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Do ECB's statements steer short-term and long-term interest rates in the euro zone?

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Abstract

In this paper, we aim at testing whether press conferences held after the meeting of the ECB's monetary policy council steer market short- and long-term interest rates in the euro zone. To meet this goal, we "codify" the statements according to whether they are neutral, hawkish, or dovish. We show, using a principal components analysis of euro-zone (short- and long-term) interest rates that the euro-zone's market rates react significantly to the bias in statements, and more particularly to changes in statements from one meeting to the next. If we study separately the reaction of short- and long-term interest rates to changes in statements, the short end of the yield curve reacts more sharply to statements than the long segment. We show that the effect of statements peaks on interest rates with a maturity of six or twelve months and is smaller for the longer maturities. Using non-parametric tests confirms our previous results.

JEL classification : E58, E52, E43
Keywords : Communication, Transparency, Monetary Policy, European Central Bank.

Résumé

Ce papier a pour objectif d'évaluer si les conférences de presse tenues à l'issue du conseil de politique monétaire de la Banque Centrale Européenne orientent les taux d'intérêt du marché en zone euro. Pour cela, nous "codons" les discours suivant l'information qu'ils contiennent concernant l'évolution future du taux directeur de la BCE : discours neutre, "dur" (*hawkish*) ou accommodant (*dovish*). Nous montrons que les taux d'intérêt réagissent significativement à la tonalité du discours, et plus particulièrement à l'évolution du discours d'un conseil de politique monétaire à l'autre. En outre, la partie courte de la courbe des taux réagit plus fortement aux discours que la partie longue : nous trouvons en effet que l'impact des discours est maximal sur les taux de maturité six et douze mois.

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1 Introduction

An extensive stream of the literature has measured the impact of monetary policy decisions on the yield curve. Nevertheless, the way those studies are conducted has evolved a lot in the last decade in a context of enhanced transparency of central banks. In order to highlight the importance of this topic, we have to recall that central banks can directly affect only one short-term interest rate through their monetary policy instruments. However, consumption and investment decisions are to a large extent influenced by longer-term yields, such as mortgage rates and corporate bond rates, and on the prices of long-lived assets, such as housing and equities. This is where assessing the impact of monetary policy decisions on the yield curve is important. Now, we will detail the evolution on those studies in the last years.

The first paper to assess markets' reaction to monetary policy actions is Cook & Hahn (1989), who examined the one-day response in the United States of bond rates to changes in the target Fed funds rate from 1974 through 1979. Their procedure was to regress the change in the bill, note and bond rates on the change in the target Fed funds rate. Their sample consists only of the days in which the Fed changed the Fed Funds target rate. The response to target rate increases was positive and significant at all maturities, but smaller at the long end of the yield curve : a one percentage point increase in the Fed funds target led to an increase of fifty-five basis points in the three-month T-bill rate, but only a ten basis point increase in the 30-year bond yield. Results for more recent periods show a much weaker relationship between target rate changes and other interest rates. For example, in applying the Cook and Hahn event-study approach to the 1987-1995 period, Roley & Sellon (1995) found that the bond rate rose a statistically insignificant four basis points for each percentage point change in the target funds rate. Similarly weak results for the 1989-1992 period were obtained by Radecki & Reinhart (1994). Therefore, can we account for the apparent deterioration of the relationship between target rate changes and market interest rates in the 1990s ? Actually, in recent years, the general move in central banks to enhance their transparency has had as a consequence to improve substantially the predictability of monetary policy decisions. Thus, target rate changes have been more widely anticipated in recent years, and this squares with the Roley and Sellon (1995) observation that interest rates rose somewhat in advance of target rate increases. Bond prices set in forward-looking markets should respond only to the surprise element of monetary policy actions, and not to anticipated movements in the funds rate. That's why Kuttner (2001)

has perfected the approach of Cook et Hahn, using the Fed Funds Futures to identify the expected and the unexpected component of the monetary policy decision. Once identified, it estimates the response of market rates to the anticipated and unanticipated changes in the Fed funds target, and documents the much stronger relationship between market rates and unexpected changes in the funds rate target.

At the same time, several papers document the extent to which U.S. monetary policy has become increasingly open and transparent and how these moves toward greater openness and transparency had increased the ability of markets to anticipate policy actions. Thus, Poole & Rasche (2000) and Poole, Rasche & Thornton (2002) investigate the extent to which market participants anticipate Federal Reserve policy actions. Their most important finding is that not only is the market better able to anticipate funds rate target changes, but it appears that the market is able to anticipate such changes further in advance. In more recent papers, Lange, Sack & Whitesell (2003) and Swanson (2004) conclude that a higher degree of transparency of the Fed is connected with a higher degree of predictability. In the euro area, Perez-Quiros & Sicilia (2002) find that market interest rates have predicted euro area interest rates comparatively well up to three months in advance. According to their approach, over the period between 4 January 1999 and 6 June 2002, which included 78 meetings of the Governing Council of the ECB, the market correctly anticipated 94% of the decisions. Moreover, Bernoth & von Hagen (2004) who analyze the impact of ECB monetary policy decisions on the volatility of the Euribor futures rates, conclude that the policy decisions of the ECB have been on average predictable and by and large the communication strategy with the market has worked surprisingly well for a relatively new institution. These authors demonstrate that, since May 2001, markets were not surprised by the decisions on the rates of the ECB[1].

