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Central Bank Communication and Monetary Policy Predictability under Uncertain Economic Conditions[1]

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Abstract: Modern central banks increasingly value monetary policy transparency, and attempt to build credibility by communicating their decisions to the public. This paper studies whether the communication of central banks can be used to explain upcoming changes in their most important monetary policy instrument, the short-term refinancing rate, and whether the public can trust central bank communication during times of financial crisis.

This is done by constructing an indicator to measure the predictability of monetary policy by calculating the median of the policy makers' official comments. The performance of this indicator is studied with ordered probit methods. The results show that predictability was reached relatively well at central bank level during the financial crisis despite the rapid growth of economic uncertainty, and that communication can be a useful tool for central banks during uncertain times.

Keywords: Monetary Policy; Central banking; Communication; Central Banks and Their Policies

JEL-codes: D83, E50, E52, E58, E59

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Introduction

During the last decades central banking has experienced some significant changes and, as Geraats (2002) notes, many central banks now favour to communicate their decisions to the public and therefore attempt to control market expectations. The increasing weight of transparency, with the help of new technologies, has expanded the amount of information central banks produce and communicate. At the same time, transparency has gotten a bigger role as a feature of monetary policy: Central banks all around the world have increased the transparency of their actions by publishing explicit indication targets and inflation forecasts. For example, the European Central Bank (ECB) organises press conferences after their monthly meetings and the Federal Reserve began publishing its short-term interest-rate target forecasts in January 2012. These actions demonstrate transparency-oriented conventions of monetary policy. Communication and discussion as ways of improving transparency have become a common part of the decision-making process in all major central banks.

Transparency can be defined in various ways[2], but in its simplest form it aims at improving openness, clarity and understanding of central bank policies (Winkler, 2000). Transparency is closely linked to discussion about central bank credibility, which according to Blinder (2000), simply means matching deeds to words. The role of communication as a requirement for credible monetary policy is also emphasized among central bankers. For example, Trichet (2007) has argued that: "Central banks are prudent in their communication to always preserve their credibility in all circumstances". In this context, a central bank is only credible if people believe what it says. To communicate understandable and trustworthy information (transparency) a central bank must also commit to its words (credibility).

Various earlier studies have indicated that central bank communication is efficient, which means it can be used to change financial market expectations and affect stock prices as well as bond prices, at least in the short run. Literature on the efficiency of communication is constantly increasing, but there is still a research gap in the empirical communication studies during periods of high uncertainty and Geraats (2002) notes that communication is especially important under uncertainty due to incomplete information.

This article examines how well the ECB and the Fed succeeded in improving transparency and credibility in crisis conditions by predictability. Predictability

[2] See, for example, Faust and Svensson (2001) or Eijffinger and Geraats (2006).

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in this context means how well communication forecasts the forthcoming target rate decisions. The article concentrates on the communication of policy-makers between 2007 and 2010 and examines the content of central bank communication. The goal is to study communication as a quantitative variable and to account for its qualitative aspects to test how consistent the policy communication relates to actual decisions concerning the main instrument of monetary policy, the main refinancing rate.

Evaluation of predictability with regards to target rate setting is made by comparing the performance of communication variables and Taylor-type macroeconomic variables. The methods and approaches of this paper closely resemble the approach of Jansen and De Haan (2009) and Hayo and Neuenkirch (2010) to study the main hypothesis: Communication contains information about the future changes in the target rate. This study focuses on the consistency of central bank communication with upcoming target rate decisions in the years 2007 to 2010. The sample period is chosen due to the high uncertainty of economic development in the United States and the euro area during this time. From 2007 onwards the financial crisis had significant weight on the development of the world economy and monetary policy decisions in the U.S. as well as the euro area. This article examines monetary policy communication strategy under high economic instability with a focus on the predictability of the monetary policy stance[3].

1. Review of Literature

Blinder, Ehrmann, Fratzscher, De Haan and Jansen (2008) divide the goals of communication policy studies into two separate issues: How communication can be used to manage expectations by creating news or by reducing noise in markets. Creating news relates to the effectiveness of communication, i.e. how central bank announcements affect expectations and financial markets by revealing new information about monetary policy developments or the economic outlook.

