha} \\ \bar{\beta} \end{pmatrix} + \begin{pmatrix} \sigma_\alpha & 0 \\ 0 & \sigma_\beta \end{pmatrix} \begin{pmatrix} \xi_j^\alpha \\ \xi_j^\beta \end{pmatrix} \quad (9)$$

with $\xi_j^\alpha, \xi_j^\beta \sim \mathcal{N}(0, 1)$. σ_α and σ_β measure the dispersion of the estimated model coefficients across the financial market experts. Systematic misperception of monetary policy is present if the mean values $\bar{\alpha}$ and $\bar{\beta}$ deviate significantly from α and β , the central bank parameters.

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 expert's interest rate forecast errors, we will further test whether these parameters have responded to the ECB communication or to the financial market crisis. With respect to the monetary policy strategy, the ECB made two announcements. First, in October 1998,⁴ the ECB declared that its strategy would consist of three elements. Price stability as the primary objective would be met with inflation rates of below two percent. Money would attain a prominent role in the assessment of the risks to price stability and the outlook for price stability would be based on a broad assessment. In May 2003,⁵ the ECB released a further statement with respect to its monetary policy strategy. This communication mainly contains a confirmation of the ECB's definition of price stability, but specifies more clearly that

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

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

inflation rates of less than, but close to two percent are desirable. At the same time, 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 deemphasized.

The ECB has repeatedly emphasized that the announcement in May 2003 should be seen as a *clarification* and must not be misinterpreted as a *change* of its monetary policy strategy, see e.g. Berger, de Haan, and Sturm (2006). Accordingly, the experts' understanding of monetary policy should have become clearer due to improved central bank communication. In terms of the econometric model, the mean coefficients should be closer to the central bank coefficients and the dispersion parameters should have decreased since May 2003. Since the ECB explicitly 'confirmed' its strategy, we have no indication that the central bank strategy may have changed. Therefore, the estimation assumes that the central bank parameters are constant over time. In the same vein, we assume that the ECB's monetary policy strategy did not change during the financial market crisis. In fact, the ECB has not published any divergent statement in this regard. Also during the financial market crisis, the ECB has motivated interest rate decreases with diminished inflation risks.

5 Why financial experts misperceive the ECB's interest rate decisions: Empirical results

Table 2 presents the results from a panel random coefficient ordered logit estimation. The upper part of the table presents the non-random coefficients. We interacted the experts' Taylor rule parameters with three dummy variables D^I, D^{II}, D^{III} respectively. Thus, we can infer how the ECB communication in 2003 or the financial crisis influenced the experts' Taylor rule parameter. The lower part of Table 2 depicts the random coefficients of the financial market experts. They are shown in terms of the parameter means across experts $(\bar{\alpha}, \bar{\beta})$ and the dispersion measures $(\sigma_\alpha, \sigma_\beta)$.

The positive central bank parameter α for inflation indicates that the probability for a

Table 2: Estimated Taylor rule coefficients and dispersion measures

Dependent variable: Interest rate forecast errors e_{jt}^i					
Central bank parameter		α	0.11		
		β	-0.47		
Financial market experts					
Jan 2000 - Oct 2003		Nov 2003 - Jul 2007		Aug 2007 - Mar 2009	
$\bar{\alpha}^I$	0.52	$\bar{\alpha}^{II}$	0.39	$\bar{\alpha}^{III}$	0.25
σ_α^I	0.34	σ_α^{II}	0.29	σ_α^{III}	0.29
$\bar{\beta}^I$	-0.72	$\bar{\beta}^{II}$	-0.76	$\bar{\beta}^{III}$	0.26
σ_β^I	0.31	σ_β^{II}	0.22	σ_β^{III}	0.65
MSE_α	0.28		0.16		0.10
MSE_β	0.16		0.13		0.96
Pseudo R^2	0.26	N	473	# obs	32,072

Notes: $e_{jt}^{i*} = \alpha \Delta_6 \pi_t - (\alpha_j^I \Delta_6 \pi_{jt}^e D^I + \alpha_j^{II} \Delta_6 \pi_{jt}^e D^{II} + \alpha_j^{III} \Delta_6 \pi_{jt}^e D^{III}) + \beta \Delta_6 y_t - (\beta_j^I \Delta_6 y_{jt}^e D^I + \beta_j^{II} \Delta_6 y_{jt}^e D^{II} + \beta_j^{III} \Delta_6 y_{jt}^e D^{III})$. $\gamma_j = \bar{\gamma} + \Lambda v_j$. $MSE_\gamma = (\bar{\gamma} - \gamma)^2 + \sigma_\gamma^2$. All estimated Taylor rule coefficients presented are significant at the 1-percent level. Estimation by simulated maximum likelihood with 250 Halton draws.

