What Matters When? The Impact of ECB Communication on Financial Market Expectations*

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Abstract

This paper analyzes financial markets' reaction to ECB communication. We apply a novel indicator that quantifies the contents of the ECB's introductory statements and allows disentangling ECB statements on prices, the real and the monetary sector. We provide evidence that it matters *what* issue the ECB is speaking about: especially the ECB's statements on price developments represent important news to financial markets. It also matters *when* the ECB affects markets: communication drives maturities above four months.

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1 Introduction

> *"... central banks 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.[1] This is mainly due to the fact that communication is an important instrument for a central bank to achieve more transparency and credibility (Geraats, 2005 and Woodford, 2005). 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 analyzing the role of communication for monetary policy making just emerged recently. Studies such as Fratzscher (2004 and 2005) , Jansen and de Haan (2005), Jansen and de Haan (2007), Rosa and Verga (2007) and Rosa and Verga (2005) analyze the impact of ECB communication on different financial market data, such as exchange rates or money market interest rates. All provide support for the theoretical predictions that communication should affect asset prices by influencing expectations.

The few studies that deal with this issue only focus on the existence of an impact of communication. In this paper we want to go a step further. Hence, we do not only check whether there exists a relationship between ECB communication and financial markets employing better measures, but also survey the horizon over that communication influences market expectations. Moreover, we investigate whether financial markets pay particular attention to the ECB's evaluation of topics like price stability, developments in the real economy or monetary indicators separately. We analyze how financial markets judge the informational content of the ECB's communication with respect to these different objectives. To the best of our knowledge this has not been done so far. We build on a standard model of the term structure to derive a structural estimation equation that allows to extract the effects of central bank communication on expectations about future interest rates. As we

[1] See e.g. Jansen and de Haan (2006)

will show later, it is of major importance to not just analyze the ECB's communication by the wording but also to take into account what topics are addressed. This is clearly a very relevant issue that should be considered in future research in this area.

To quantify communication we employ the 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] It furthermore allows to quantify the ECB's statements on the different topics price stability, real economic developments and monetary developments separately and therefore allows to test for differences in financial market reactions to these topics.

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] An interesting refinement of this result is the time structure: communication starts to become relevant for expectations about four months ahead. For maturities from four 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 expect the ECB to change interest rates at the soonest four months later, but not earlier. An interest rate change is perceived to become more and more likely during the following four to twelve 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 prepares them for a change in interest rate well in advance. The *timing* of interest rate changes, however, is still surrounded by uncertainty.

In a finer grained analysis we, furthermore, evaluate the relevance of the content and the topic of the statement. Especially information the ECB reveals on their interpretation of price developments is driving financial market expectations, whereas interpretations about monetary developments contain little "news" and communication about real economic developments even do not show any effect on asset prices. As it seems unlikely that financial markets have better measures of the monetary aggregate this supports the view that the development of monetary indicators is of minor relevance for the assessment of the ECB's strategy, confirming the analysis of Berger et al. (2006). On the other hand financial market agents observe indicators that give them similar information on real developments the ECB has. The interpretation of the ECB about these appears to be no news to financial markets. Hence, there is less response to the ECB's assessment on the developments of the real economy. However, with respect to the ECB's view on price developments ECB communication contains new information for financial markets which they cannot extract from other sources such as macroeconomic data or their own models.

The remainder of this chapter 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

[2]Studies like Farvaque et al. (2007) emphasize the impact of uniform voting for the volatility of financial markets.

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

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 central banks' 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 in the 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, 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

[4] See, e.g. Blinder (1998), Woodford (2003 and 2005). For an overview see also Geraats (2002).

[5] See, e.g. Bernanke (2004).

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

[7] A 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 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 no incentive to push output or employment above the natural rate.

and exchange rates. As argued in the first point, central bank transparency and a sound communication can reduce uncertainty in expectations. Less uncertainty lowers the volatility in financial markets, thereby reduces financing costs and improves 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 the 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 for the ECB is that revealing too much of their private information to the public may cause confusion. Financial markets receive more signals from the central bank and are therefore likely to overreact, as they are only able to digest a limited amount of information (Kahnemann, 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 they may have a comparative advantage in using their private signal. Thus expectations would be moved away from their fundamentals, which in turn harms the coordination of the central bank.[10]

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

[9] In 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, being not 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.

[10] However, there has been a heated debate about this model in the context of central bank transparency.

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 detailed 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 (2005) find that efforts of the ECB to support the EUR-US$ 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 (2007) report that ECB communication has only short-run effects on the EUR-US$ exchange rate. Conrad and Lamla (2007) find a significant impact of ECB communication on exchange rates highlighting the importance of news on price developments as well as the complementariness of the different communication devices.

Heinemann and Ullrich (2007) compile a wording index based on certain signal words and use it to refine an estimation of a standard Taylor type rule.[11] They conclude that the incorporation of their wording indicator can substantially meliorate the model predictions. In a similar fashion Jansen and de Haan (2009) use an ordered probit approach to test whether the communication of the ECB can be used to improve the forecast of the target rate. Indeed they provide evidence that news on the target rate as well as communication on the inflation rate improve the interest rate forecast. Also besides exchange rates, money market rates reflect, as mentioned earlier, public expectations about *future* interest rate developments, too. Rosa and Verga (2007) and Rosa and Verga (2008) show that ECB communication affects European bond markets. In a similar vein, Andersson et al. (2006) 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

Svensson (2006) comments that their finding is actually *pro* transparency since their conditions are likely to be violated. Also Gosselin et al. (2006) question the assumptions of Morris and Shin (2002). They use an extended version of their model where the central bank must anyway publish some information by setting the interest rate. In this set up, full transparency is socially optimal in many cases. In some cases, however, the central bank can distill information to either influence public expectations or to reduce the unavoidable information content of the interest rate itself.

