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Arbeitspapiere/ Working Papers

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The Impact of ECB Communication on Financial Market Expectations

The Impact of ECB Communication on Financial Market Expectations*

Michael J. Lamla[†] and Sarah M. Rupperecht[‡]

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Abstract

This paper analyzes European financial markets' comprehension and interpretation of ECB communication signals. By applying a novel indicator developed by Berger et al. (2006), that quantifies the contents of the ECB's introductory statements, we find that communication affects the term structure of interest rates in the medium run over a horizon between five months to one year. Our results suggest that financial market agents expect the ECB to prepare them for a change in interest rates well in advance. However, judging upon the dynamics of the response, the exact timing of a decision is less foreseeable. Disentangling the effects of ECB statements on prices, the real and the monetary sector, we provide evidence that especially the ECB's interpretation and forecasts of price developments represent important news to financial market agents.

JEL classification: E43, E44, E58

Keywords: Central Bank Communication, Expectations, Term Structure of Interest Rates, Yield Curve, ECB.

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1 Introduction

“...the central bank’s communication should ensure that markets understand the systematic responses of monetary policy to economic developments and the current assessment of the central bank. Successful central bank communication supports predictability and correct price formation in financial markets, contributes to efficient allocation of funds and reduces uncertainty about future interest rates.”

Jean-Claude Trichet (2005)

This statement by Jean-Claude Trichet is presumably a response to the earlier criticism about the public’s understanding of ECB communication and reflects the relevance of this issue by the ECB itself.

Over the last decade central bank communication gained rising attention. From a theoretical point of view, there is a broad consensus that communication, under certain conditions, increases the effectiveness of monetary policy and hence improves welfare (Jansen and de Haan (2004)).¹ However, the relationship between communication and welfare is not necessarily positively related, i.e. more communication is not always welfare enhancing. Theory also stresses that sharing *all* the information with the public may not be beneficial for a central bank to pursue its mandate either (Mishkin (2004)). Hence, an optimal design of central bank communication is still to be discovered.

Despite the practical and theoretical focus on the topic of central bank communication, empirical interest in analysing the role of communication for monetary policy making just emerged recently. For example, Fratscher (2004 and 2005), Jansen and de Haan (2005a) and Jansen and de Haan (2005b) analyze whether exchange rates respond to speeches of central bank officials. They provide evidence that speeches affect the level as well as the volatility of the exchange rate. Rosa and Verga (2005) examine responses of short-term interest rates towards changes in a risk index which they set up out of introductory statements of the ECB. They find that communication has an effect on short-term money market interest rates. Heinemann and Ullrich (2005) use a wording indicator constructed from the introductory statements and estimate an augmented version of the Taylor rule including their indicator. They show that the wording-augmented version has a better fit than the baseline Taylor rule model.

¹Geraats (2005) and Woodford (2005) point out that communication is an important instrument for a central bank to achieve more transparency and credibility.

In this paper we do not only focus on the existence of an impact of communication, but also survey the horizon over that communication influences market expectations. Moreover, we investigate whether financial markets pay particular attention to the ECB's interpretation of price stability, developments in the real economy or monetary indicators separately.

To quantify communication we employ the novel index from Berger et al. (2006) (BHS henceforth). This ECB communication indicator portrays the views of all council members expressed in the president's introductory statement at the monthly press conferences after a monetary policy meeting.² The statements are assessed by giving each a grade on a scale from -3 (strong downside risks) to +3 (strong upside risks).

The impact on expectations is measured by the day-to-day reaction of the Euribor at different maturities. If the ECB is seen as *credible*, financial markets should believe its communication. Moreover, if the ECB is *transparent* enough, markets should not be surprised by monetary policy decisions and henceforth be able to anticipate changes in the central bank controlled interest rates. Applying this setup we are able to evaluate the role ECB communication plays in managing expectations of the public and hence to evaluate credibility, transparency and effectiveness of communication in the first five years of the ECB's monetary policy.

Our estimations provide evidence that ECB communication can indeed influence short-term expectations and the shape of the yield curve at the short end.³ Hence, we conclude that market participants thoroughly watch central banker's lips and incorporate this information into their own expectations. Furthermore, the contents of the statements are perceived to be especially important for the ECB's interpretation of price developments, whereas interpretations about real economic developments contain little "news" for financial markets. An interesting refinement of this result is also the time structure: Communication starts to become relevant for expectations about five months ahead. For maturities from five months up to one year the impact of a communication signal gradually increases. We interpret this in the following way: Given a communication signal today, financial markets on average expect the ECB to change interest rates at the soonest five months later, but not earlier. An interest rate change is perceived to become more and more likely during the following five to 12 months. This finding shows that markets distill *the direction* of the upcoming step of the interest rate change from the statements and furthermore, that the ECB

²The ECB has two important communication devices: one is the Monthly Bulletin, the other are the introductory statements. The latter are used in the BHS indicator, as these statements are advantageous to the Monthly Bulletin for three reasons. Firstly, they focus exclusively on monetary policy matters. Secondly, as the council members all have to agree upon the statement before releasing it to the press, each line is a reflection of the consensus of all members of the council. Finally, there is de facto no publication lag with respect to the press release which potentially increases its news value as compared to the Monthly Bulletin.

³Long-run expectations as well as the long-end of the yield curve remain unaffected.

prepares them for a change in the ECB controlled interest rates well in advance. The *timing* of these changes, however, is still surrounded by uncertainty.

The remainder of this paper is structured as follows. Section 2 presents a literature overview. Section 3 gives the theoretical foundation for the estimation set-up. Section 4 introduces the data and the methodology we utilize. In Section 5 the results are presented and discussed while Section 6 draws the conclusions.

2 Literature Overview

Especially for a young central bank as the ECB, that is in a process of building up reputation, the its communication catches a lot of interest. There is a broad consensus amongst researchers that central bank communication, by improving credibility and transparency, can enhance monetary policy outcomes and hence welfare.⁴ Blinder et al. (2001) distinguish three channels through which clear communication can be welfare enhancing:

Firstly, communication can reduce transmission lags of monetary policy actions. The ECB controlled overnight interest rate has an effect on the real economy through inflation expectations. Arguably, a transparent central bank is more credible. This credibility induces wage and price setters to adjust quickly to policy changes. This in turn decreases transmission lags and therefore is beneficial for the effectiveness of monetary policy.⁵

Secondly, communication about the long-term inflation goal results in more credibility and thereby in greater trust in the commitment of the central bank to the target.⁶ This allows the central bank to be more flexible in their response to shocks in the short run (King (1997)). As an example, more transparency via clear communication reduces the costs of changes of policy direction. Central banks usually try to avoid policy reversals, because these reversals may cause confusion about their future policy path. Forward-looking central banks might have to reverse policy decisions in response to other-than-anticipated economic developments. Via clear communication, the central bank ensures that the public understands such a reversal as an optimal response to changing economic conditions and not as an attempt to push output above its potential.⁷ Thus,

⁴E.g. Blinder (1998), Woodford (2003 and 2005).