tighter monetary policy increases with inflation. This result is in line with the ECB's monetary policy strategy, which clearly emphasizes price stability as primary objective. In contrast, the sign of the estimated output parameter β of the central bank is puzzling because it suggests that positive economic growth makes a tighter monetary policy less likely. In case of the financial market experts, we interact the explanatory variable with dummy variables such that we obtain three parameter values. In particular, to test whether the May 2003 clarification has eased the understanding of the ECB's policy, we introduce a dummy variable D^{II} for the period from November 2003, the first month when expectations from May 2003 were realized, until July 2007. The dummy variable D^I captures the first part from January 2000 to October 2003. In August 2007, the financial market crisis started and is accounted for by D^{III} .

Table 3: Wald tests on Taylor rule parameter equality

$\mathcal{H}_0 :$	$\mathcal{D} = 0$	\mathcal{D}	p-value
Misperception of ECB policy (Expert - ECB coefficient)			
Inflation	$\bar{\alpha}^I - \alpha$	= 0.41	0.00
	$\bar{\alpha}^{II} - \alpha$	= 0.28	0.00
	$\bar{\alpha}^{III} - \alpha$	= 0.14	0.00
Output	$\bar{\beta}^I - \beta$	= -0.25	0.00
	$\bar{\beta}^{II} - \beta$	= -0.29	0.00
	$\bar{\beta}^{III} - \beta$	= 0.73	0.00
Impact of ECB communication in 2003			
	$\bar{\alpha}^{II} - \bar{\alpha}^I$	= -0.13	0.00
	$\bar{\beta}^{II} - \bar{\beta}^I$	= -0.04	0.21
Change in expert's coefficient due to crisis			
	$\bar{\alpha}^{III} - \bar{\alpha}^{II}$	= -0.14	0.00
	$\bar{\beta}^{III} - \bar{\beta}^{II}$	= 1.02	0.02

Notes: Wald statistics refer to the estimated coefficients in Table 2.

According to Table 2, the experts have a significantly positive inflation parameter in all three subperiods. Table 3 shows the average analysts' misperception of the central bank reaction with respect to inflation ($\bar{\alpha} - \alpha$) and output growth ($\bar{\beta} - \beta$). According to the corresponding Wald test statistics the experts significantly overestimated the central bank's inflation parameter. The ECB's clarification in 2003 induced a significant change in the analysts' perception of ECB policy such that their estimated coefficient is now closer to the ECB's coefficient α . Since the financial market crisis, the experts' inflation parameter has further significantly decreased. This finding reflects that the experts seemed to see less need for the ECB to fight inflation given the severe economic environment. Whereas $(\bar{\alpha} - \alpha)$ measures the accuracy of the financial analysts' expectations regarding the 'true' value α , σ_α measures their disagreement. Table 2 shows that the disagreement with respect to the inflation parameter is relatively moderate and hardly changes during the complete sample period. In particular,

their disagreement about the ECB's reaction to inflation does not increase during the financial crisis.

With respect to output growth, the estimated parameters of the financial market experts are negatively signed until July 2007 and positively signed since August 2007, see Table 2. The latter finding suggests that the financial analysts expected that the ECB would bolster the economic risks and be more supportive of output growth. Indeed, the ECB decreased interest rates from 4 percent in August 2007 to 1.5 percent in March 2009. The ECB motivated monetary policy easing primarily with declining inflationary risks. Table 3 shows that the experts' assessment of the weight of output growth deviated significantly from the central bank's weight in all subperiods. The strongest misperception regarding the ECB's reaction to output growth appeared during the period of the financial crisis. Until July 2007, the disagreement about the output parameter (σ_β) has been of similar size as the dispersion parameter for inflation. By contrast, it has considerably increased since the financial crisis, suggesting a stronger disagreement of the ECB's reaction to output.

The mean squared error (*MSE*) in the third panel represents a summary impreciseness measure for the experts' misperception of the ECB's interest rate policy. For example, $MSE_\alpha = (\bar{\alpha} - \alpha)^2 + \sigma_\alpha^2$ accounts in each subperiod for the deviation of the experts' average inflation parameter $\bar{\alpha}$ from the central bank parameter α and the dispersion σ_α . Table 2 shows that for inflation, this measure rather decreases over time whereas for the output parameter, the mean squared error is highest since the outbreak of the financial crisis.