[11] For other papers that investigate the monetary policy of the ECB using a Taylor type rule see also Belke and Polleit (2007), Garcia-Iglesias (2007), Jansen and de Haan (2009) and Moons and Van Poeck (2008).

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. Furthermore, we analyze which *kind of information* contained in the statements is particularly driving expectations and also *when*, i.e. during periods of higher or lower inflation than the target communication contains valuable news. We derive our estimation set-up from a theoretical model, which is presented below, that allows us to extract changes in expectations about future interest rates from money market rates.

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 the so-called main refinancing bid rate with a maturity of nowadays one week (repo), the pass-through of short-run to medium- and to long-run interest rates is extremely important for monetary policy.[12] 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 are the expectations markets have about future short-term interest rates. We make use of this model, which motivates the relationship between the short-term policy controlled interest rate and medium- and long-term interest rates and add an effect of the central bank's communication on financial market expectations.

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

The underlying concept of equation (1) is the so-called expectations hypothesis of the term structure.[13] 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

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

[13] Following 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.

same expected return, otherwise investors would arbitrage away any differences.[14] From equation (1) we see that the longer the maturity of an 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 $i = 1, ..., j$ 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

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

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

Taking the first difference allows to cancel out the risk premium and formulate the first difference of r as a function of a surprise (given by the expectation of the expected value of the ECB's rate prior to the meeting and the actual announced value) and the change in expectations on future *repo* rates from t to $t+1$.

$$\begin{aligned} r_{t+1}^M - r_t^M = {} & \frac{k_1}{M} \left(repo_{t+1} - E_t[repo_{t+1}] \right) \\ & + \frac{k_2 - k_1}{M} \left(E_{t+1}[repo_{t+k_1+1}] - E_t[repo_{t+k_1+1}] \right) + \dots \\ & + \frac{1}{M} \left(E_{t+1}[repo_{t+k_j+1}] - E_t[repo_t] \right) \\ & + \frac{M - k_j}{M} \left(E_{t+1}[repo_{t+k_j+1}] - E_t[repo_{t+k_j+1}] \right) \end{aligned} \tag{4}$$

Simplifying equation (4) yields the following equation

$$\Rightarrow \Delta r_{t+1}^M = c_1 \left(repo_{t+1} - E_t \left[repo_{t+1} \right] \right) + \sum_j c_{j+1} \Delta E_{t+1}[repo_{t+k_j+1}] + \varepsilon. \tag{5}$$

For our estimations, we use an event-study approach, i.e. the index t does not have a specified frequency. The subscript t denotes the day of a meeting. The changes in

[14] King 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 U.S. 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.

the rates from these days to the days after the meeting $t+1$ are included in our data set.[15] Overall our data set contains 68 meetings, the first in January 1999 and the last in December 2004. Following the derivations above the day to day change of interest rates as presented in equation (5) is a function of two distinct components. The first is the difference between the resulting repo rate set by the ECB council and the repo rate which was anticipated by market participants and hence captures the unexpected component (surprise) in the ECB's decision. The second source of news which may affect the change in expectations is mainly driven by the informational content of the introductory statements. 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.[16] 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 new information from the new level of the ECB's rate to form their expectations about future interest rates.

Hence, following equation will be tested empirically:

$$\Delta r^{M}_{t+1} = c_1(repo_{t+1} - E_t[repo_{t+1}]) + c_2 \Delta comm_t + \varepsilon. \tag{6}$$

We will estimate the change of the Euribor rates as a function of the surprise in the interest rate decision measured by the difference of the new refinancing rate and the expected refinancing rate derived from the Reuters survey of professional forecasters and the information content of the introductory statements measured by the change in our communication indicator. 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. We 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. Indeed, Rosa and Verga (2007) find that ECB communication contains more information than macroeconomic indicators. They use the difference between the policy rate and the core inflation rate, the Euro-Dollar exchange rate and, as a measure for real activity, the principal component of the European Sentiment

[15] The timing is the following: At 11.00 CET we measure the spot rate of r_t, then the decision of the Governing Council meeting at t is being announced at 13.45 CET. In the following press conference, which is always at 14.30 CET, the Press Conference is started with the Introductory statement read out by the ECB's President. On the following day at 11.00 CET we measure the spot rate of r_{t+1}, when the relevant information released on the meeting day is incorporated into the Euribor rates. Throughout the thesis all dates are reported as Central European Time (CET).

[16] That 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).

indicator, Eurogrowth and the Eurocoin indicator to control for real-time macroeconomic dynamics. Communication is still driving bond markets, also after controlling for these variables.

Another topic of interest is the effect on the slope of the yield curve. 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.[17] 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 influences 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.[18] 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 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.

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

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

[18] See, e.g. Evans and Marshall (2007). Also Bomfim (2003) formulates a two-factor model of the term structure of interest rates and shows that the shape of the U.S. 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.

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^m_{t+1} with a lower maturity $m<M$ from the left hand side of the equation.

$$\Delta r^M_{t+1} - \Delta r^m_{t+1} = b_1(repo_{t+1} - E_t[repo_{t+1}]) + \sum_{j=m}^{M} b_{j+1}\Delta E_{t+1}[repo_{t+k_j+1}] + \varepsilon. \tag{7}$$

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. It should be noted that we assume a constant term premium, similar to Beyaert and Perez-Castejon (2009). This assumption is made as these premia are not observable. Clearly, this is a caveat that we have to bear in mind when interpreting the results.

The considerations above eventuate in the following estimation equation:

$$\Delta r^M_{t+1} - \Delta r^m_{t+1} = b_0 + b_1(repo_{t+1} - E_t[repo_{t+1}]) + b_2\Delta comm_t + \varepsilon. \tag{8}$$

The left hand side of equation (8) represents the change in the slope of the yield curve between maturities m and M. Analogously to equation (6), this slope of the yield curve is a function of the unexpected change of the repo and the expected future stance of monetary policy, which can be extracted from information inherent in the communication indicator.