⁵See e.g. Bernanke (2004).

⁶See Posen (2002) for a more extensive discussion on the gains in flexibility through transparency and communication.

⁷A dependent central bank may be tempted to create monetary policy surprises in order to temporarily push output above its potential at the cost of inflation. This problem is referred to as “dynamic inconsistency”, which is defined as a policy problem that can result if a policymaker has the ability, at a future time, to alter his strategy in a way that is inconsistent with both the desires and strategies of private individuals and with his own initially announced intentions. However, if a central bank is not credible, private agents anticipate the time inconsistent

clear communication ensures that reversals do not harm the credibility and reputation of a central bank (Lowe and Ellis (1997)).

Thirdly, communication may reduce volatility in markets and consequently improve the accuracy of monetary policy. Expectations about the future path of overnight interest rates affect the economy by being incorporated in longer-term interest rates, asset prices and exchange rates. As argued in the first point, central bank transparency and a sound communication can reduce uncertainty in expectations. Less uncertainty reducing volatility in financial markets, thereby reduces financing costs and improving efficient allocation of resources. Furthermore, reduced volatility in expectations stabilizes the link between monetary policy and the economy: because the market's expectations about future changes in the overnight rate also influence market rates of much longer maturities today, they affect aggregate spending more effectively. Hence, communication induces a self-enforcing effect: communication reduces volatility in expectations which in turn offers the central bank a more precise estimate of the future impact of monetary policy decisions and hence increases the accuracy of monetary policy.⁸

On the other hand, some strands of literature support the view that too much transparency may harm the effectiveness of monetary policy. Cukierman and Meltzer (1986) for instance show that being too precise in the announcement of targets would decrease the possibility of creating a policy surprise without loss of reputation.⁹ In this respect precise announcements would lead to the time inconsistency problem in the line of Kydland and Prescott (1977). Hence, the central bank does not reveal all its information. Stein (1989) and Garfinkel and Oh (1995) also argue that the announcement of imprecise and fuzzy statements (i.e. announcing a range) instead of a precise target would solve this inconsistency issue: the central bank can remain credible by not systematically failing to meet the target. They can also allow for deviations from their target, as long as the policy target is still within a previously announced range. A more relevant issue

behavior of the central bank and rely on the inflation rate they expect in their wage contracts for the following period. This causes inflation to be higher in the next period but does not push output above its potential. The resulting inflation rate is referred to as "inflation bias". See Kydland and Prescott (1977) for the seminal discussion on the time inconsistency problem and Cukierman (1992) for a survey. However, this problem is less relevant for an independent central bank such as the ECB, as it has less an incentive to push output or employment above the natural rate.

⁸See e.g. Blinder et al. (2001), page 12.

⁹In this setting, the central bank has private information about its preference on the trade-off between monetary growth and economic stimulation. The public can only infer the current (time-varying) policy objectives from the noisy signal from the money supply. Thus, not being transparent and not revealing this private information to the public allows the central bank to engage in inflationary surprises when the marginal benefit of output is relatively high. Transparency in this case would allow the public to infer the central bank's goals and therefore future policy. Because monetary policy is assumed to affect the real economy only through surprises, transparency would not be beneficial for monetary policy. In the case of full transparency it would even become impotent. See also Carpenter (2004). Eijffinger et al. (2000) obtain similar results even when assuming zero degree of persistence in the central bank's objectives. They address this issue of secrecy and institutional design of a monetary authority from the society's perspective.

for the ECB is that revealing too much of their private information to the public may cause confusion. Thus, financial markets are likely to overreact in case they receive more signals from the central bank than they are able to digest (Kahneman (2003)). This in turn would increase volatility. A best response to this magnification of noise would be to reduce the precision in public announcements. Also Amato et al. (2002) point out that a better communication of the central bank may not always be welfare enhancing. Building on a model of Morris and Shin (2002), they show that, assuming that agents have access to independent sources of private information, an improvement of the precision of the public signal compared to the private signal may lower the average welfare function. Private agents would then rely on the public signal of the central bank despite that they may have a comparative advantage in their private signal. Thus expectations would be moved away from their fundamentals, which in turn harms the coordination of the central bank. However, there has been a heated debate about this model in the context of central bank transparency. Svensson (2006) comments that their finding is actually *pro* transparency since their conditions are likely to be violated.

Summing up, the picture emerging from the theoretical literature shows that the effectiveness of monetary policy is enhanced by harnessing the power of transparency via central bank communication. However, too much transparency might cause confusion and therefore too much central bank communication may be harmful for monetary policy effectiveness. Hence, theory gives no clear advice about the optimal design of communication to realize that communication indeed *“supports predictability and correct price formation in financial markets, contributes to efficient allocation of funds and reduces uncertainty about future interest rates”*, as postulated by Trichet (2005). This makes an empirical analysis necessary to evaluate the success of the ECB in achieving these goals.

Several attempts have been made to quantify the impact of communication on economic agents' expectations empirically. Most of the empirical literature analyzes the effect of communication on the exchange rate. The evidence is rather mixed. While Jansen and de Haan (2005a) find that efforts of the ECB to support the euro/US dollar exchange rate did not affect its level but rather increased its volatility, Fratzscher (2004) shows that communication can influence both the level as well as the volatility of the exchange rate. According to his results, it moves in the desired direction and reduces market volatility. Utilizing high frequency exchange rate data Jansen and de Haan (2005b) report that ECB communication has only short-run effects on the euro/US dollar exchange rate.

Besides exchange rates, money market forward rates reflect, as mentioned earlier, public expectations about *future* interest rate developments, too. For example, Rosa and Verga (2005) employ the Euribor as a proxy of market expectations. They generate an index to capture inflation and real economy risks discussed in the press statements of the ECB and show that at different maturities the Euribor reacts to changes in this communication measure. Heinemann and Ullrich (2005) compile an index based on certain signal words and use it to refine and estimate a standard Taylor type rule. They conclude that the incorporation of their wording indicator can substantially meliorate the model predictions. In a similar vein, Andersson et al. (2004) find that speeches by the Sveriges Riksbank's central bankers are an important determinant for Swedish medium-term interest rates. For the Fed Demiralp and Jorda (2004) prove that public announcements affect short-term interest rates rather than the liquidity channel of open market operations. All these studies commonly support the supposition that central bank communication indeed affects expectations of financial markets. We extend this literature by not just analyzing *whether* communication has an effect on expectations on future interest rates, but also *over what horizon* these expectations are being affected and, hence, how well financial markets can predict the *future path* of interest rates by listening to the ECB's communication. Finally, we analyze which *kind of information* contained in the statements is particularly driving expectations. To derive our estimation set-up, which is presented below, we use the expectations theory of the term structure.