Transparency of monetary policy allows financial markets to better anticipate the measures being implemented by the central bank. As a result, the response of interest rates to the publication of macroeconomic data depends on the degree of transparency in the conduct of monetary policy. When financial markets properly understand the factors that affect inflation, how the central bank evaluates them and the steps it will likely take to deal with them, interest rates should instantly adjust to the information provided by new

[1]In this regard, the decision of the Governing Council of the ECB in November 2001 to switch from bimonthly to monthly discussion of monetary policy may have affected the predictability of the ECB, as the timing of its interest changes can be anticipated more easily by the market.

macroeconomic data. The theory of efficient markets predicts that the prices of financial instruments will always reflect all available information. If markets are efficient, interest rates should adjust virtually instantaneously after the release of data that modify financial markets' expectations concerning monetary policy. Transparency thus cause financial markets to adjust their interest rate expectations as soon as macroeconomic data are published, in advance of any action by the central bank. In this vein, Haldane & Read (2000) show that a reduction in the markets' uncertainty about the central bank's reaction function implies that market prices will react less to monetary policy changes since market participants are better able to anticipate them. This implies that the markets' better knowledge of the central bank's reaction function causes the markets to react more fully to news about the state of the economy, in particular macroeconomic data releases on which the reaction function is (in part) conditioned. Consequently, markets react to macroeconomic announcements they view as important arguments to the monetary policy reaction function and, moreover, react more strongly to those unanticipated data releases that have greater impact on potential future monetary policy. Thus, in a world where the central bank's reaction function was known to the market participants with certainty, one would in principle observe no financial asset price reactions at the time of monetary policy changes, but significant reactions to the release of surprise macroeconomic data that occur before the monetary policy action date.

Insofar as monetary policy decisions are now largely predictable and consequently well expected, one can wonder what role is played by central banks in the implementation of monetary policy if the financial markets are themselves able to digest and factor in new information into interest rates. Have central banks the possibility to make monetary policy more effective ? Transparency helps financial markets better anticipate monetary policy decisions and thus cause financial markets to adjust their interest rate very quickly and well before the meeting of monetary policy. However, can central banks go beyond in moving asset prices in the desired direction ? The recent behavior of long rates highlight the importance of communication as a tool of monetary policy from the role played by Fed's statements on the day of the FOMC meeting. "*It's not what they do, it's what they say*": this was the sort of thing one could read in 2004[2]. Thus, the statement that followed the 28 January 2004 meeting led to "record" reactions in the Treasuries market: two- and five-year interest rates rose 21 and 25 bp, respectively, in the half hour that followed the

[2]Statements reported by Bernanke (2004b).

announcement. This excessive reaction was triggered by what the Fed had said, and not by what it had done: indeed, the decision to leave interest rates unchanged was perfectly expected by the financial markets, but the FOMC's decision to delete the sentence "*policy accommodation can be maintained for a considerable period*" and replace it by "*the Committee believes it can be patient in removing its policy accommodation*" was interpreted by the financial markets as a signal that the Fed was going to tighten its monetary policy faster than what had been previously anticipated. This is why we need to study the impact of statements in addition to the monetary policy decision to explain asset prices' reactions.

In this paper, we aim at testing whether the statement made during the press conference that follows the announcement of the ECB's decision about the key intervention rate, for its part, has an impact on interest rates. To do so, we are going to look whether the tone of the ECB's statement (which we are going to codify) or the change in the tone from the previous statement explains changes in the euro zone's short- and long-term interest rates. Before proceeding to this empirical studies, we explain in the following section, why central bank communication is so important and, by guiding market expectations, helps to make monetary policy more effective. Then, we briefly review, in section 3, empirical studies on central bank communication. Section 4 then discusses the issue of how to measure communication. This is followed by our empirical analysis of the effectiveness of ECB statements in influencing euro-zone interest rates in the desired way in section 5. Section 6 concludes.

2 Communication and effectiveness of monetary policy : the role of monetary policy expectations

In this section, we underline the usefulness of central bank communication as a mean of informing the policy expectations of financial markets, and *in fine* making monetary policy more effective. We already mentioned that the ECB directly affects only one very short-term whereas most private-sector borrowing and investment decisions depend on longer-term rates. So, what is the link between short-term interest rate (controlled by the central bank) and longer-term rates, such as Treasury bond yields ? The earlier studies quoted in the introduction find a positive relationship between target rate changes and other interest rates. In other words, a tightening of monetary policy is generally followed by an increase of long-term rates whereas an easing of monetary policy is followed by a decrease of interest

rates. However, the link between long-term rates and the policy rate of the central bank can be quite loose at times [3]. For example, in the United States, although the FOMC has raised its target for the federal funds rate by 75 basis points in its three meetings sine June 2004, the yield on ten-year Treasury securities has fallen by almost the same amount during that period. Can we account for this unusual recent movement in long-term yields ?

Basic financial theory implies that a link does exist between short-term interest rates and longer-term rates. The connection between the official policy rate and long term interest rates operates less through the current values of the policy rate, however than through the interest-rate actions that the central bank is expected to take in the future. Consequently, expectations about monetary policy are at least as important as the current level of short-term interest rates in terms of determining long-term interest rates (theory of expectations). So, with risk and term premiums held constant, long-term yields move closely with the expectations that financial market hold about the future evolution of the policy rate. For example, if short-term interest rates are expected to be high on average over the relevant period, then long term rates will tend to be high as well. Likewise, if futures short-term interest rates are expected to be low on average, then long-term rates will tend to be low.

Finally, the level of short-term policy rate provides at best only partial information about the overall tightness or ease of monetary conditions. What matters especially in the determination of the long rates are the private-sector expectations of the future policy actions. But how are expectations about the future path of the policy rate formed ? We understand here the role played by the communication of the central bank. Indeed, thanks to its communication, the central bank is going to be able to give its interpretation as for the evolution of the economic activity (growth, inflation) allowing financial markets to form expectations about the future policy rate. So, the more the central bank provides information about its way to forecast the evolution of the inflation, or of real activity, the more expectations of financial markets and central bank will tend to converge and finally, the more the central bank will influence long-term rates[4].

Several Fed governors' interventions, such as Bernanke (2004a), Bernanke (2004b) or Kohn

[3] Bernanke (2004b).

[4] Naturally, we can add that markets will take into account the information provided by the central bank only if this latter benefits from certain credibility on markets.