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 interest rates data to extract financial market expectations and reactions 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 interest rates, which are traded on the money market with maturities of one week to twelve months. These 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 the change in the Euribor data as our dependent variable with

all available monthly maturities (one to twelve months).[19] Data for the Euribor can be downloaded from www.euribor.org.

One explanatory component is the market surprise due to the unexpected change in the refinancing rate set by the ECB. This monetary policy surprise is computed by deducting the expectation of the announcement from the actual announcement value of the ECB's interest rate. The expectation is depicted by the mean of the Reuters survey of professional forecasters' expectations of the monetary policy decision. This measure is selfsame to the one used in Ehrmann and Fratzscher (2005a), who show that these survey expectations are generally unbiased and efficient. The second explanatory variable for the change in the Euribor rate is the effect of the introductory statement as measured by the change in the BHS communication indicator.

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 like Heinemann and Ullrich (2007) identify "code words" from ECB statements or publications to construct indicators for "hawkishness" in ECB statements. The advantage of such approaches 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. 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. The mechanical quantification by only counting certain expressions therefore disregards too much information relevant for our purpose. Incorporating the entire content and allow for "reading

[19] Unfortunately, the Euribor is only available for maturities up to twelve 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 be explained to a large extent 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.

between the lines" – as is done by Berger et al. (2006) – seems to be more appropriate in our case.[20]

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.[21]

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 ag. We run an analogous procedure to cancel out subjectivity of the different ratings to obtain series for ec, m and p. We call the series obtained from the aggregation of the series that quantify ag "aggregate communication indicator" or "BHS indicator" henceforth.[22] This approach allows to cancel out subjectivity to a large extent.[23] Furthermore, by using not only the information from the overall statement but also from

[20]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. 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 (2007a), as the content of these statements reflects 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.

[21]Three 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 were on purpose non-experts in the field of monetary economics, i.e. they were not biased by actual and past policy discussions in this field.

[22]To 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 becomes less important in the second half of our observation period. 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 lies between 0.95 to 0.99.

[23]Comparing 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.

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.

Our measurement of the overall communication is plotted together with the main refinancing bid rate in Figure 1. 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 might be due to the indicator's construction but might also 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

As derived in the last section we want to analyze the impact of communication by explaining the day-to-day change of the Euribor by the unexpected change of the ECB refinancing rate (measured by the difference between the Reuters survey and the actual refinancing rate) and the change of the communication indicator. We estimate equation (6) for all available maturities of the Euribor. The results are reported in Table 1. Overall, the significance of the BHS indicator in explaining day-to-day changes of medium- to long-term interest rates shows that ECB communication indeed plays a prominent role in forming expectations of market agents. Besides that, the monetary policy surprise is sizeable and highly significant at every maturity. This suggests, that both the news from deeds and from words matter for financial market participants' expectations.

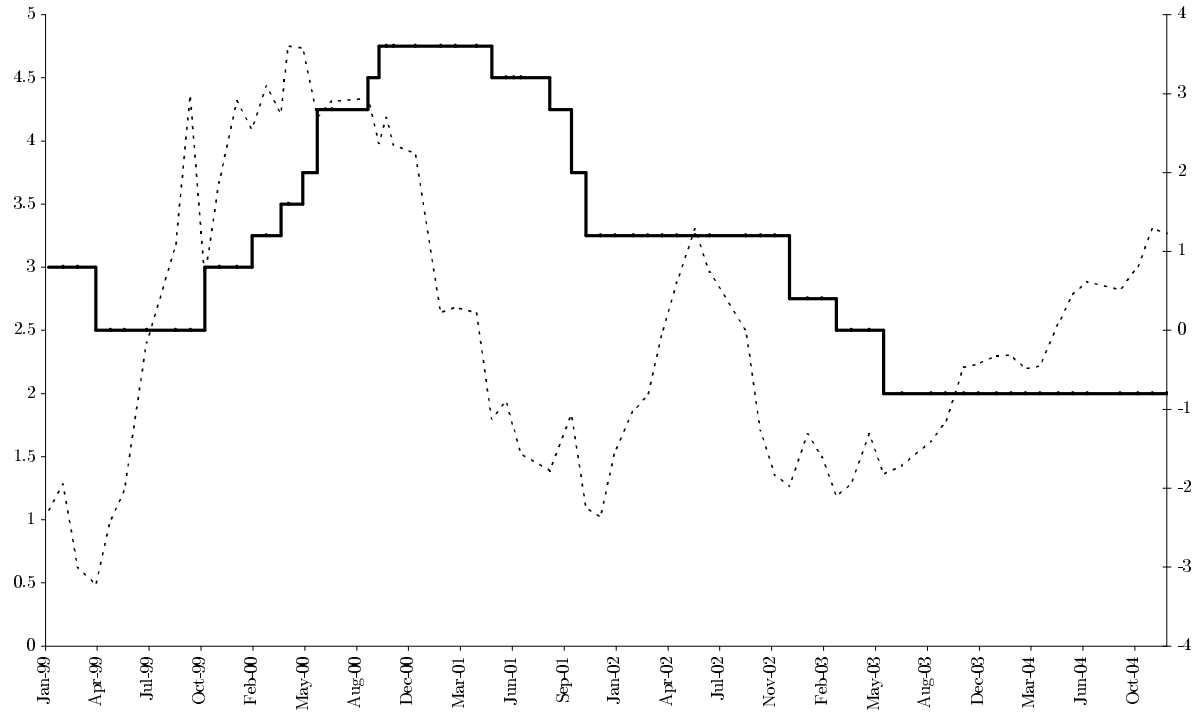
Having a closer look at the estimation results across the different maturities reveals an

Table 1: Results Impact of Communication

Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Cons	0.001	0.000	0.001	0.002	0.003	0.004	0.005	0.005	0.006	0.006	0.006	0.007
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
$\Delta comm$	-0.009	0.000	0.004	0.007	0.010	0.011*	0.013*	0.015*	0.015*	0.017**	0.018**	0.020**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)
SURP	0.541***	0.47***	0.437***	0.441***	0.436***	0.438***	0.45***	0.448***	0.452***	0.459***	0.464***	0.462***
	(0.052)	(0.050)	(0.049)	(0.048)	(0.048)	(0.053)	(0.057)	(0.061)	(0.063)	(0.065)	(0.067)	(0.070)
R-Squ.	0.682	0.611	0.549	0.562	0.549	0.505	0.485	0.447	0.432	0.426	0.420	0.405
Obs.	67	67	67	67	67	67	67	67	67	67	67	67

Note, dependent variable: Δr^M_{t+1}; Robust standard errors in parenthesis; ***/**/* denote the 1/5/10%-significance level.