3 The Expectations Theory of the Term Structure

Particularly long-term interest rates have an impact on the economy as they determine investment decisions and thereby influence aggregate demand. As central banks only control a limited number of short-term interest rates on the money market, including what is for the ECB called the main refinancing bid rate with a maturity of nowadays one week (repo), the pass-through of short-run to medium- and long-run interest rates is extremely important for monetary policy.¹⁰ Roley and Sellon (1995), amongst others, show how medium- and long-term interest rates are affected by current interest rates—a model commonly known as expectations theory of the term structure. The main component of this link is the expectations markets have about future short-term interest rates. We make use of this model of the term structure, which motivates the relationship between the short-term policy controlled interest rate and medium- and long-term interest rates and allow

¹⁰Sellon (2004) gives an excellent overview of the expectation hypothesis and the role of expectations for the monetary policy transmission.

for central bank's communication to affect financial market expectations.

$$r_t^M = E_t \left[\sum_{s=0}^M repo_{t+s} \right] / M + \rho. \quad (1)$$

The underlying concept of equation (1) is the so-called expectations hypothesis of the term structure.¹¹ The basic idea is that, with the exception of a term premium, there should be no difference in the returns from holding a long-term bond or rolling over a sequence of short-term bonds. As a result, the long-term interest rate should be an average of future expected short-term interest rates plus a term premium (e.g. Dotsey and Otrok (1995)). The reasoning behind this is that two equivalent investment options should have the same expected return, otherwise investors would arbitrage away any differences.¹² From Equation (1) we see that the longer the maturity of a forward interest rate r , the longer the time horizon of expectations about future repo rates. Assuming that k_i equals the number of days between day t and meeting i and $i = 1, \dots, j$ is the number of meetings from t to $t + M$, the interest rate of a money market or government bond at t (equation 2) and $t + 1$ (equation 3) respectively is

$$r_t^M = \frac{1}{M} repo_t + \frac{k_1}{M} E_t[repo_{t+1}] + \frac{k_2 - k_1}{M} E_t[repo_{t+k_1+1}] + \dots \\ + \frac{k_j - k_{j-1}}{M} E_t[repo_{t+k_{j-1}+1}] + \frac{M - k_j}{M} E_t[repo_{t+k_j+1}] + \rho \quad (2)$$

$$r_{t+1}^M = \frac{k_1}{M} repo_{t+1} + \frac{k_2 - k_1}{M} E_{t+1}[repo_{t+k_1+1}] + \dots \\ + \frac{M - k_j + 1}{M} E_{t+1}[repo_{t+k_j+1}] + \rho. \quad (3)$$

Taking the first difference allows to cancel out the risk premium and formulates the first difference of r as a function of the first difference of the policy instrument $repo$ and the change in expectations

¹¹Following for example Gurkaynak et al. (2002) a change in expectations about future interest rates can be derived from the rate r_t^M on a market instrument. The rate of return at time t with maturity M is determined by the expected return from the repo rate $repo$ plus a constant reflecting a term premium ρ (which is assumed to remain constant from a meeting day to the day after). Thus an investment with maturity M in t with a fixed rate of return in $t + M$ equals the expected return on an investment in t for M periods in the repo rate

¹²King and Kurmann (2002) note that, although the rather strong implications of this theory have been rejected in various studies, there nonetheless remain important elements of truth. Therefore, many central bankers and other practitioners of monetary policy continue to apply it as an admittedly imperfect but still useful benchmark. Fuhrer (1996) shows that, when accounting for changes in the monetary policy regime, this model is fitted well by the US data. As we include communication, it is reasonable to assume that a shift in the monetary policy regime would be captured by the change in the communication variable. Hence, we use this common theory as an underlying foundation for our empirical set-up.

on future *repo* rates from t to $t + 1$.

$$\Leftrightarrow r_{t+1}^M - r_t^M = \frac{1}{M}(repo_{t+1} - repo_t) + \left(\frac{k_1 - 1}{M} E_{t+1}[repo_{t+1}] - \frac{k_1}{M} E_t[repo_{t+1}] \right) + \dots \\ + \left(\frac{M - k_j}{M} E_{t+1}[repo_{t+k_j}] - \frac{M - k_j + 1}{M} E_t[repo_{t+k_j}] \right) \quad (4)$$

Simplifying equation (4) yields the following equation

$$\Rightarrow \Delta r_{t+1}^M = c_1 \Delta repo_{t+1} + c_2 \sum_j \Delta E_{t+1}[repo_{t+k_j+1}] + \varepsilon. \quad (5)$$

Following the derivations above the day to day change of interest rates as presented in equation (5) is a function of two different components.¹³ The first is the change in the repo rate, which should have itself an effect especially if it is (partially) unexpected.¹⁴ The second source of news which affects the change in expectations is mainly driven by the informational content of the introductory statements. Given that monetary policy makers have an information advantage about their own objectives, the statements can be informative for financial markets as they can use the central bank's assessment of the economic situation and the information on their pursued strategy to adjust their expectations.¹⁵ This information should be adequately proxied by the change of the communication indicator. A significant impact of the communication indicator would mean that agents use information they extract from the press releases about the interpretation of economic developments and the monetary policy stance in addition to the change in the repo rate to form their expectations about future interest rates.

A more or less “stylized fact” in the interest rate reaction function literature is that central banks adjust interest rates step-by-step into one direction in response to changes in economic conditions.¹⁶ Sauer and Sturm (2006) estimate several specifications of an interest rate reaction functions of the ECB and show that the degree of policy inertia is highly significant.¹⁷ To control for the possibility that financial markets expect interest rate smoothing behavior, we include two

¹³Note that the index t does not have a specified frequency. The subscript t denotes the day of a meeting (and only these days). The changes in the rates from these days to the days after the meeting $t + 1$ are included in our data set. Overall our data set contains 68 meetings, the first in January 1999 and the last in December 2004.

¹⁴Note that the impact of the expected change in the repo rate is incorporated in r with a weight of $1/M$, hence the coefficient can be expected to be higher, the lower the maturity of an interest rate.

¹⁵That private agents “learn” about the unobservable objectives of monetary policy makers is an assumption that the literature on learning and monetary policy makes use of. For example, Orphanides and Williams (2003 and 2005) show that in this modelling set-up, the revealing of information by the central bank on their policy objectives generally leads to better economic outcomes. See also Bernanke (2004).

¹⁶Woodford (1999) highlights the benefits of a gradual adjustment in interest rates.

¹⁷A similar result is obtained by Gerlach-Kristen (2003). On the contrary, Rudebusch (2002) argues that although the observed policy inertia is present in the US only in shorter time frequency, the observed inertia in quarterly data frequency is more likely to reflect persistent shocks than a “smoothing behavior”. As we use data with a higher frequency, the latter problem is not present in our model.

variables that count how many interest changes have already occurred into one direction. Those variables are denoted by *DUP* and *DDOWN*.