(2005) emphasize the role of central banks communication, insofar as communication leads to a better effectiveness of the monetary policy[5]. For Bernanke, it is of utmost importance that central banks reveal a maximum of information to markets concerning their own forecast for future economic outlook, growth and inflation and even target of long-term inflation, in order to improve the long-run predictability of monetary policy[6]. Before turning to our analysis, we briefly review, in section 3, empirical papers related to the communication of central banks.

3 Literature on central bank communication : empirical studies

The empirical papers aiming at estimating the effect of central banks communication on asset prices (yield curve, equity prices, exchange rates) are recent and are mainly focused on Fed speeches. However, references related to theoretical models estimating the impact of communication are older and numerous. Our objective here is not to supply an exhaustive list of all these papers[7]. Theoretical papers dealing with central banks communication, and more generally with central banks transparency do not provide a well-defined answer: indeed, according to the transparency dimension considered (on the economic model, on forecasts, on preferences of the central bank...) and according to the way of modelling the economy (neoclassic *versus* neokeynesian Phillips' curve) conclusion diverges.

Concerning empirical work on central bank communication, the literature is still quite small, partly reflecting the difficulty of measuring it and partly due to the relatively recent adoption of transparency as a major characteristic of central bank policy. Here we focus on the impact of central banks communication on the yield curve. Nevertheless, some papers

[5]Some theoretical papers (Amato, Morris & Shin (2002) and Morris & Shin (2002)) conclude on the contrary that too much public information (that is information provided by the central bank) is detrimental to welfare. Specifically, the greater the precision of the agents' private information, the more likely it is that increased provision of public information lowers social welfare. The detrimental effect of public information arises from the fact that agents overreact to public information, placing too much weight on the public signal relative to weights that would be used by the social planner (here the central bank).

[6]Bernanke (2004a) distinguishes between short-run and long-run predictability of policy. Short-run predictability for Bernanke focuses on monetary policy actions over short horizons whereas long-run predictability focuses on the ability of the public to forecast policies at long horizons.

[7]We can refer to surveys on the transparency : the most recent is Carpenter (2004), other surveys are those of Geraats (2002), and Hahn (2002).

analyze the effect of communication on exchange rates : Jansen & de Haan (2003) find some effect from ECB statements on the volatility of the euro and Fratzscher (2004) finds more systematic evidence in favor of effectiveness for the three G3 monetary authorities in changing the level and volatility in the desired direction.

Other papers study the market reaction to speeches of central banks. The first article to analyze the effect of Fed communication on market rates is Kohn & Sack (2003). These authors use daily data and show that when Fed holds a speech (statements which can be three types of communication : statements by the FOMC Chairman Greenspan on the day of the FOMC meeting, testimonies and other speeches of Greenspan), then market rates variance (which corresponds to the volatility of the error term in regressions) is much stronger. This suggests that financial markets react to statements delivered by the Fed. Furthermore, Kohn and Sack distinguish two types of statements, one referring to the monetary policy inclination and the second one to the economic outlook. These authors conclude that statements by Greenspan about the monetary policy inclination has a significant effect on the volatility of short-term interest rates while statements about the economic outlook tend to have a significant impact on longer maturities. In the same vein, Bernanke, Reinhart & Sack (2004) and Gürkaynak, Sack & Swanson (2004) find that US financial markets attribute considerable importance to statements that include an indication about the future path of policy.

Ehrmann & Fratzscher (2004) analyze the communication strategies and assess their effectiveness for three central banks : the Fed, the Bank of England and the ECB. They focus on forward-looking policy statements (speeches, interviews and testimonies)delivered by all policy-makers (not only central bank's governor) distinguishing communication on meeting days from inter-meeting statements. Following the terminology also used by Kohn & Sack (2003), these authors decided to keep the categorization as simple as possible. They conclude that US markets react significantly stronger to statements by Greenspan and less to statements by other FOMC members, whereas euro area markets respond to communication by the ECB President and other Governing council members to a very similar extent. Finally, they find that US markets react to statements both about monetary policy inclination and the economic outlook, whereas UK and euro area markets respond mostly only to communication about monetary policy[8].

[8]This difference likely reflects, according to Ehrmann and Fratzscher, the different market perceptions of policy reaction functions.

4 Measuring communication : how do we "codify" the statements made at the ECB's press conferences ?

In this section, we turn to the issue of how to measure communication. We have already underlined that the literature concerning empirical work on central bank communication is quite small, reelecting the difficulty of measuring it. Our objective is to test whether the statement made during the press conference that follows the announcement of the ECB's decision about the official policy rate, has an impact on euro-zone short-term and long-term interest rates. To do so, we are going to look whether the tone of the ECB's statement (which we are going to codify) or the change in the tone from the previous statement explains changes in the euro zone's short- and long-term interest rates. Our study, which bears on the euro zone, therefore is based on the following hypothesis : we suppose here that the monetary policy decision is widely expected by the markets, and consequently the relevant short- and long-term interest rates do not react to the ECB's announcement about interest rates. This hypothesis is largely consistent with studies quoted in the introduction [9] who conclude that monetary policy decisions of the ECB have been on average predictable. In other words, markets were not surprised by the decisions on the rates of the ECB (in particular since May 2001).

Contrary to Kohn & Sack (2003) and Ehrmann & Fratzscher (2004) who distinguish between *monetary policy inclination* statements and *economic outlook* statements, we have codified all the statement made at press conferences from 1999 to October 2004 (*i.e.* a statement per month generally speaking) by drawing a distinction between statements with a "hawkish" (that is, statements that seemed to indicate that future policies might involve higher rates than previously thought), "very hawkish", "neutral", "dovish" or "very dovish" tone. A variable we call *statement code* variable thus takes the values + 2, + 1, 0, - 1 and - 2 according to the tone of the statement (Table 1). A study of Gerlach (2004) is based on the same codifying principle applied to the editorial of the ECB monthly bulletin. However, unlike our *statement code* variable that summarizes all the information into a single value, Gerlach allocates a different value to three dimensions : inflation, real activity and M3[10].