Although the influence of communication causes some disagreement among researchers, the main contribution of earlier communication studies is that central bank communication is effective, i.e. it enables market movements. Evidence suggests that communication is effective and financial markets react to information that central banks provide to private sector agents (Andersson, Dillén & Sellin,

[3] Coenen et al. (2017) approach the subject of monetary policy communication under unconventional times as a broader subject.

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2006 and Ehrmann and Fratzscher, 2007b)[4]. Although the effects of communication are acknowledged in the literature, they may vary widely according to who is speaking and which market is in focus.

In the classification of Blinder et al. (2008) reducing market noise means that higher predictability of monetary policy decisions has advantages in the form of decreased uncertainty in the market. Poole (2001) argues that market participants make a higher amount of correct decisions when they can predict decisions of the central bank. This means that, optimally, the market participants have all the information they need to assess the developments of the economy and this decreases the uncertainty in the market. Although both issues, creating news and reducing noise, have been widely studied, few empirical studies have been dedicated to the content of central bank communication and its ability to reduce noise, i.e. the consistency between communication and actual monetary policy decisions.

There is a clear distinction between the predictability literature and efficiency literature: In the latter, communication gets more weight than actual monetary policy decisions through the process. In practice, this means that market participants follow the central bank's assessment of the economy closely and make their own evaluation based on those assessments. Kohn and Sack (2003) focused on the Federal Reserve communication between 1989 and 2003 and discuss the statements by the Federal Open Market Committee (FOMC), Alan Greenspan's testimony, and his speeches and compare these news effects to different market indicators. They argue that long-term Treasury forward rates[5] are driven more by what the FOMC says than what it decides, but the effects are dependent on the topic of statements. However, markets are also interested in forthcoming changes in monetary policy. Therefore, communication must be assessed based on how well it predicts the future stance of monetary policy. When market participants can anticipate the changes in monetary policy, uncertainty in the market is reduced. In this theory, the first step is to assess how extensively communication contains information about changes in monetary policy and, after that, study how well market participants can anticipate policy changes based on the communication.

Although central bank communication has been in the scope of recent research, the understanding of the effectiveness of communication, especially under crisis conditions, is still limited. The main conclusion of previous studies is that central bank communication is effective in enhancing market movements. The central

[4] see also Rosa and Verga (2007), Bernanke and Kuttner (2005) and Bomfim (2003) about efficiency.

[5] Maturity of one year or more.

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bank has a monopoly over monetary policy decisions, the main driver for future interest rate paths, so it is inevitable that people inside the central bank know more about the future policy and its goals than the public. Communication is a method of diminishing the information gap between a central bank and the public created by asymmetric information. In addition, a central bank may have superior information on the economic outlook compared to other information providers such as commercial banks and research institutions. This is because traditionally central banks allocate more resources to forecasting than the private sector does (Blinder et al., 2008 or Romer and Romer, 2000). Various studies find that financial markets react to the information on the economic outlook and inflation that a central bank provides. For instance, Andersson et al. (2006) argue that inflation forecasts have a significant effect on the term structure of interest rates in the case of the Swedish Riksbank.

Communication effectiveness depends on the content and the source of information as well as the timing of communication. Ehrmann and Fratzscher (2007b) compared the communication effectiveness of the ECB and Federal Reserve between 1999 and 2004 and find that in the case of the ECB, financial markets react to statements by all policy makers in a similar way, but in the case of the Federal Reserve the governors' statements are observed more closely than other policy makers. In another paper, Ehrmann and Fratzscher (2007a) conclude that not only does the status of a policy maker matter, but also statements which are in line with the current monetary policy stance, or which are so-called neutral stances, weigh more in financial markets. The timing of communication can also be crucial. Ehrmann and Fratzscher (2009) find that communication, which is expressed during the silent period, "purdah", before the monetary policy committee meetings, has more powerful effects on the market compared to communication outside the silent period. The frequency of central bank forecasts and reports also plays a role and Ehrmann and Sondermann (2012) show that market volatility increases as more time passes after an announcement.

Jansen and De Haan (2009) examine the consistency of ECB communication during the first years after the establishment of the European Monetary Union (EMU), concentrating on the years 1999 to 2002. They use an ordered probit model based on the Taylor rule as a methodological framework and add communication as one explanatory variable in their regression. They conclude that decisions are most closely linked to changes in forward-looking macroeconomic indicators: Inflation expectations and economic sentiment. Communication, however, provides additional help in modelling target rate decisions in the ECB, but it does not perform better than Taylor-type variables in the prediction of the target rate. Jansen and De Haan use international news as the measure of communication.