Hence, following equation will be tested empirically:

$$\Delta r_{t+1}^M = c_1 \Delta repo_{t+1} + c_2 \Delta comm_t + c_3 DUP + c_4 DDOWN + \varepsilon. \quad (6)$$

To analyze the dynamic aspects of the relationship we employ Euribor rates at different maturities. Information revealed by ECB statements is likely to have a different impact on different maturities.¹⁸

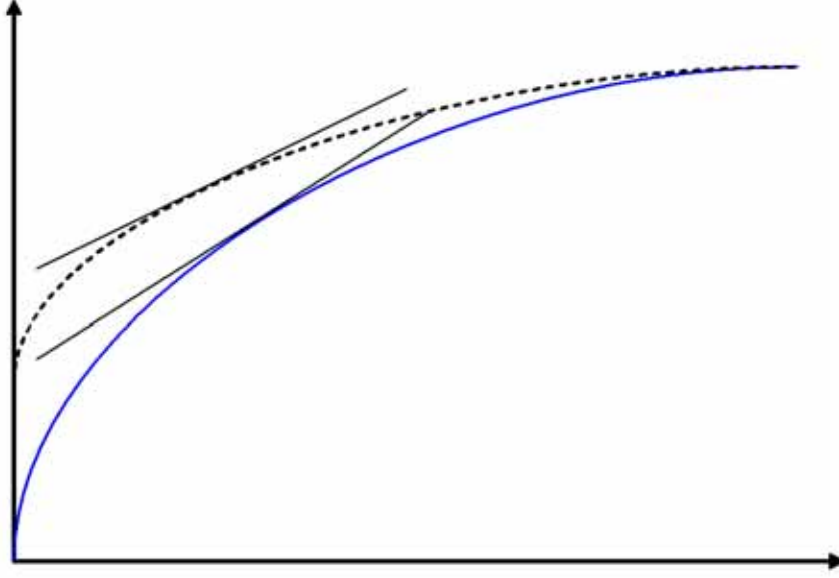
All these market interest rates can be expressed as a function of their maturities, a relationship that is known as the so-called yield curve.¹⁹ A flat yield curve indicates that the agents at financial markets expect the interest rates to remain mostly equal over the horizon that the yield curve is constructed over. A downward sloping yield curve implies that financial markets expect a lower interest rate in the future. Respectively, an upward sloping yield curve reflects that a future higher level of interest rates are expected. Hence, if a factor affects only the interest rates at lower maturities, but not at higher maturities, only the so-called “short end” of the yield curve is affected, which means that financial markets expect an effect of the factor of interest on interest rates in the short-term, but no change in the course of nominal interest rates in the long-term (Roley and Sellon (1995)). One line of the macro finance literature not just interprets changes in the slope of the yield curve as indicator for future changes in the economic situation but also of a change in monetary policy targets (Fuhrer (1996)). This would mean that the yield curve flattens if the short-term interest rates are expected to increase only temporarily and long-term rates remain at their current level and a steepening of the curve in case of a decrease of short-term rates respectively. A deviation from the current monetary policy target, however, moves long-term rates as well.²⁰ A sound communication of the central bank with financial markets should be able to prepare financial markets for an upcoming change in the repo rate, and hence should affect the short end of the yield curve. However, if the long end of the yield curve was affected, expectations

¹⁸We assume that on the day of the ECB meeting no other new information is systematically released, i.e. additional information is distributed randomly and captured in the error term. Hence, to a large extent movements of the different Euribor rates can be attributed to information reflecting the monetary policy stance as presented at the ECB press conference. The time path is as follows: r_t^M is determined in t before the policy meeting (at 11.00 am), then the new rate of the repo $t + 1$ is published at about 1.45 pm. At 2.00 pm the statement of the ECB in the press conference is given. On the next day, at $t + 1$, we have the next observation from the Euribor spot rate r_{t+1}^M at 11.00 am.

¹⁹See Campbell (1995) and Cook and Hahn (1990) for an overview on the relationship between interest rate expectations and the shape of the yield curve.

²⁰See e.g. Evans and Marshall (2001). Also Bomfim (2003) formulates a two-factor model of the term structure of interest rates and shows that the shape of the US Treasury yield curve can be explained by one factor corresponding to the current setting of the federal funds rate and the second by medium-term policy expectations.

Figure 1: Yield Curve



Note: Y-axis: yield, X-axis: maturity

about the long-term target of inflation would have changed, which would imply that the financial market interprets a statement of the central bank as a persistent change in the stance of policy. Depending on the direction of the change, this could be either a sign of successful communication that leads to anchoring inflation expectations at a lower inflation level or it could be a sign of inadequate communication that makes markets expect a higher inflation level in the future. A frequent impact of these statements on long-term interest rates would thus cause volatility in long-term interest rates, which—as argued in the theoretical part—would be an obstacle to an efficient allocation of resources.

Figure 1 shows an example of a yield curve: the slope as proxied by the difference between two maturities decreases when short-term rates become more equal to long-term rates and hence expectations about the perception of the course of monetary policy can be estimated from the slope of the yield curve.

To analyze how communication affects the shape of the yield curve we proxy the slope by the spreads between different maturities. Given that interest rates with higher maturities are affected by the whole trajectory of expected short-term rates, the slope of the yield curve contains important information. Hence, from equation (4) we subtract the change of Δr_{t+1}^m with a lower maturity $m < M$ from the left hand side of the equation.

$$\Delta r_{t+1}^M - \Delta r_{t+1}^m = b_1 \Delta repo_{t+1} + b_2 \sum_{j=m}^M \Delta E_{t+1}[repo_{t+k_j+1}] + \varepsilon. \quad (7)$$

Equation (7) formulates the change of the spread between interest rates of different maturities as a function of the expected change in the repo in the time between m and M in the future.

The considerations above eventuate in the following estimation equation:

$$\Delta r_{t+1}^M - \Delta r_{t+1}^m = b_1 \Delta repo_{t+1} + b_2 \Delta comm_t + b_3 DUP + b_4 DDOWN + \varepsilon. \quad (8)$$

The left hand side of equation(8) represents the change in the slope of the yield curve between maturities m and M . Analogous to equation (6), this slope of the yield curve is a function of changes in the current repo, the expected future stance of monetary policy, which can be extracted from information in the communication indicator, and expected interest rate smoothing behavior of the central bank.²¹

4 Data

As the underlying idea of our analysis is to check whether and to what extent ECB communication affects expectations of financial market agents, we need two types of indicators. On the one hand, we need to utilize forward interest rates data to extract financial market expectations as derived in section 3. On the other hand it is necessary to find an indicator that captures the communication of the ECB. The latter is obviously a problem as it is hard to quantify “communication”.

4.1 Financial Market Data

We look at financial market agents for two reasons: First, financial markets watch the ECB closely and are not expected to be biased from media coverage, which was found by De Haan and Amtenbrink (2002). Second, it is possible to extract expectations about future monetary policy from bond markets, as shown in section 3. For the Euro Area, the Euribor investment products are forward interest rates, which are traded on the money market with maturities of one week to twelve months. These forward rates are useful for our analysis as they are complementary to the interest rates we derived theoretically in the preceding section. For our analysis, we use data with

²¹Bomfim (2003) shows in a theoretical model that – besides the level – also the slope of the yield curve can be approximated well by the two factors current and expected monetary policy stance.

all available monthly maturities (one to 12 months).²² Data for the Euribor can be downloaded from www.euribor.org.