[9] Perez-Quiros & Sicilia (2002), Bernoth & von Hagen (2004) and lately Ehrmann & Fratzscher (2004).

[10] We compared our codification of statements with that carried of Gerlach (2004). We take the sum of the ratings set by Gerlach or calculate a weighted average (with larger weight for "activity" and "inflation" ratings, *i.e.* 40% than for the rating relative to M3, *i.e.* 20%). We conclude that our assessment of ECB

At each press conference, the ECB discusses the prospects with respect to how prices will

	Value taken by the statement code variable
Very hawkish	+ 2
Hawkish	+ 1
Neutral	0
Dovish	- 1
Very dovish	- 2

Table 1: Codes reflecting the tone of the statements

trend in the medium term (as its main objective is medium-term price stability) via several dimensions : it analyzes and directly anticipates trends in consumer prices (moves in energy prices, prices of food goods, wages, etc.) but also in real activity (insofar as robust growth can go hand in hand, in the long term, with inflationary pressures) and in the money supply via growth in monetary aggregate M3. In its statement, the ECB therefore presents its inflation and growth scenarii, as well as the implicit (upside or downside) risks for its central scenarii. It is by drawing on these scenarii and associated risks that we ascribe a "rating" to the statement (for example, a scenario of growth equal to its potential with upside risks and a rise in inflation and with also upside risks in the medium term will be deemed very hawkish). The codification stems from our interpretation of the ECB's statements, it is therefore subjective by definition.

A noteworthy point is that the structure of the press conference changed from May 2003 onwards. From 1999 to April 2003, risks weighing on medium-term price stability were analyzed by drawing on the two pillars (pillar one : trends in M3 and pillar two : a collection of indicators having an impact on prices). Subsequently, from May 2003 onwards, the two pillars were replaced by economic analysis and monetary analysis. This does not modify, however, our codifying work. The codification we obtain is presented in Appendix 1 (Table 3). In this study, we have drawn on the records of press conferences found on the ECB's web site. We can see that no press conference is held in August. Furthermore, two press conferences were held in March and October 2000, and this explains why there were thirteen press conferences in 2000 instead of eleven in the other years.

statements is quite similar to the one drawn upon by Gerlach, especially when we look at the weighted average of his ratings. The only major difference concerns 2004, when ECB statements where relatively hawkish in our opinion, while he deems them to have been neutral.

Note that the tone of ECB statements (Appendix 1, Table 2) is more often hawkish than accommodating even though in four out of the six years of observation, growth in the euro zone was lower than its potential growth rate (for the ECB, potential growth is close to 2-2.25%). Simultaneously, the inflation target has exceeded 2% every year except in 1999 (and inflation is the objective of the ECB's monetary policy).

5 Results : market reactions to ECB communication

We now turn to the question whether ECB statements influence financial markets by moving market interest rates. We aim at testing whether moves in short- and long-term interest rates between the day of the ECB's meeting and the day before the meeting, are related to the tone of the statement : hawkish, very hawkish, neutral, dovish or very dovish. The studies conducted in the United States and reviewed in our introduction use intraday data and, therefore, assess the impact of the Fed's statement in the minutes just after the statement[11]. We use daily data since our objective is to test whether the statements have a durable impact on interest rates. It is normal that the markets should react to a macroeconomic figure or a statement : consequently, asset prices move in the wake of announcements. However, what we would like to ascertain, is whether the initial reaction lasts a few hours and is always factored into interest rates at the end of the day. To do so, we calculate, for each interest rate we consider, the difference between the interest rate on the day of the monetary policy council meeting and the interest rate on the day before the Governing Council meets (closing price). This ascertains the impact of the ECB meeting on interest rates. For each ECB meeting (66 were held between January 1999 and October 2004) and for each interest rate we consider, we calculate the difference between the interest rate the day of the Governing council meeting and the day before the meeting.

What euro-zone interest rates do we consider? We want to analyze the impact of the ECB's statements on the euro-zone's short- and long-term interest rates. We have therefore chosen to focus on several money market rates, in other words the 1-month Euribor, 3-month Euribor, 6-month Euribor and 12-month Euribor spot rates . With respect to long-term interest rates for the euro zone, we draw on German contracts (which are the benchmark of the euro-zone yield curve), 2-year (Schatz), 5-year (Bobl) and 10-year (Bund) rates. The interest of working on contracts (for the long segment) rather than spot rates lies in the fact that, generally speaking, futures are far more reactive (and thus factor in

[11] Only Kohn & Sack (2003) use daily data.

any additional information far faster)[12]. We propose two methodologies : first, the commonly used dummy variable regression approach in the event-study literature. And then, we perform non-parametric tests in order to test the robustness of our previous results.

5.1 A dummy variable regression approach

In the event-study literature, authors generally regress the change in asset prices on the change of official policy rate. The sample consists only on days of central banks' meetings.

$$\Delta\ R_t = \ \alpha + \beta\ \Delta\ k_t + \varepsilon_t \tag{1}$$

where $\Delta\ R_t$ stands for the change in asset prices and $\Delta\ k_t$ stands for the change in monetary policy rate.

In the introduction of this paper, we mentioned the evolution of the way those event-studies are conducted. Thus, Cook & Hahn (1989), $\Delta\ k_t$ stands for the change in the Fed Funds target rate. Then, in Kuttner (2001) , $\Delta\ k_t$ stands for the monetary policy surprise, *i.e.* the unexpected component of the monetary policy decision. Finally, in a context of enhanced transparency of central banks, as long as monetary policy decisions are perfectly expected, a surprise on the day of the monetary policy meeting is no longer provided by the decision about intervention rates. Consequently, $\Delta\ k_t$ tends to be null. This is why we need to study, on days of policy meetings, the effect of statements to explain the reactions of interest rates. We propose to estimate now the following equation :

$$\Delta\ R_t = \ \alpha + \beta\ D_{ECB} + \varepsilon_t \tag{2}$$

where D_{ECB} stands for our *statement code* variable.