Figure 1: ECB Communication Indicator and Main Refinancing Bid Rate



Left hand scale: ECB Main Refinancing Bid Rate (solid line); right hand scale: ECB Communication Indicator, weighted by principal components (dashed line); source: ECB, Berger et al. (2006) and authors calculations.

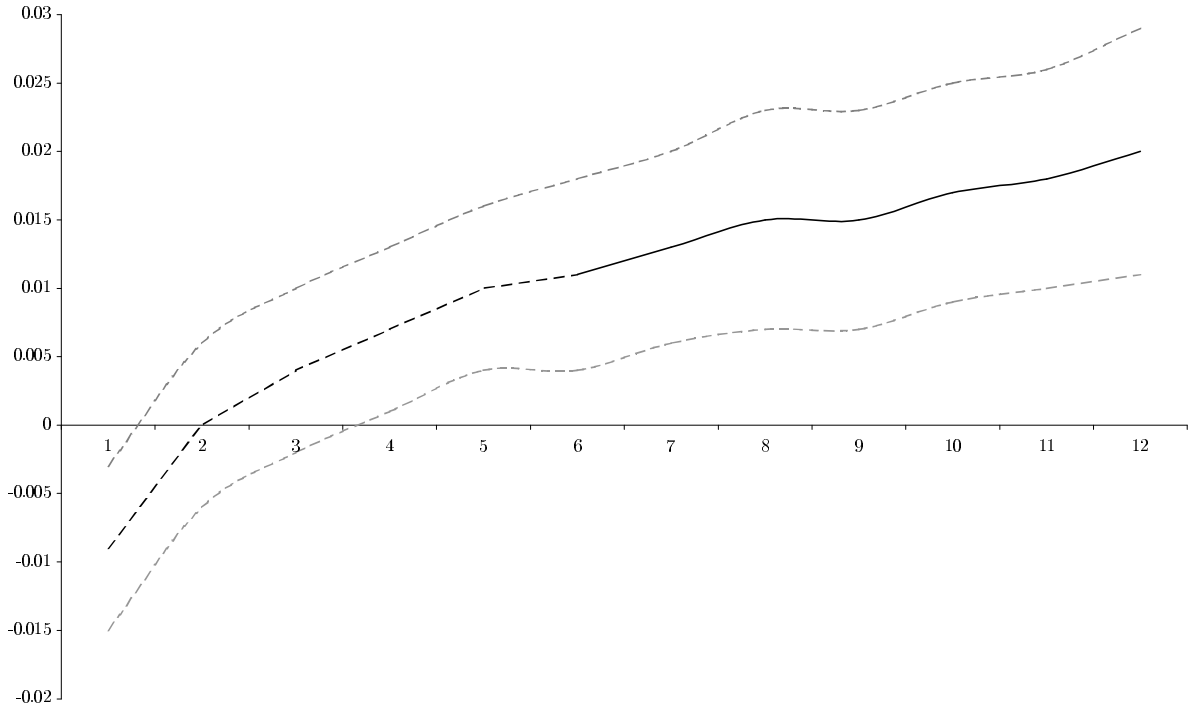
compelling picture: the BHS indicator is significant for maturities from six up to twelve months. Interestingly, Euribor rates with lower maturities are not affected by a change in the communication signal.[24] The effect of a change in our communication indicator on the Euribor rates at different maturities is plotted in Figure 2.

The figure shows that the size of the communication effect increases for maturities up to twelve months. However, the level of these impact coefficients are not statistically different from each other.[25] The overall monetary policy stance as communicated via the introductory statements of the ECB president mainly appears to affect medium- to long-term expectations on financial markets. Given that we measure the overall stance of monetary

[24]Note, we opt to control for a sizeable peak in the one month maturity series. Residuals statistics as well as the news headlines suggest a anomaly on 8 Oct. 1999. Comparing estimations —with respectively without the control— a gaugeable change appears only for the overall indicator at the one month maturity where the coefficient becomes insignificant.

[25]Estimates on the difference are reported in the following paragraph.

Figure 2: Coefficients Values at Different Maturities



X-axis: maturity, Y-axis: coefficient value, solid line: at 10% significant coefficients, dashed lines: coefficient bands one standard deviation.

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 six 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 changes of the statements rather than to the overall risks expressed in the statements.[26]

To ferret out if developments in specific areas of the economy– 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 three months to one year. In contrast, the monetary indicator is only relevant between two to seven months. The real