4.2 The Berger-de Haan-Sturm ECB Communication Indicator

Most of the empirical studies focus on the impact of communication events such as central bankers speeches or central bank statements. Mostly, binary proxies are used (i.e. if there was a statement or not). This, however, only allows to analyze the effect of a statement, no matter what the content is. In reality financial markets closely watch central bankers lips and analyze their speeches thoroughly. Therefore, we need a measure that allows us to quantify *contents* of these statements.

Some recent studies identify “code words” from ECB statements or publications to construct indicators for “hawkishness” in ECB statements. Rosa and Verga (2005) set up a glossary of words from the introductory statements of the ECB to construct a communication index.²³ In a similar vein, Heinemann and Ullrich (2005) use specific expressions or code words that are frequently applied in press conferences to explain interest rate decisions to construct a communication index.²⁴ The advantage of approaches like Rosa and Verga (2005) and Heinemann and Ullrich (2005) is that they are relatively mechanical in quantifying ECB communication and are therefore in principle reproducible. Financial market agents, especially the so called “ECB Watchers”, however, exactly analyze the statements and pay particular attention to the content of these statements. The mechanical quantification by only counting certain expressions therefore disregards the reading “between the lines”, which is considered to be much more important. Therefore, this strategy to derive an indicator for the content of ECB communication might disregard too much information relevant for our purpose. Incorporating the entire content and allow for “reading between the lines” – as is done by Berger et al. (2006) – seems to be more appropriate in our case.

The indicator is constructed on the basis of the information communicated in the ECB’s introductory statement at the press conference following an interest rate meeting.

²²Unfortunately, the Euribor is only available for maturities up to 12 months. To obtain financial market data for higher maturities we would have to use government bond yield data. As the Eurostat data for government bond yields for the Euro Area are aggregated from country specific bond yields, the aggregate might be driven by country specific factors rather than the monetary policy stance. Bernoth et al. (2003) empirically analyze the government bond yield differentials between EU countries. They find that the differentials can to a large extend be explained by a positive default and liquidity risk premium. They increase with the debt, deficit and debt service level and depend positively on the issuer’s relative bond market size. Taking this into account, we opt to focus on Euribor data only.

²³They construct seven groups of words and give each group a grade from -3 to +3, where -3 indicate words that insinuate a decrease in interest rates such as “strong downside risks to economic growth”. On the other hand, extreme expressions such as “the risks to price stability are confirmed” are graded with a +3.

²⁴To “safeguard a high degree of objectivity” they group these expressions by the current period line of monetary policy, say easing, neutral, and tightening. Then they use these groups to test for a significant difference between the three periods of monetary policy. The expressions that showed significant differences are then used to construct their indicator.

The introductory statements play a crucial role as the ECB itself highlights them as the most important communication device besides the monthly bulletin. This approach accounts of the fact that the ECB follows the collegial communication approach, as discussed by Ehrmann and Fratzscher (2005a), as the content of these statements reflect the views of *all* members of the council. These statements should therefore also contain important information for interest rate expectations. Indeed, Ehrmann and Fratzscher (2005b) find that the predictability of interest rates for financial markets significantly improves when analyzing communication that does not reflect dispersion across council members' opinions but rather their consensus.

Furthermore, in the indicators constructed by Rosa and Verga (2005) and Heinemann and Ullrich (2005) the three sections monetary, real economy and prices, that are usually commented on separately in the statement, are not distinguished from each other. This is especially important as Berger et al. (2006) for example find that these sub-indicators weight differently in the overall assessment of the ECB. Hence, there is no distinction of whether a "code word" such as "upside risk" is related to developments in the real economy, in prices or in money growth. This, however, might be important, as the interpretation of the ECB on developments in one sector may be more or less expected by financial markets, whereas interpretations on other sectors might come as a surprise and thus – if considered to be important – significantly affect expectations about future interest rates.

Thus, the advantage of the BHS indicator is that it uses both subjective measurements of content of introductory statements of the ECB's monthly press conference and that also each of the statements are quantified separately with regards to (1) price developments p , (2) the real economy ec , (3) the monetary sector m , and finally (4) the overall conclusively assessment of the current situation ag are quantified.²⁵

One issue in this respect is a sensible weighting of the index. We use a principal components analysis (pca) twice: firstly, we have to cancel out subjectivity across the different individuals that rated the statements. Therefore, we use the pca to extract the common information contained in the different subjective ratings on price developments to obtain a series of p . We run an analogous procedure to cancel out subjectivity of the different ratings to obtain series for ec , m and ag . Secondly, to obtain an aggregate of the information contained in the statements in all four sub-sectors for p , ec , m and ag , we again use a pca to calculate the weights for each series, which

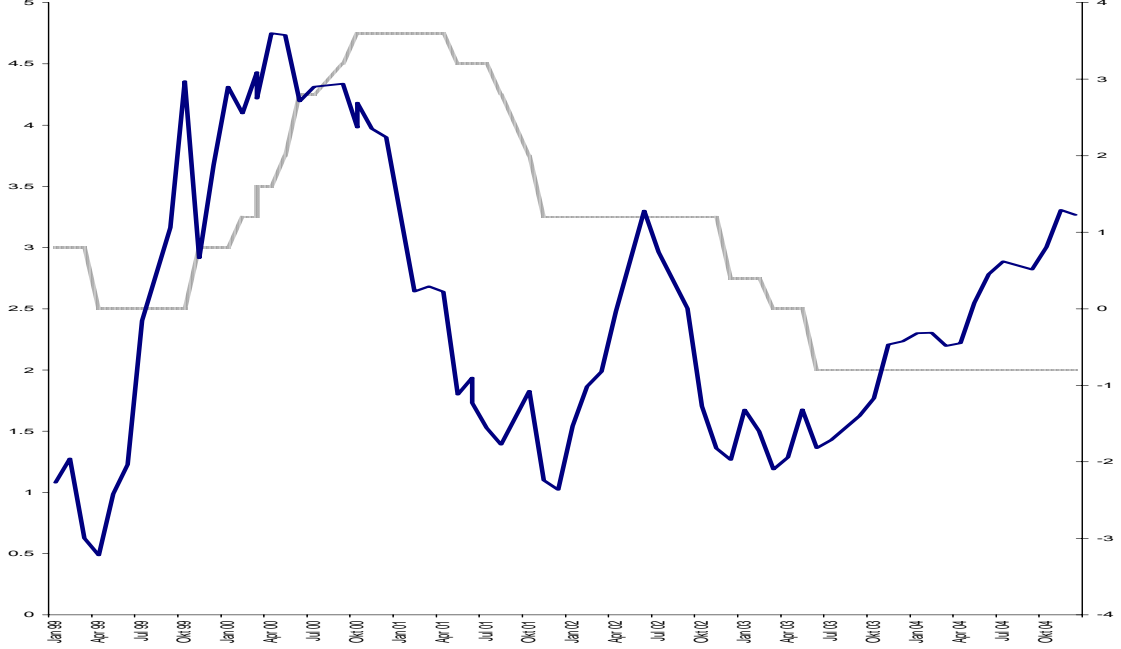
²⁵Three independent economists read the ECB introductory statements and rated each month's statement on prices and price developments, the real economy, the monetary sector and the overall conclusively assessment of the current situation using a scale from -3 to +3. Despite their economic background, these junior researchers are on purpose non-experts in the field of monetary economics, i.e. they are not biased by actual and past policy discussions in this field.