We carry out a Principal Component Analysis on the series of changes in interest rates (centered and reduced daily differences for 1M-Euribor, 3M-Euribor, 6M-Euribor, 12M-Euribor, Schatz, Bobl and Bund) to obtain "summarized" information about general moves in interest rates around the date of the statement. PCA consists in projecting the n daily changes in the interest rates we consider (euro-zone short- and long-term interest rates) on the basis of n vectors (orthogonal with one another). Centering and reducing data prevent the more volatile series from "crushing" the estimate. Furthermore, this enables us to interpret the relative weight of each interest rate in the axes derived from our PCA (via the correlations).

[12]For futures contracts, we use the continuous series calculated by Datastream that interpolates, according to their volume, the two closest contracts.

5.1.1 Interest rates react far more to the change in the tone from one statement to the next than to the statement in absolute terms

Initially, we carry out a PCA on all interest rates (short- and long-term interest rates), then we subsequently carry out a PCA on short-term interest rates exclusively and then long-term interest rates. When we carry out the PCA of changes in short- and long-term interest rates, we obtain a first factor that explains 52% of the variance of all the changes in short- and long-term interest rates. This factor is well linked to all the changes in short- and long-term interest rates : the correlations range between 0.30 and 0.37 which means that the series are weighted in a virtually identical manner in this first factor. Consequently, this first factor satisfactorily represents the common moves in short- and long-term interest rates in the euro zone.

We now estimate via Ordinary Least Squares (OLS) the relationship between the first factor derived from our PCA and our variable that codifies the statement between -2 and +2. We call this latter variable *statement code* variable and we note it D_{ECB}. The estimation obtained is presented in appendix 2 (table 4)[13]. We can see from this estimation that our codification variable is significant : the ECB's statements therefore do have an impact on the euro-zone's short- and long-term interest rates as they result from the main component. Regarding the sign of the coefficient of our *statement code* variable, it is positive, and this clearly means that when the statements are hawkish (codes +1 or +2), short- and long-term interest rates tend to rise and, vice-versa, when the statements are dovish (codes -1 or -2), interest rates tend to decrease. Conversely, the explanatory power is relatively low. We then seek to improve the estimate by proposing a variant of our variable that codifies ECB statements : we build a new variable that reflects changes in the ECB statement's tone in comparison with the tone of the previous month.

The new variable of *statement code* is introduced in our equation :

$$\Delta\ R_t = \ \alpha + \beta\ \Delta\ D_{ECB} + \varepsilon_t \tag{3}$$

where $\Delta\ D_{BCE}$ stands for the change in the ECB's statement in comparison with the statement of the previous month.

[13]Note that the value of the coefficient of the *code statement* variable cannot be interpretable economically since we have used changes in short-term interest rates but also from the opposites of changes in prices of contracts on long-term interest rates, bearing in mind that all data are centered and reduced.

The estimation is presented in appendix 2, table 5. Now, the correlation between the first axis derived from the PCA and the change in the tone of the statement between two ECB meetings appears clearly. Our *statement code* variable in difference is far more significant and this variable allows us to explain far better our main component of short-term interest rates and long-term interest rates. The coefficient of the variable remains positive : thus, if the statement becomes more hawkish, euro interest rates tend to rise and, vice-versa, if the statement moves from hawkish to neutral, or from neutral to dovish, interest rates will then trend downwards. The markets do not react so much to the statement in absolute terms as to changes in the statement. Thus, if the statement is hawkish after a monetary policy council and remains hawkish at the meeting of the following month, the markets will hardly react. Conversely, when the statement changes and moves from hawkish (code +1) to very hawkish (code +2), the markets react far more. The manner in which ECB statements move at its monthly press conference allows us to explain more than 31% of moves in interest rates recorded on the day of the ECB meeting[14].

PCA analysis returns several factors decreasingly ordered by variance proportion. Our first factor explains 52% of the whole variance of short- and long-term rates in euro zone. We concluded that changes of the tone of ECB statements affects this first axis. We now turn to the question whether the second PCA factor is affected or not by the tone of ECB statements. This question is all the more interesting that the second PCA axis corresponds to the slope[15] of the yield curve (it explains 32% of the variance of all the changes in short- and long-term interest rates) . The estimation is presented in appendix 2 (table 6). It reveals that the tone of statements has no effect at all on the slope of the yield curve, which is consistent with our previous results (we find indeed that statements have a simultaneous effect on both short- and long-term rates.). To confirm this, we use the same methodology to fine-tune our analysis of the impact of statements on euro-zone short-term interest rates

[14]When we observe the estimation graphically, however, we can see a small lag during 2001 between trends in interest rates and the tone of statements. Note that as soon as early 2001, the markets were expecting a rate cut by the ECB. Nevertheless, the ECB did not change its key interest rate in February, March, or even in April 2001, whereas the economic slowdown seemed to justify a rate cut (inflation was admittedly still high despite the fall in oil prices and was picking up again in March-April but this was mainly the result of the mad cow disease, *i.e.* an external supply shock). Even as the markets were banking on a rate cut, the ECB's statements remained neutral. The fact that its statements did not change from one month to the next should not have led to fluctuations in interest rates and yet they were trending downwards : at this point in time, the markets believed in economic indicators more than in the ECB. In fact, it eased its monetary policy in May, thus comforting the markets, while still making rather neutral statements, as inflation had precisely peaked in this month at its highest level since the launch of the EMU at 3.1% (but 3.4% according to its measure at the time, which was subsequently revised).

[15]The slope of the yield curve is defined as the difference between long term rates and short term rates.

(1M Euribor, 3M Euribor, 6M Euribor, 12M Euribor) before doing the same for long-term interest rates.

5.1.2 What is the impact of statements on short-term interest rates?

When we carry out a Principal Component Analysis of euro-zone short-term interest rates, we obtain a first factor that allows us to explain about 78% of the information found in the initial series. This factor corresponds, depending on the correlation, to a virtually equiweighted average of all short-term interest rates.