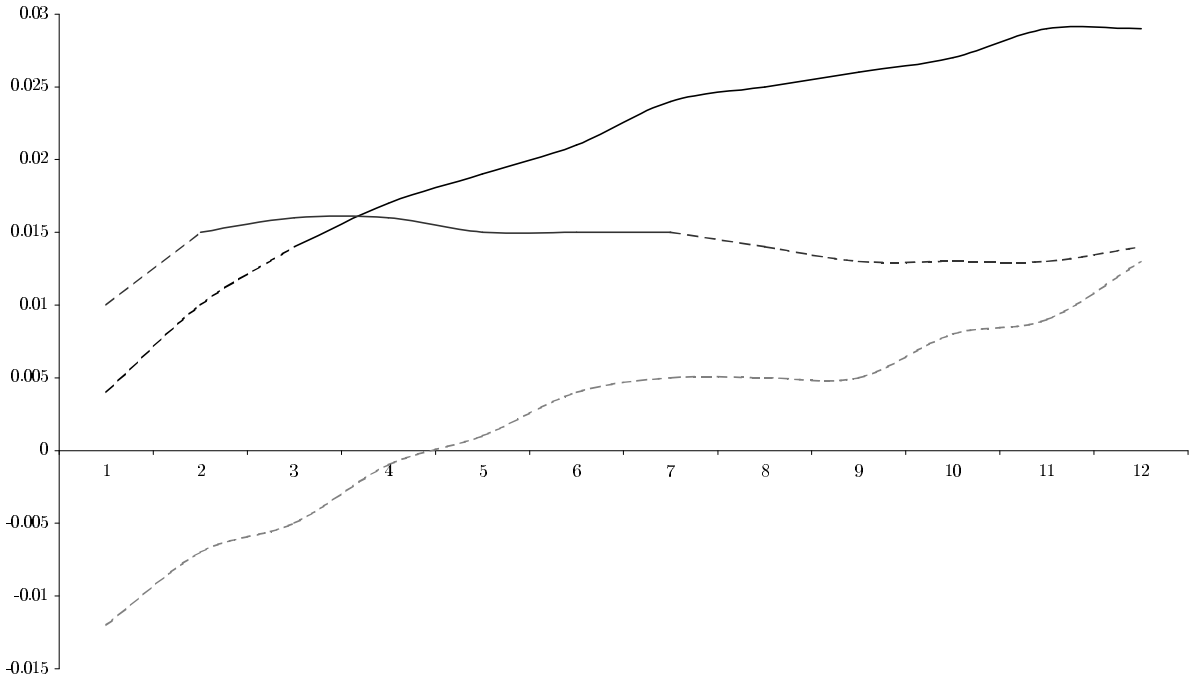
[26]This is in line with the findings of Heinemann and Ullrich (2007), who find that only the change of their wording indicator significantly improves a standard Taylor rule type.

Table 2: Results Sub-Indicators Impact of Communication

	Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Prices	Cons	0.001	0.000	0.001	0.002	0.003	0.004	0.005	0.005	0.006	0.006	0.006	0.007
		(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
	$\Delta comm$	0.004	0.01	0.014 *	0.017 **	0.019 ***	0.021 ***	0.024 ***	0.025 ***	0.026 ***	0.027 ***	0.029 ***	0.029 ***
		(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)
	SURP	0.55 ***	0.468 ***	0.429 ***	0.429 ***	0.421 ***	0.42 ***	0.43 ***	0.426 ***	0.429 ***	0.433 ***	0.437 ***	0.433 ***
		(0.052)	(0.049)	(0.047)	(0.046)	(0.047)	(0.052)	(0.055)	(0.059)	(0.062)	(0.064)	(0.066)	(0.068)
	R-Squ.	0.672	0.62	0.567	0.582	0.569	0.525	0.506	0.467	0.451	0.441	0.434	0.414
Real	Cons	0.001	0.000	0.001	0.002	0.003	0.004	0.005	0.005	0.006	0.006	0.006	0.007
		(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
	$\Delta comm$	-0.012	-0.007	-0.005	-0.001	0.001	0.004	0.005	0.005	0.005	0.008	0.009	0.013
		(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)	(0.015)
	SURP	0.548 ***	0.469 ***	0.431 ***	0.433 ***	0.426 ***	0.427 ***	0.437 ***	0.434 ***	0.437 ***	0.442 ***	0.446 ***	0.443 ***
		(0.052)	(0.050)	(0.048)	(0.048)	(0.049)	(0.054)	(0.058)	(0.062)	(0.065)	(0.067)	(0.069)	(0.071)
	R-Squ.	0.677	0.613	0.548	0.552	0.53	0.483	0.458	0.415	0.399	0.388	0.38	0.363
Money	Cons	0.001	0.000	0.000	0.002	0.003	0.004	0.005	0.005	0.005	0.006	0.006	0.007
		(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
	$\Delta comm$	0.010	0.015 **	0.016 **	0.016 **	0.015 **	0.015 *	0.015 *	0.014	0.013	0.013	0.013	0.014
		(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)
	SURP	0.550 ***	0.470 ***	0.432 ***	0.433 ***	0.425 ***	0.425 ***	0.435 ***	0.432 ***	0.435 ***	0.44 ***	0.444 ***	0.44 ***
		(0.051)	(0.048)	(0.047)	(0.046)	(0.048)	(0.052)	(0.056)	(0.061)	(0.064)	(0.066)	(0.068)	(0.071)
	R-Squ.	0.678	0.634	0.578	0.583	0.558	0.508	0.481	0.434	0.413	0.401	0.391	0.370
	Obs.	67	67	67	67	67	67	67	67	67	67	67	67

Note, dependent variable: Δr^M_{t+1}; Robust standard errors in parenthesis; ***/**/* denote the 1/5/10%-significance level.

Figure 3: Impact Sub-Indicators at Different Maturities



X-axis: maturity, Y-axis: coefficient value, dashed lines: coefficients insignificant at 10% significance level, dark line: Price indicator, dark grey line: Money indicator, light grey line: Real economy indicator.

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.[27] 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 the double size for the price indicator. Also comments on monetary developments reveal some "news" for financial markets for the medium-term of

[27]This is in line with earlier findings, that suggest that economic outlook communication generally moves financial markets only very little (Ehrmann and Fratzscher, 2005d). Similarly, Conrad and Lamla (2007) underline the importance of communication of price developments for exchange rate movements.

two to seven months ahead expectations.[28] Figure 3 additionally highlights the importance of the price component in comparison to the other sub-components of ECB statements.

These results are 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, 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.