results in a single series, which we call “aggregate communication indicator” or “BHS indicator” henceforth.²⁶ This approach allows to amalgamate the information content of the four sub-indices into one index and cancel out subjectivity to a large extent.²⁷ Furthermore, by using not only the information from the overall statement but also from those parts of the statements that address prices, real and monetary developments, we also analyze how expectations react to the contents of the statements distinguished by topic as measured by p , ec and m . This allows us to disentangle the “news” contained in the introductory statements in these three sectors from each other. Financial markets have already incorporated the (real-time) information on the latest available business cycle indicators, inflation rates and monetary aggregate indicators. What is “news” to them is the interpretation of these developments by the ECB. Hence, some of the paragraphs addressing these sectors separately might contain more important “news” than others. We have computed the correlation coefficients between the real-time developments given by “hard” data (i.e. the latest data available in real time) and the single indicators. The correlation between the real-time economic sentiment indicator (ESIN) and the sub-indicator ec is 0.64; for the real-time M3 growth and the sub-indicator m the correlation is still 0.20 and for the real-time HICP and p , the correlation is 0.00. Hence, the statement and interpretation of the ECB on real developments follows quite closely the currently available data and hence the “news” content on statement days should be quite small. On the other hand, there is no correlation between real time HICP rates and the ECB’s statement on current and future price developments. This is also a finding in Berger et al. (2006), who conclude, that the contents of the statements with respect to price developments are more forward looking and therefore contain not much information on recent data interpretations but rather on the ECB’s price development expectations. Hence, the ECB’s statements seem to have more information content for future interest rates than the latest HICP data.

²⁶To capture the impact of the weighting scheme on the results we basically compare two more approaches. We use the three indicators of ag and cancel out subjectivity by computing simple averages of the three series. The reason for using only the rankings of ag is that the overall assessment mostly summarizes a large part of the rest of the statement, i.e. p , ec , and m , which would include information on some of the sub-indicators unproportionately: Berger et al. (2006) find that the assessment of the monetary sector changes over time, but is generally of hardly any importance. Including the assessment on the monetary sector with an equal weight as the other two sectors ec and p would give the impact on the communicated importance of the monetary pillar too much weight relatively to the other two sub-sectors. Second, we weight each of the sub-indices by the amount of words spent on each topic. This measure does not include the ag indicator, as for most of the cases, the overall impression cannot directly be attached to a specific paragraph in the statements. A relevant development that affects central banking should be measured by the index but also honored by an in-depth discussion, consequently leading to long text passage and a large amount of words. The correlation coefficients between the three alternative indices spawned by the different weighting schemes is between 0.95 to 0.99.

²⁷Comparing the output it becomes evident that all three weighting schemes lead qualitatively to the same results. Hence we opt to present only the results of one weighting scheme. In terms of performance, as measured by the goodness of fit, the principal component weighted indicator dominates the other two.

Figure 2: ECB Communication Indicator



Note: Left hand scale: ECB Main Refinancing Bid Rate (grey line), Right hand scale: ECB Communication Indicator, weighted by principal components (blue line), Source: ECB and Berger et al. (2006) and authors calculations.

Our measurement of the overall communication is plotted together with the main refinancing bid rate in Figure 2. The indicator seems to lead the interest cycle, which confirms that the ECB tries to prepare markets for an increase in interest rates. However, the indicator still shows a non-deniable volatility which may lead to the conclusion that communication is still noisy and ambiguous to some extent. Therefore, the analysis of financial markets' understanding of ECB communication is an important issue for monetary policy.

5 Results

We estimate equation (6) for all available maturities of the Euribor. The results are reported in Tables 1. Overall, the the BHS indicator significantly explains day-to-day changes of longer-term interest rates. Hence, shows that ECB communication indeed plays a prominent role in forming expectations of market agents. Besides that, the change in the repo rate is significant at every maturity. This suggests, that the timing as well as the magnitude is not fully anticipated by financial market participants.

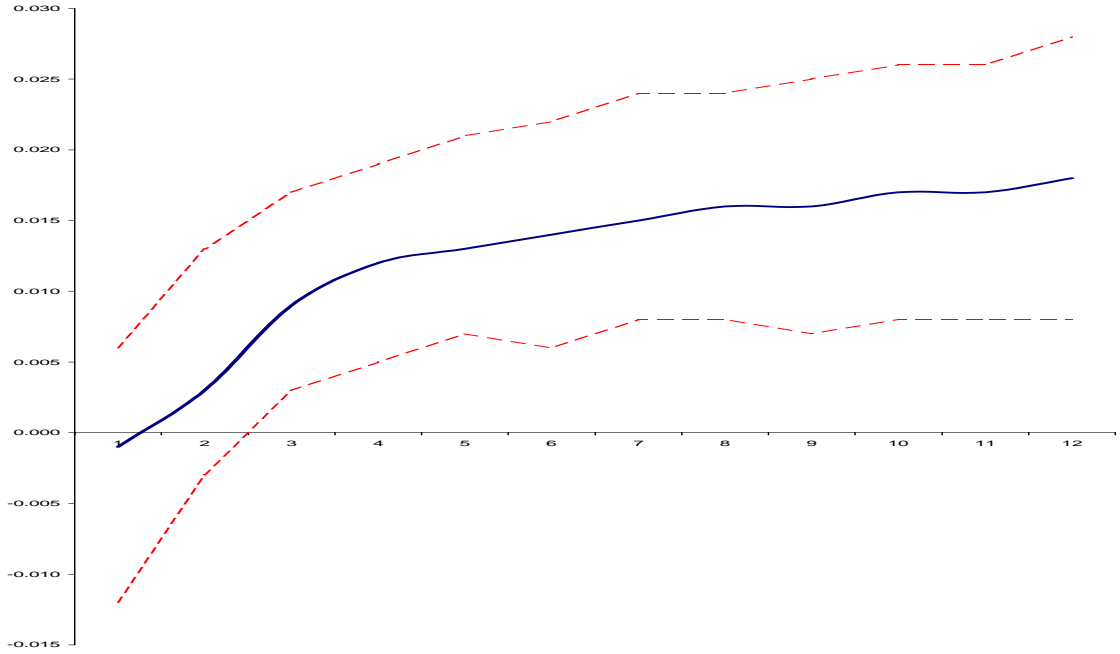
Table 1: Results Impact of Communication controlled for Policy Inertia

Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
$\Delta repo$	0.414 (0.060)	*** 0.342 (0.057)	*** 0.310 (0.052)	*** 0.297 (0.052)	*** 0.285 (0.053)	*** 0.272 (0.057)	*** 0.267 (0.061)	*** 0.256 (0.064)	*** 0.248 (0.067)	*** 0.247 (0.069)	*** 0.242 (0.071)	*** 0.235 (0.074)
$\Delta comm$	-0.001 (0.008)	0.003 (0.008)	0.009 (0.007)	0.012 (0.007)	0.013 (0.007)	* 0.014 (0.008)	* 0.015 (0.009)	* 0.016 (0.009)	* 0.016 (0.009)	* 0.017 (0.010)	* 0.017 (0.010)	* 0.018 (0.010)
DUP	-0.015 (0.008)	* -0.017 (0.008)	** -0.015 (0.007)	** -0.012 (0.007)	* -0.011 (0.007)	-0.009 (0.008)	-0.007 (0.008)	-0.006 (0.009)	-0.005 (0.009)	-0.004 (0.010)	-0.003 (0.010)	-0.003 (0.010)
DDOWN	0.037 (0.008)	*** 0.030 (0.007)	*** 0.028 (0.007)	*** 0.025 (0.007)	*** 0.024 (0.007)	*** 0.022 (0.007)	*** 0.021 (0.008)	*** 0.019 (0.008)	** 0.018 (0.009)	** 0.018 (0.009)	* 0.017 (0.009)	* 0.016 (0.009)
R-Squ.	0.454	0.359	0.362	0.349	0.324	0.277	0.253	0.216	0.196	0.189	0.174	0.158
Obs.	65	65	65	65	65	65	65	65	65	65	65	65

Note: Dependent variable: Δr_{t+1}^M ; Standard errors in parenthesis; */**/***/ denote significance at 10%, 5% and 1% level.

Having a closer look at the estimation results across the different maturities reveals an compelling picture: the BHS indicator is significant for maturities from five up to twelve months. Interestingly, Euribor rates with lower maturities are not affected by a change in the communication signal. The effect of a change in our communication indicator on the Euribor rates at different maturities is plotted in Figure 3.

Figure 3: Impact of Communication



X-axis: maturity, Y-axis: coefficient value, dashed lines: confidence bands at one standard deviation.

The figure shows that the size of the communication effect increases for maturities up to 12 months. However, the level of these impact coefficients are not statistically different from each other.²⁸ The overall monetary policy stance as communicated via the introductory statements of the ECB president appear to mainly affect medium-term expectations on financial markets. Given that we measure the overall stance of monetary policy with the BHS indicator, we find that financial markets expect to be prepared for a change in the repo rate due to a change in the monetary policy stance at least five month before the decision to change the repo rate is actually conducted. Another interesting result is that only the change in the wording indicator is significant. Implementing the absolute index in the estimation equation leads to barely significant results. Hence, financial markets especially react to a changing of the statements rather than to

²⁸Estimates on the difference are reported in the following paragraph.

the overall risks expressed in the statements.²⁹

Also the variables (DUP and DDOWN) counting the changes in the repo that have already been made in one direction are significant for some maturities and have the expected sign: the more upward interest rate steps have already been made, the less likely a further step upward is expected. In a similar vein, the more downward steps have already been made, the lower the expectations of a further step in that direction are. However, the variable controlling for policy inertia in upward steps is significant for maturities from one to four months only, whereas the downward inertia variable is significant for all maturities.³⁰ Hence, market participants are well aware of the inertia process and consequently are able to judge upon the likelihood of an upcoming interest rate step in a specific direction.

To ferret out if developments in specific areas of the economy – i.e. price, real or monetary issues – discussed in an introductory statement are particularly relevant (and over which horizon) for market participants, we regress the sub-indicators using the same setup. Results are presented in Table 2.

We find that the price indicator is highly significant from 3 months to one year. In contrast, the monetary indicator is only relevant between 3 to 7 months. The real indicator is insignificant at all maturities. This result is intuitively appealing. The current developments in the real economy can be inferred from survey data, that are available on a high frequency and have good forecast properties. Arguably, the picture the ECB has is similar to the picture the financial markets have, as interpretations of these data are relatively similar. The “news” that statements contain about the central bank’s interpretation of the data are therefore negligible.³¹ According to our results, especially the ECB’s interpretation on current and expected price developments surprises financial markets. The interpretation on price developments is also perceived to be of high importance: comparing the effect of the price communication indicator with the effect of the aggregate indicator, the coefficients have roughly double the size for the price indicator. Also comments on monetary developments reveal some “news” for financial markets for the medium-term of three to seven months ahead expectations. This is consistent with our argument that the interpretation of the ECB on economic developments is expectedly close to what financial markets read from current business cycle indicators. Their interpretation of price developments, however,

²⁹This is in line with the findings of Heinemann and Ullrich (2005), who find that only the change of their wording indicator significantly improves a standard Taylor type rule.

³⁰As we only have one interest rate cycle in our data sample, we cannot draw conclusions whether the policy inertia is expected to be more persistent from 2002-2004, after financial market agents have learned about ECB monetary policy (as the downwards steps occurred in 2002-2004), or whether a structural break explains this finding.

³¹This is also in line with earlier findings, that suggest that economic outlook communication generally moves financial markets only very little (Ehrmann and Fratzscher (2005c)).

Table 2: Results Sub-Indicators Impact of Communication controlled for Policy Inertia

Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Prices												
Δ_{repo}	0.416 (0.059)	*** (0.056)	*** (0.050)	*** (0.050)	*** (0.051)	*** (0.055)	*** (0.059)	*** (0.062)	*** (0.064)	*** (0.066)	*** (0.069)	*** (0.071)
Δ_{comm}	0.006 (0.012)	0.010 (0.011)	0.019 (0.010)	* (0.010)	** (0.010)	0.026 (0.011)	*** (0.012)	*** (0.012)	*** (0.013)	*** (0.013)	*** (0.014)	*** (0.014)
DUP	-0.014 (0.008)	* (0.008)	** (0.007)	** (0.007)	-0.011 (0.007)	-0.008 (0.008)	-0.005 (0.008)	-0.005 (0.009)	-0.003 (0.009)	-0.003 (0.009)	-0.002 (0.010)	-0.001 (0.010)
DDOWN	0.038 (0.008)	*** (0.007)	*** (0.006)	*** (0.006)	*** (0.007)	*** (0.007)	*** (0.007)	0.02 (0.008)	*** (0.008)	0.019 (0.008)	** (0.009)	0.017 (0.009)
R-Squ.	0.456	0.365	0.378	0.366	0.345	0.3	0.282	0.249	0.231	0.223	0.209	0.188
Real Eco.												
Δ_{repo}	0.415 (0.059)	*** (0.056)	*** (0.051)	*** (0.052)	*** (0.053)	*** (0.058)	*** (0.061)	*** (0.065)	*** (0.067)	*** (0.069)	*** (0.072)	*** (0.074)
Δ_{comm}	-0.017 (0.015)	-0.015 (0.014)	-0.010 (0.013)	-0.005 (0.013)	-0.003 (0.013)	0.000 (0.015)	0.001 (0.016)	0.001 (0.016)	0.001 (0.017)	0.004 (0.018)	0.004 (0.018)	0.008 (0.019)
DUP	-0.017 (0.008)	** (0.008)	*** (0.007)	*** (0.007)	** (0.007)	-0.011 (0.008)	-0.009 (0.008)	-0.009 (0.009)	-0.008 (0.009)	-0.007 (0.010)	-0.006 (0.010)	-0.005 (0.010)
DDOWN	0.036 (0.007)	*** (0.007)	*** (0.007)	*** (0.007)	*** (0.007)	0.019 (0.007)	*** (0.008)	0.017 (0.008)	0.015 (0.009)	0.015 (0.009)	* (0.010)	0.014 (0.009)
R-Squ.	0.465	0.368	0.349	0.321	0.29	0.238	0.212	0.177	0.158	0.148	0.136	0.121
Monetary												
Δ_{repo}	0.417 (0.059)	*** (0.056)	*** (0.050)	*** (0.051)	*** (0.052)	*** (0.056)	*** (0.060)	*** (0.064)	*** (0.066)	*** (0.069)	*** (0.071)	*** (0.073)
Δ_{comm}	0.006 (0.010)	0.011 (0.010)	0.017 (0.009)	* (0.009)	* (0.009)	0.017 (0.010)	* (0.010)	0.017 (0.011)	0.016 (0.011)	0.016 (0.012)	0.015 (0.012)	0.015 (0.013)
DUP	-0.015 (0.008)	* (0.008)	** (0.007)	** (0.007)	* (0.007)	-0.010 (0.008)	-0.008 (0.008)	-0.008 (0.009)	-0.007 (0.009)	-0.006 (0.009)	-0.005 (0.010)	-0.005 (0.010)
DDOWN	0.037 (0.007)	*** (0.007)	*** (0.006)	*** (0.006)	*** (0.007)	*** (0.007)	*** (0.008)	0.017 (0.008)	0.015 (0.008)	0.015 (0.009)	* (0.010)	0.013 (0.009)
R-Squ.	0.456	0.37	0.38	0.357	0.325	0.273	0.246	0.206	0.183	0.171	0.156	0.137
Obs.	67	67	67	67	67	67	67	67	67	67	67	67

Note: Dependent variable: Δr_{t+1}^M ; Standard errors in parenthesis; * / ** / *** denote significance at 10%, 5% and 1% level.

is much driven by their outlook on future price developments, that mostly are private information to the central bank. Somewhere between these two extremes lies the (lower) surprise generated by the interpretation of monetary developments.

So far our results show that communication has indeed an effect on bonds with a specific maturity. These findings only allow to draw conclusions for single points on the yield curve separately. However, from a policy perspective, it is equally important to check the effect of communication on the slope of the yield curve, which is commonly proxied by the spreads between the bonds at different maturities. Hence, we also estimate the response of the slope of the yield curve by estimating equation (7) using all possible permutations between maturities. This allows us to draw a picture of the effect on the slope of the yield curve.

Table 3: Difference Matrix

	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
1M		0.04	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.03	0.03
2M	0.51		0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.04	0.04
3M	0.38	0.18		0.16	0.17	0.15	0.13	0.18	0.22	0.17	0.20	0.19
4M	0.33	0.15	0.07		0.32	0.21	0.17	0.25	0.30	0.21	0.26	0.24
5M	0.31	0.14	0.08	0.08		0.22	0.16	0.25	0.32	0.22	0.28	0.26
6M	0.28	0.14	0.09	0.08	0.07		0.18	0.36	0.46	0.26	0.35	0.31
7M	0.25	0.13	0.09	0.08	0.09	0.09		0.75	0.80	0.37	0.50	0.41
8M	0.24	0.12	0.09	0.08	0.07	0.06	0.06		0.91	0.25	0.45	0.35
9M	0.23	0.12	0.09	0.08	0.08	0.08	0.08	0.08		0.08	0.31	0.26
10M	0.22	0.12	0.09	0.08	0.08	0.07	0.05	0.05	0.04		0.86	0.59
11M	0.22	0.12	0.09	0.08	0.08	0.07	0.06	0.06	0.04	0.06		0.32
12M	0.22	0.12	0.09	0.08	0.08	0.07	0.06	0.06	0.04	0.05	0.05	

Note: Upper right triangular part p-values, lower left triangular part R-Squares

Our estimates reported in Table 3 show the significance (expressed in p-values) of an effect of communication on the *slope* of the yield curve using all permutations of proxies for the slope between one month and 12 months maturity. There is a significant different impact from communication on one respectively two months compared with higher maturities. Hence, the relation between short- and medium-term interest rates alters significantly. None of the spreads between higher-than-two months maturities is shifted significantly by the change in the communication indicator derived from the ECB press statements. The lower triangular matrix in Table 3 shows the R^2 of the regressions of equation (7). The first and second columns exhibit larger values than the remaining columns, which shows that the communication indicator can explain up to 50 percent of the yield curve slope variation between one and two months maturity, and 22 percent of the variation in the slope of the yield curve on meeting days between one months and 12 months ma-

turity. Recalling that these spreads proxy for the slope of the yield curve, this result substantiates our findings when testing the absolute responses in Table 1, where we did not find significantly *different* coefficients. This indicates that markets cannot distill the future path of interest rates from communication. They anticipate the direction and the timing of the upcoming step which is to be conducted in a horizon of about five to twelve months ahead.

6 Conclusion

In this paper we investigate the importance of ECB communication for the structure of financial market participants' expectations. We test whether central bank communication affects the term structure of interest rates and thereby the shape of the yield curve. Our findings suggest that central bank communication indeed has an effect on short-term interest rates. We are able to show that the communication indicator has significant explanatory power for the day to day change in interest rates with maturities from five to twelve months. Furthermore, we prove that ECB communication significantly affects the short end of the yield curve. Hence, we conclude that financial market agents expect the ECB to prepare them for upcoming changes in interest rates *at least* three to five months before. This implies that the ECB is not expected to create surprise inflation and financial markets rely on its predictability, which is good news for the evaluation of the effectiveness of ECB communication. However, the exact timing of a decision is less foreseeable: financial markets expectations show that the change in the policy controlled interest rate is expected to be conducted the soonest at three to five months and the latest within the coming twelve months, which is a range of eight to ten months.

Looking at the contents of the statements by subject, the comments of the ECB on prices are the part financial markets react most strongly to, whereas the ECB's interpretation of developments in the real economy seem to be mostly expected by financial market agents.

Overall, the ECB is found to be *credible* as financial market agents believe in the content of its statements. With respect to *transparency*, we can observe some surprise in the effect of the main refinancing rate on expectations, independent of the news contained in the statement. This shows that the ECB is credible but still the exact timing and the magnitude of interest rate changes are not completely anticipated by financial markets.

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