Once again, we find that the *statement code* variable (in difference) is very significant (see appendix 3, table 7) and is allocated a positive coefficient, compatible with the previous results. Lastly, the day of the ECB meeting, the statement allows us to explain 27% of the change in short-term interest rates (more precisely, 27% of 78% of the information common to all short-term interest rates).

5.1.3 What is the impact of statements on long-term interest rates?

We now want to analyze the impact of the ECB's press conferences on the euro-zone's long-term interest rates that we represent by the Schatz, Bobl and Bund contracts. We therefore carry out a Principal Component Analysis of the differentials of the two-year, five-year and ten-year euro zone contracts. The first factor we obtain this time on its own allows us to explain 92% of the variance of the three contracts and represents the information (with very similar correlations ranging between 0.56 and 0.59) common to the contracts. As previously, we regress this first component on our *statement code* variable in difference (see appendix 3, table 7).

Lastly, our variable *statement code* that codifies the ECB's statements allows us to explain 11% of the change in long-term interest rates (or more precisely, 11% of 92% of the information contained in the Schatz, Bobl and Bund contracts). According to the foregoing, the ECB's statements, and more precisely changes in the tone of the statement made after the press conference that follows the monetary policy council meeting plays a significant role in moves in short- and long-term interest rates in the euro zone. Thus, we have shown that the statements could explain up to 27% of the fluctuations in short-term interest rates and about 11% of the fluctuations in long-term interest rates. Consequently, the short end of the yield curve reacts more noticeably to the contents of the statement than the longer end, represented here by the Schatz, Bobl and Bund contracts.

5.1.4 Differentiated impact of statements according to the maturity of interest rates

After using the principal component analysis to study the impact of the press conferences of the ECB on short-term interest rates, long-term interest rates and interest rates considered overall, we complete this analysis by studying separately the effect of our statement variable on interest rates at different maturities. We have already shown that the statements had a more pronounced impact on the group of short-term interest rates than on the group of long-term interest rates. Now, we will look for the horizon (among short-term interest rates) for which the statements have the greatest impact. The results of various regressions are shown in appendix 4 (table 8).

The estimations confirm the role played by the change in the tone of ECB statements : thus, our variable that codifies the statement is always significant and its coefficient is positive : when the statement becomes more hawkish, the interest rates of the yield curve rise. Conversely, it can be seen that the statements seem to have a maximum effect on interest rates with a maturity ranging between six months and twelve months. Beyond one year, the effect of statements fades. Here, the result is quite surprising insofar as the statements would apparently have a greater impact on 5- and 10-year interest rates (Bobl and Bund contracts) than on 2-year interest rates (Schatz).

5.2 Non parametric statistics

In this section, we present another methodology of the impact of ECB communication on market interest rates using non-parametric tests. Non-parametric tests are often used in place of their parametric counterparts when certain assumptions about the underlying population are questionable. They may be, and often are, more powerful in detecting population differences when certain assumptions are not satisfied : they can be done without the assumption of normality (that is why they are very appropriate when the sample sizes are small). Non-parametric statistics use "ordinal" data. These data are obtained by taking the raw data and giving each sample a rank. These ranks are then used to create test statistics. In non parametric statistics, one deals with the median rather than the mean. Since a mean can be easily influenced by outliers or skewness, and we are not assuming normality, a mean no longer makes sense. The median is another judge of location, which makes more sense in non parametric statistics. The median is considered the center of the distribution.

Tables 9 and 10 in appendix 5 present the mean and the median of our series (in first difference). We can see a strong relationship between our *statement code* variable in difference ($\Delta\ D_{ECB}$, which reflects the change in the ECB's statement in comparison with the statement of the previous month) and the difference between market interest rates on the day and on the day before of the monetary policy council meeting. If the ECB statement becomes more hawkish, market interest rates tend to rise and if the statement becomes more dovish, market interest rates will then trend downwards. Nevertheless, when the tone of the ECB statement remains the same between two months, the relationship is more variable. We will then test for a difference between the three subgroups.

We employ a methodology used by Clare & Courtenay (2001) by splitting the sample period into days when the ECB statement becomes more hawkish or more dovish. We use the split between more dovish or more hawkish days to investigate the pattern of market reactions to ECB statements. Our sample is divided in three subgroups : first, days when the tone of the ECB statement becomes more hawkish ($\Delta\ D_{ECB} = +1$) and the opposite case when the ECB statement becomes more dovish ($\Delta\ D_{ECB}$ = -1). The last subgroup contains days when the tone of the statement remains the same between two consecutive monetary policy meetings ($\Delta\ D_{ECB} = 0$). The differences in market reactions to ECB statements between days where the tone of ECB statement becomes more hawkish or more dovish are tested using a non-parametric statistic. The non parametric test which we use is the Kruskall-Wallis test which is given by :

$$H = \frac{12}{N(N+1)} \sum_{k=1}^{K} \frac{{R_k}^2}{n_k} - 3(N\ +\ 1) \tag{4}$$

where K = 3 since there are three subgroups ($\Delta\ D_{ECB} = +1$, $\Delta\ D_{ECB} = 0$, $\Delta\ D_{ECB}$ = -1) in our sample ; n_k is the number of observations from series k and $R\ =\ \sum_{i=1}^{n_i} r_{i,k}$ is the rank sum for series k. This test statistic is distributed $\chi^2\ (K-1)$ under the null hypothesis of equal medians.

The results of the Kruskal-Wallis test to assess the significance of the differences between more hawkish, more dovish or neutral days are given in table 11, appendix 6. They indicate that the test for equality failed : we reject the null hypothesis for all market interest rates (except for one-month Euribor rate). The medians of the three subgroups differ. These results confirm our previous conclusion : the reaction of market interest rates depend

on the change in the ECB's statement in comparison with the statement of the previous month. We can now present a more precise analysis by running the non-parametric test for only two series, that is to say we want to compare the medians between two subgroups only.