This result is in line with very recent papers in this field. For instance Jansen and de Haan (2009) show that announcements on the ECB target rate and communication with respect to inflation can be used in an ordered probit model to improve the forecast of future interest rate changes. Using the KOF Monetary Policy Communicator Conrad and Lamla (2007) provide supporting evidence for exchange rate movements. Only forward-looking news on inflation move the EUR-$ exchange rate.

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.

Our estimates reported in Table 3 show the significance (expressed in p-values) of an effect of communication (aggregate indicator) on the *slope* of the yield curve using all permutations of proxies for the slope between one month and twelve months maturity. There is a significant different impact from communication on one to eight months compared with higher maturities. Hence, the relation between short- and medium-term interest rates alters significantly. None of the spreads between higher-than-eight 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 16 percent of the variation in the slope of the yield curve on meeting days between one months and twelve months maturity. 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

[28] Berger et al. (2006) find that the communication strategy changed during the observation period: especially the (minor) role the ECB attached to monetary developments changed. Hence, the significance of this indicator could reflect the fact that financial markets noticed the role of monetary developments only over the course of the years and thus reacted to the interpretations in the first place, but, after noticing that the monetary sector appears to play a minor role in the ECB's strategy, did not react to the monetary developments-statements afterwards.

Table 3: Difference Matrix Maturities (1-12 Months)

	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
1		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.568		0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001
3	0.465	0.255		0.015	0.008	0.012	0.009	0.011	0.014	0.008	0.013	0.014
4	0.425	0.253	0.127		0.016	0.031	0.020	0.024	0.027	0.014	0.023	0.025
5	0.414	0.255	0.151	0.146		0.133	0.041	0.043	0.048	0.023	0.037	0.039
6	0.384	0.235	0.145	0.121	0.081		0.023	0.034	0.045	0.016	0.034	0.035
7	0.358	0.228	0.156	0.134	0.124	0.140		0.104	0.110	0.026	0.064	0.062
8	0.342	0.219	0.151	0.131	0.117	0.117	0.103		0.237	0.026	0.091	0.081
9	0.334	0.217	0.154	0.137	0.127	0.126	0.115	0.099		0.011	0.086	0.080
10	0.332	0.220	0.158	0.142	0.130	0.133	0.117	0.103	0.090		0.808	0.351
11	0.326	0.216	0.154	0.139	0.128	0.126	0.107	0.093	0.072	0.060		0.204
12	0.322	0.213	0.150	0.134	0.122	0.122	0.106	0.091	0.071	0.062	0.055	

Note, upper right triangular part depicts p-values, lower left triangular part shows R-Squares.

the timing of the upcoming step which is to be conducted in a horizon of about six to twelve months ahead.

To check the consistency of our results we investigate two further issues: first, we analyze whether the impact of ECB communication has changed over time. Second, we explore whether the effect of ECB communication is different during periods when the inflation rate is above the ECB's communicated objective of close to but below two percent.

To tackle the first point we perform robust regressions: it is reasonable to assume that in the early meetings market participants had to learn how to interpret the statements of the ECB. Hence, inappropriate reactions may have occurred. Such effects may also impact our estimation results in tilting the regression line. Hence, to verify our estimation results we employ least trimmed squares (LTS) estimation with robust standard errors as introduced by Rousseeuw and Leroy (1987). This estimation technique has been proved to be extremely robust to outliers and reasonable efficient. Table 4 exhibits the estimation results. Overall, it solidifies our inferences. It remains a significant effect of communication which is largely driven by the information content of prices. Moreover, it clearly reveals, especially for short to medium maturities, the presence of outliers. It seems that those maturities are particularly volatile.

To address the second point we need to re-construct the latest information that was available to the ECB and financial markets about the real time inflation rate at the meeting day. Hence, we use the flash estimate of the HICP if this was the latest information available or the release of the final version of the HICP, respectively.[29] We then generate a

[29]Since Nov 2001 Eurostat publishes a preliminary estimate on the Euro area inflation rate of the current month on the end of that month before, approximately two weeks after the actual number is being released.