6 Conclusions

There is a growing consensus among economists and central bankers that the expectations' management of a central bank is of major importance for the effectiveness of

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, the analysis of expectations data should reveal that individual forecasters misunderstand future interest rate decisions in a systematic way.

This paper investigated why financial market experts misperceived 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 unfold the sources of forecast errors. To that aim, we decomposed the individual interest rate forecast errors of financial experts into two components: The first part of the error is unrelated to central bank communication and occurs because forecasters err on future inflation and output. The second part of the error, however, occurs because markets are confused about monetary policy, i.e. how the central bank sets interest rates in response to inflation and output. In this case, communication is 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 the heterogeneity and disagreement of forecasters.

Our empirical results show that financial experts have systematically misperceived the ECB's interest rate rule. While experts tend to overestimate the impact of inflation on future interest rates, the perception of monetary policy has become more accurate since the clarification of the ECB's monetary policy strategy in May 2003. Reflecting the improved communication, we find that the disagreement about the ECB's response to inflation has remained low during the financial crisis.

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A Appendix

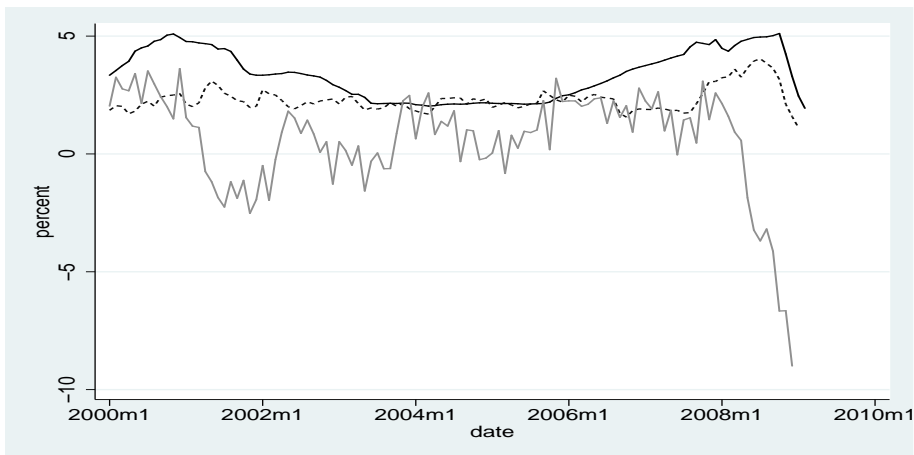
A.1 More information about the data

Table 4: Survey expectations of inflation and output: Descriptive statistics

	Jan 00 - Oct 03	Nov 03 - Jul 07	Aug 07 - Mar 09
Expected 6-month change in inflation			
$\mu(\pi_{jt}^e)$	-0.12	0.21	-0.08
$\sigma(\pi_{jt}^e)$	0.74	0.65	0.83
Expected 6-month change in output			
$\mu(y_{jt}^e)$	0.40	0.34	-0.39
$\sigma(y_{jt}^e)$	0.65	0.61	0.63

Notes: The table shows descriptive statistics of the individual survey expectations with respect to output and inflation. The data are qualitative with possible discrete values $\{-1,0,1\}$.

Figure 1: Euro zone time series data



Notes: 3-month Euribor (black line), HICP inflation (dashed line) and six month growth rate of industrial production (grey line) in the euro zone.

Table 5: Description of variables

Variable	Definition
$\Delta_6 i_t$	Change in 3-month Euribor from $t - 6$ to t
$\Delta_6 \pi_t$	Change in annual HICP inflation from $t - 6$ to t , SA
$\Delta_6 y_t$	Growth of industrial production from $t - 6$ to t , SA
Survey expectations	Survey question
$\Delta_6 i_{jt}^e$	"In the medium-term (6 months) the short-term interest rates (3-month-Interbank rate) will ... increase / no change / decrease"
$\Delta_6 \pi_{jt}^e$	"In the medium-term (6 months) the macroeconomic annual inflation rate will ... increase / no change / decrease"
$\Delta_6 y_{jt}^e$	"In the medium-term (6 months) the overall macroeconomic situation will ... improve / no change / worsen"
Definition of subperiods	
D^I	January 2000 to October 2003
D^{II}	November 2003 to July 2007
D^{III}	August 2007 to March 2009

Notes: All data refer to the euro zone. Data sources: ECB, Thomson Financial Datastream, ZEW.