We perform now the same test, but our objective is to test the equality of medians between two subsamples. The results are given in table 12. We calculate the Kruskal-Wallis statistic by using first the split between more hawkish *versus* more dovish days ($\Delta\ D_{ECB} = 1$ *versus* $\Delta\ D_{ECB} =$ -1 in the first column). In the second column, we present the H statistic who tests the equality of medians for days when the ECB's statement becomes more hawkish with days when the tone statement does not change in comparison with the tone of the last month ($\Delta\ D_{ECB} = 1$ *versus* $\Delta\ D_{ECB} = 0$). Lastly, the third column reports the Kruskal-Wallis statistic to asses the difference in medians between days when the tone of the ECB's statement becomes more dovish with days when the tone remains the same between two consecutive months ($\Delta\ D_{ECB} =$ -1 *versus* $\Delta\ D_{ECB} = 0$). For the two first columns, we can clearly conclude that market interest rates react differently, depending of the change in the ECB's statement tone. However, we can not reject the null hypothesis between the last two subgroups (column three).

We conclude from these results that financial markets are much more sensitive (and consequently react more) when the tone of ECB statements is more hawkish. On the contrary, market interest rates don not react so strongly when the tone of ECB statements is less hawkish (or more accommodating). This result seems logical. Financial markets are interested in the contents of the speech delivered by the BCE the day when the Governing council meets : if the tone of ECB in comparison to the tone of the previous month becomes more hawkish, then market interest rates react more strongly (insofar as inflation is the objective of the ECB's monetary policy) than when the tone of the speech becomes accommodating.

6 Conclusion

Communication policy of central banks is therefore fundamental in terms of explaining moves in interest rates, around ECB meetings but also more generally speaking. Anticipating short-term moves in interest rates between the day before a meeting of the ECB's Governing Council and the day of the meeting (closing price) supposes predicting not only changes in intervention rates but also the tone of the ECB's statement (in addition to

other possible determinants such as US data for example). Our results suggest that ECB communication on meeting days (press conferences delivered after the announcement of monetary policy decision) significantly influences expectations of future monetary policy. Hence the importance of the ex ante information about this statement, notably via interviews in the press of Council members (and the importance of "rumors" or "leaks"). Hence also the introduction of a degree of subjectivity, in the interpretation of the words of the Governor or the Sub-governor. Of course, the impact of monetary policy communication has to be judged in the light of other news events, which can have a much larger effect on the market, such as international developments, domestic macroeconomic data releases ...

In the United States, communication of the Fed particularly steered long-term rates these last months. Several speeches of Fed's governors, such as Bernanke (2004a), Bernanke (2004b) or Kohn (2005) emphasize the role of central bank communication for the effectiveness of monetary policy. As evidence that communication policy is a work in progress, the FOMC has recently shifted its views in favor of expediting the release of its minutes. The Committee unanimously decided on December 14, 2004 to expedite the release of the minutes of each of its regularly scheduled meetings by issuing them three weeks after the date of the policy decision[16].

Certainly, financial markets are today able to predict monetary policy decisions on key interest rates fairly accurately. Nevertheless, central banks could become more transparent and increase their efforts to communicate their views about the economic outlook and its implications for monetary policy. By helping financial markets to anticipate the future level of monetary policy rate, monetary authorities will exercise more influence on long rates. Can nevertheless central bank transparency go too far ? This is the question asked by Mishkin (2004). In his paper, Mishkin argues that some suggestions for increased transparency (particularly a central bank announcement of its objective function or projections of the path of the policy interest rate) will complicate the communication process and weaken support for a central bank focus on long-run objectives. Transparency can indeed go too far ...

[16]The previous practice had been to release the minutes of a regularly scheduled meeting on the Thursday following the subsequent regularly scheduled meeting.

Appendix

Appendix 1 : Analysis of ECB's press conferences

	Number of press conferences
Very hawkish	10
Hawkish	22
Neutral	19
Dovish	15
Very dovish	0
Total	**66**

Table 2: Distribution of statement variable

Date	Statement variable	Date	Statement variable
7 jan 99	0	**8 nov 01**	-1
4 feb 99	-1	**6 dec 01**	0
4 mar 99	-1	**3 jan 02**	0
8 apr 99	-1	**7 feb 02**	0
6 may 99	-1	**7 mar 02**	0
2 jun 99	0	**4 apr 02**	0
15 jul 99	0	**2 may 02**	1
9 sep 99	1	**6 jun 02**	1
7 oct 99	1	**4 jul 02**	1
4 nov 99	1	**12 sep 02**	0
2 dec 99	1	**10 oct 02**	0
5 jan 00	1	**7 nov 02**	-1
3 feb 00	1	**5 dec 02**	-1
2 mar 00	2	**9 jan 03**	-1
30 mar 00	2	**6 feb 03**	-1
13 apr 00	2	**6 mar 03**	-1
11 may 00	2	**3 apr 03**	-1
8 jun 00	2	**8 may 03**	-1
6 jul 00	2	**5 jun 03**	-1
14 sep 00	2	**10 jul 03**	-1
5 oct 00	2	**4 sep 03**	-1
19 oct 00	2	**2 oct 03**	0
2 nov 00	2	**6 nov 03**	1
14 dec 00	1	**4 dec 03**	1
1 feb 01	1	**8 jan 04**	1
1 mar 01	0	**5 feb 04**	1
11 apr 01	0	**4 mar 04**	1
10 may 01	0	**1 apr 04**	1
7 jun 01	0	**6 may 04**	1
21 jun 01	0	**3 jun 04**	1
5 jul 01	0	**1 jul 04**	1
30 aug 01	0	**2 sep 04**	1
11 oct 01	0	**7 oct 04**	1

Table 3: Codes given to ECB's statements

Appendix 2 : Estimation of the relationship between the first and second factor and the tone of the ECB statement

$$PC_1^{st,\ lt} \ = \ \alpha + \beta \ D_{ECB} + \varepsilon \tag{5}$$

with st, lt standing for short-term (st) and for long-term interest rates (lt) and PC_1 for the first factor derived from the Principal Components Analysis (PCA).