Table 4: Least Trimmed Squares (LTS) Results Impact of Communication

		1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
All	Cons	0.000	-0.001 *	0.001	0.003	0.001	0.001	0.003	0.005	0	0.001	0	-0.001
		(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
	$\Delta comm$	-0.002	0.001	0.001	0.001	0.003	0.004	0.007	0.006	0.013 *	0.015 **	0.016 *	0.021 ***
		(0.002)	(0.001)	(0.001)	(0.003)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)
	SURP	0.215 ***	0.241 ***	0.225 ***	0.184 ***	0.163 ***	0.179 ***	0.149 **	0.148 **	0.302 ***	0.305 ***	0.306 ***	0.368 ***
		(0.037)	(0.013)	(0.013)	(0.038)	(0.048)	(0.056)	(0.068)	(0.072)	(0.096)	(0.096)	(0.093)	(0.078)
	R-Squ.	0.45	0.846	0.782	0.292	0.158	0.116	0.071	0.035	0.284	0.277	0.258	0.356
	Obs.	54	45	49	55	58	59	60	62	62	62	62	63
Prices	Cons	-0.001	-0.001	0.001	0.003	0.001	-0.001	-0.003	-0.003	-0.001	-0.004	-0.001	0.001
		(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
	$\Delta comm$	0.001	0.000	0.000	0.002	0.008	0.004	0.014	0.024 **	0.025 **	0.022 **	0.027 **	0.027 **
		(0.003)	(0.002)	(0.002)	(0.004)	(0.006)	(0.007)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
	SURP	0.209 ***	0.254 ***	0.224 ***	0.196 ***	0.16 ***	0.169 ***	0.328 ***	0.351 ***	0.347 ***	0.346 ***	0.344 ***	0.347 ***
		(0.035)	(0.011)	(0.013)	(0.041)	(0.048)	(0.056)	(0.094)	(0.083)	(0.081)	(0.080)	(0.079)	(0.077)
	R-Squ.	0.478	0.868	0.781	0.272	0.167	0.147	0.439	0.455	0.42	0.427	0.38	0.340
	Obs.	52	47	49	57	59	57	59	62	63	61	63	64
Real	Cons	0.000	-0.001 *	0.001	0.004 *	0.001	0.000	0.001	0.002	-0.002	0.001	0.001	0.002
		(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
	$\Delta comm$	-0.001	0.001	0.002	0.003	0.009	0.005	0.015	0.02 *	0.018	0.021	0.023	0.025 *
		(0.004)	(0.003)	(0.002)	(0.006)	(0.006)	(0.007)	(0.010)	(0.011)	(0.013)	(0.013)	(0.014)	(0.014)
	SURP	0.218 ***	0.252 ***	0.223 ***	0.191 ***	0.198 ***	0.215 ***	0.214 ***	0.115	0.279 ***	0.278 ***	0.278 ***	0.527 ***
		(0.038)	(0.012)	(0.012)	(0.042)	(0.045)	(0.050)	(0.060)	(0.072)	(0.105)	(0.110)	(0.109)	(0.080)
	R-Squ.	0.441	0.804	0.785	0.304	0.282	0.233	0.216	0.095	0.31	0.252	0.235	0.514
	Obs.	54	49	49	56	57	56	57	60	60	62	62	63
Money	Cons	0.000	-0.001	0.001	0.003	0.002	0.001	0.005	0.005	0.005	0.005	0.006	0.002
		(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
	$\Delta comm$	0.001	-0.002	0.000	0.003	0.003	-0.004	0.004	0.003	0.001	0.001	0.003	0.003
		(0.003)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)	(0.008)	(0.008)	(0.010)	(0.011)	(0.010)	(0.012)
	SURP	0.217 ***	0.258 ***	0.224 ***	0.197 ***	0.159 ***	0.225 ***	0.143 **	0.137 **	0.495 ***	0.5 ***	0.145 *	0.46 ***
		(0.035)	(0.013)	(0.013)	(0.039)	(0.049)	(0.053)	(0.064)	(0.070)	(0.078)	(0.080)	(0.080)	(0.079)
	R-Squ.	0.441	0.824	0.781	0.275	0.122	0.217	0.037	0.02	0.515	0.495	0.009	0.436
	Obs.	54	49	49	57	60	57	62	62	65	65	62	63

Note, dependent variable: Δr^M_{t+1}; Robust standard errors in parenthesis; ***/**/* denote the 1/5/10%-significance level.

dummy variable that has the value one when real time inflation was above or equal to two percent and zero when it was below. Then we interact this dummy with the communication indicator variable. Doing this allows us to distinguish the coefficient of the indicator when inflation was below two percent from times when it was above two percent. The results are reported in Table 5. The findings reveal that it indeed matters whether inflation is above or below the target rate of two percent. If it is below, the impact of communication is higher. If it is above the impact of communication drops dramatically. However, the overall picture stays the same. As before the price indicator seems to be the most prominent topic.

The question remains why markets are reluctant to react to ECB communication in times where inflation is above the ECB's definition of price stability. One could think of two possible explanations. First, arguably the content of the statement becomes less informative. In that case, communication does not contain that much news about the future path of interest rates and the ECB might be more reluctant to give out new information in order to obviate any overreaction. A second possibility is that the ECB remains informative but financial markets do not watch central bankers' lips that closely as contemporary inflation data already contains enough relevant information. If market participant see that inflation is going to hit the relevant threshold of two percent they can infer that the ECB is most likely to step up and fight inflation back into its set limits. Probably both of these reasons are at play. Notably, while these tentative results point into an interesting relationship we should be cautious overstating the outcome. Especially as we do not specifically control for the distance to the target rate.

Finally we checked the robustness of our results with respect to the sample. The results are presented in table 6. This exercise is conducted with the aggregate communication indicator. Using the price indicator the results remain much more stable that with the aggregate indicators. As the structure of the statement changed in May 2003, putting more emphasis on real economic developments and less on the monetary analysis, we reproduce our estimates for equation (6) with only the data from Jan 1999- May 2003. As there are only 17 observations remaining for the sample from June 2003 - Dec 2004, we do not report results for the second sample, as the degrees of freedom for a reliable estimation are simply too low. Table 6 shows the results. Interestingly, the main results remain unchanged and the size of the coefficients is close to the size of the coefficients reported in the other Tables.

6 Conclusions

In this paper we investigate the importance of ECB communication for the financial market participants' expectations. We do not only test whether central bank communication affects the term structure of interest rates and thereby the shape of the yield curve but also which paragraphs of the statements contain relevant information and which maturity is affected the most. Four main conclusions arise from this study.

First, confirming previous studies, our findings suggest that central bank communication indeed has an effect on short-term interest rates.

Second, concerning the dynamics of the impact we find that the communication indi-