	α	**t-Stat**	β	**t-Stat**	R^2
$PC_1^{st,lt}$	-0.23	-0.95	0.57	**2.51***	0.09

Table 4: Estimation via OLS

$$PC_1^{st,\ lt} \ = \ \alpha + \beta \ \Delta \ D_{ECB} + \varepsilon \tag{6}$$

where $\Delta \ D_{ECB}$ denotes change in the ECB's statement in comparison with the statement of the previous month.

	α	**t-Stat**	β	**t-Stat**	R^2
$PC_1^{st,lt}$ (52%)	-0.021	-0.108	2.388	**5.321*** **	0.31

Table 5: Estimation of the first PCA factor

$$PC_2^{st,\ lt} \ = \ \alpha + \beta \ \Delta \ D_{ECB} + \varepsilon \tag{7}$$

* = Significance at the 90% level

	α	**t-Stat**	β	**t-Stat**	R^2
$PC_2^{st,lt}$ (32%)	0.003	0.018	-0.271	-0.636	0.006

Table 6: Estimation of the second PCA factor

** = Significance at the 95% level

*** = Significance at the 99% level

Appendix 3 : Impact of statements on euro-zone short-term and long-term interest rates

$$PC_i^j \;=\; \alpha + \beta \;\Delta\; D_{ECB} + \varepsilon \quad i = 1, 2 \quad j = st, lt \tag{8}$$

where PC_i denotes the *i-th* principal component with *st* standing for short-term interest rates and *lt* standing for long-term interest rates.

	α	**t-Stat**	β	**t-Stat**	R^2
${PC_1}^{st}$ (78 %)	-0.01	-0.099	2.06	**4.8*** **	0.27
${PC_2}^{st}$ (17 %)	0.006	0.066	0.302	1.295	0.025
${PC_1}^{lt}$ (92 %)	-0.01	-0.0542	1.225	**2.74***	0.11

Table 7: Estimation of the first and second PCA factors for short term rates and of the first PCA factor for long term rates via OLS

* = Significance at the 90% level

** = Significance at the 95% level

*** = Significance at the 99% level

Appendix 4 : Differentiated impact of statements according to the maturity of interest rates

$$\Delta\ R_t\ =\ \alpha + \beta\ \Delta\ D_{ECB} + \varepsilon_t \tag{9}$$

where $\Delta\ R_t$ is the change in rate between the day before the ECB meeting and the day of the meeting, all data being centered and reduced. As regards long rates, we use contracts and thus the change in price with the opposite sign.

Market interest rates	α	**t-Stat**	β	**t-Stat**	R^2
1 month Euribor	-0.01	-0.12	0.76	**2.87***	0.11
3 month Euribor	-0.01	-0.1	0.97	**3.83****	0.19
6 month Euribor	-0.003	-0.03	1.16	**4.86*****	0.27
12 month Euribor	-0.008	-0.076	1.22	**4.95*****	0.29
(-) Schatz (2 year)	0.01	0.01	0.575	**2.11***	0.07
(-) Bobl (5 year)	-0.06	-0.05	0.76	**2.88***	0.12
(-) Bund (10 year)	-0.01	-0.11	0.76	**2.88***	0.12

Table 8: Regressions results for various maturities.

Appendix 5 : Descriptive statistics for market interest rates in euro zone

	$\Delta\ D_{ECB} = -1$	$\Delta\ D_{ECB} = 0$	$\Delta\ D_{ECB} = 1$
1 month Euribor	-0.032	-0.005	0.002
3 month Euribor	-0.024	-0.003	0.006
6 month Euribor	-0.021	-0.002	0.018
12 month Euribor	-0.023	-0.002	0.044
2-year	-0.009	0.031	0.146
5-year	-0.031	0.029	0.371
10-year	-0.092	0.046	0.487

Table 9: Mean of series (first difference)

	$\Delta\ D_{ECB} = -1$	$\Delta\ D_{ECB} = 0$	$\Delta\ D_{ECB} = 1$
1 month Euribor	-0.004	-0.002	0.000
3 month Euribor	-0.014	-0.002	0.002
6 month Euribor	-0.019	-0.003	0.009
12 month Euribor	-0.021	-0.0005	0.018
2-year	0.004	0.0047	0.164
5-year	-0.029	0.0096	0.427
10-year	-0.096	0.063	0.494

Table 10: Medians of series (first difference)

Appendix 6: Non-parametric tests

	Kruskal-Wallis statistic	P-value
1 month Euribor	3.731	0.153
3 month Euribor	8.305	**0.015****
6 month Euribor	13.424	**0.001*****
12 month Euribor	15.692	**0.000*****
2-year	6.531	**0.038****
5-year	9.773	**0.007*****
10-year	8.813	**0.012****

Table 11: Test for equality of medians between the three subgroups

	$\Delta\ D_{ECB}\ =\ 1\ /\ -1$		$\Delta\ D_{ECB}\ =\ 1\ /\ 0$		$\Delta\ D_{ECB}\ =\ 0\ /\ -1$	
1 month Euribor	2.46	0.116	3.05	**0.081***	0.49	0.482
3 month Euribor	5.22	**0.022****	6.05	**0.013****	1.93	0.164
6 month Euribor	6.61	**0.010*****	9.65	**0.001****	3.86	**0.049****
12 month Euribor	9.00	**0.002*****	11.87	**0.000*****	3.47	**0.062*****
2-year	4.59	**0.032****	6.05	**0.013****	0.06	0.798
5-year	5.22	**0.022****	9.28	**0.002*****	0.26	0.609
10-year	4.59	**0.032****	8.044	**0.004*****	0.62	0.428

Table 12: Test for equality of medians between two subgroups (Kruskal-Wallis statistic and P-value)

* = Significance at the 90% level

** = Significance at the 95% level

*** = Significance at the 99% level

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