Table 5: Impact of Communication if HICP> 2

		1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
All	$\Delta comm$	0.005	0.015	0.018 *	0.019 **	0.02 **	0.022 **	0.022 **	0.024 **	0.024 **	0.025 **	0.026 **	0.029 **
		(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.011)	(0.012)	(0.012)	(0.013)	(0.013)	(0.014)
	SURP	0.576 ***	0.507 ***	0.47 ***	0.472 ***	0.463 ***	0.467 ***	0.477 ***	0.475 ***	0.479 ***	0.484 ***	0.489 ***	0.489 ***
		(0.053)	(0.051)	(0.050)	(0.050)	(0.051)	(0.056)	(0.060)	(0.064)	(0.067)	(0.069)	(0.071)	(0.074)
	CDHICP2	-0.025 *	-0.027 **	-0.024 **	-0.021 *	-0.018	-0.018	-0.016	-0.016	-0.016	-0.014	-0.014	-0.016
		(0.013)	(0.013)	(0.012)	(0.012)	(0.013)	(0.014)	(0.015)	(0.016)	(0.017)	(0.017)	(0.018)	(0.018)
	R-Squ.	0.7	0.637	0.574	0.579	0.559	0.512	0.486	0.447	0.431	0.422	0.416	0.400
Prices	$\Delta comm$	0.012	0.027 *	0.031 **	0.036 ***	0.038 ***	0.045 ***	0.047 ***	0.049 ***	0.051 ***	0.054 ***	0.057 ***	0.061 ***
		(0.016)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)	(0.016)	(0.017)	(0.018)	(0.019)	(0.019)	(0.020)
	SURP	0.558 ***	0.484 ***	0.446 ***	0.448 ***	0.439 ***	0.444 ***	0.453 ***	0.45 ***	0.454 ***	0.459 ***	0.465 ***	0.464 ***
		(0.054)	(0.050)	(0.048)	(0.047)	(0.048)	(0.052)	(0.056)	(0.060)	(0.063)	(0.065)	(0.067)	(0.069)
	CDHICP2	-0.013	-0.025	-0.027	-0.029 *	-0.028	-0.036 *	-0.035 *	-0.036 *	-0.038 *	-0.04 *	-0.043 *	-0.048 *
		(0.019)	(0.018)	(0.017)	(0.017)	(0.017)	(0.019)	(0.020)	(0.022)	(0.023)	(0.023)	(0.024)	(0.025)
	R-Squ.	0.669	0.625	0.575	0.594	0.58	0.545	0.521	0.482	0.466	0.459	0.454	0.438
Real	$\Delta comm$	0.003	0.01	0.015	0.017	0.02	0.029	0.029	0.031	0.031	0.035	0.036	0.043 *
		(0.018)	(0.017)	(0.016)	(0.016)	(0.017)	(0.018)	(0.020)	(0.021)	(0.022)	(0.023)	(0.023)	(0.024)
	SURP	0.561 ***	0.484 ***	0.449 ***	0.45 ***	0.443 ***	0.449 ***	0.459 ***	0.457 ***	0.46 ***	0.466 ***	0.471 ***	0.47 ***
		(0.053)	(0.051)	(0.049)	(0.049)	(0.050)	(0.055)	(0.059)	(0.063)	(0.066)	(0.068)	(0.070)	(0.073)
	CDHICP2	-0.024	-0.027	-0.033	-0.03	-0.031	-0.041 *	-0.041	-0.043	-0.043	-0.045	-0.046	-0.051
		(0.023)	(0.022)	(0.022)	(0.021)	(0.022)	(0.024)	(0.026)	(0.028)	(0.029)	(0.030)	(0.031)	(0.032)
	R-Squ.	0.677	0.616	0.558	0.559	0.538	0.498	0.472	0.428	0.411	0.4	0.392	0.378
Money	$\Delta comm$	0.02 *	0.033 ***	0.035 ***	0.037 ***	0.036 ***	0.04 ***	0.04 ***	0.041 ***	0.041 ***	0.043 ***	0.045 ***	0.047 ***
		(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)	(0.015)	(0.016)
	SURP	0.565 ***	0.493 ***	0.457 ***	0.461 ***	0.453 ***	0.457 ***	0.469 ***	0.467 ***	0.473 ***	0.479 ***	0.485 ***	0.484 ***
		(0.053)	(0.048)	(0.046)	(0.045)	(0.047)	(0.051)	(0.055)	(0.060)	(0.062)	(0.065)	(0.067)	(0.069)
	CDHICP2	-0.02	-0.032 **	-0.035 ***	-0.039 ***	-0.04 ***	-0.045 ***	-0.046 ***	-0.049 ***	-0.052 ***	-0.055 ***	-0.058 ***	-0.062 ***
		(0.017)	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.018)	(0.019)	(0.020)	(0.021)	(0.021)	(0.022)
	R-Squ.	0.681	0.652	0.607	0.621	0.598	0.555	0.526	0.481	0.464	0.454	0.449	0.434
	Obs.	67	67	67	67	67	67	67	67	67	67	67	67

Note, dependent variable: Δr^M_{t+1}; Robust standard errors in parenthesis; ***/**/* denote the 1/5/10%-significance level.

Table 6: Results Sample Splits

Maturity	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Jan 1999 - May 2003												
Constant	0	-0.001	0	0.001	0.002	0.004	0.006	0.007	0.007	0.007	0.008	0.009
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
$\Delta comm$	-0.01	0	0.004	0.008	0.01	0.012	0.014 *	0.016 *	0.016 *	0.018 *	0.019 **	0.021 **
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
SURP	0.548 ***	0.476 ***	0.442 ***	0.445 ***	0.438 ***	0.437 ***	0.447 ***	0.443 ***	0.447 ***	0.453 ***	0.458 ***	0.455 ***
	(0.060)	(0.059)	(0.056)	(0.054)	(0.054)	(0.059)	(0.063)	(0.067)	(0.069)	(0.071)	(0.073)	(0.075)
R-Squ.	0.683	0.61	0.556	0.576	0.566	0.52	0.5	0.465	0.453	0.448	0.447	0.433049
Obs.	50	50	50	50	50	50	50	50	50	50	50	50

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

cator has significant explanatory power for the day to day change in interest rates with maturities from four to twelve months. Hence, we conclude that financial market agents expect the ECB to prepare them for upcoming changes in interest rates at least four 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 four months and the latest within the coming twelve months, which is a range of eight to nine months.

Third, evaluating the impact of the contents of the statements by topic, 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 and the monetary aggregates seems to be mostly expected or not of concern for financial market agents. This reveals that the ECB's interpretation about current and expectations about future price developments are unforeseeable and important for financial market agents and therefore affects asset prices via changes in financial market expectations. This is not the case for the interpretation and expectation about real economic developments and variances of monetary aggregates. Hence, the topic of communication is of major importance for analyzing the effect of ECB wording.

Finally, we can conclude that 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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