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Hayo and Neuenkirch (2010) study communication conventions in the Federal Reserve between 1998 and 2006 and also use the forward-looking Taylor rule as their econometric framework. In their study communication in the Federal Reserve had a more substantial role in predicting target rate decisions compared to Jansen and De Haan (2009) and their study on the ECB. The results of Hayo and Neuenkirch suggest that the more informal part of the Federal Reserve communication, the speeches of policy-makers, contain valuable information about future monetary policy changes.

Although many researchers have noticed the central bank's powerful role as a market mover, the profound role of the content of communication has been ignored in most studies. The interest in the subject has arisen quite lately and, for instance, Bulíř, Čihák and Jansen (2012) and Bulíř, Čihák and Šmídková (2013) have assessed the clarity of content of the central bank communication in the ECB. By using methods of qualitative research it is possible to create new aspects in theories of central bank communication. This paper combines theories of communication studies (content analysis) and central banking theories to develop the understanding of communication policy and its evaluation.

2. The ECB and the Federal Reserve – The institutional setting, instruments, deeds and communication

2.1 Financial crisis, debt crisis and the instruments of central banks

The institutional setting and the main targets of the ECB and the Federal Reserve provide the framework for this study[6]. One of the main objectives of monetary policy for both is to maintain price stability, which for both means keeping the annual inflation rate below 2%[7]. This inflation target forms the basis of the decision-making process for both central banks, which includes the decisions concerning price stability, but also financial stability. The separation principle distinguishes these two and a separation must be made between the stance of monetary policy and the implementation of that policy. For example, the former president of the ECB, Jean-Claude Trichet (2008) summarises the separation principle in his speech with "The ECB makes clear separation between the determination of

[6] This paper concentrates on the ECB and Federal Reserve during the crisis period of 2007 to 2010, but a more comprehensive listing of central banks, their current status and monetary policy systems can be found, for example, in Mossner at al. (2017).

[7] The Federal Reserve set its first explicit inflation target in January 2012.

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monetary policy stance and, on the other hand, its implementation of liquidity operations". The monetary policy stance is expressed by the Governing Council's decisions in the ECB and in the Federal Reserve by the FOMC's decisions. They set the appropriate level of key interest rates that will best serve the main objective of the central banks, price stability. The consequences of the chosen monetary policy are conveyed to the economy through the transmission mechanism, where the change in the official interest rates is the initial shock which affects market expectations and money market interest rates. The shock then continues through several channels and affects asset prices, exchange rates, and eventually, price development.

Generally, the functions of the financial market play a crucial role in the operation of the interest rate channel. Once the central bank has set its key interest rates, it implements monetary policy by providing financial stability and controlling the liquidity in the banking sector to ensure that the transmission mechanism operates well. The time period around the financial crisis was challenging for the economies around the world. After the housing bubble burst in the U.S. and the collapse of Lehman Brothers in September 2008, a financial crisis developed and spread rapidly to real economy and the financial sector by freezing the international banking system. The financial crisis was realised in the European banking system in November 2008 as the banking and insurance giant Fortis was partly nationalised. Already before that, in August 2007, the tensions in the interbank market began to rise: risk premiums increased in interbank loans and market activity declined. The Federal Reserve reacted by lowering its Federal funds rate between September 2007 and December 2008 from 5.25 % to a range of 0.0–0.25%. The European Central Bank reacted in a similar way at a later time by lowering their target rate to ensure the liquidity conditions and cut its policy rate by 3.25 percentage points to 1.0 percent between October 2008 and May 2009.

After having decreased the Federal funds rate to effectively 0.0% and economic growth still struggling in the U.S., the Federal Reserve began a program of quantitative easing[8]. In Europe the second wave of the crisis, the sovereign debt crisis, began in May 2010, when government bond spreads in the euro area reached record highs. In May 2010, Greece became the first euro area country to receive a bailout. During the same month, the ECB announced its program to buy government bonds of euro area members from secondary markets, the Securities Markets Programme (SMP). To summarize the actions in 2007-2010, the ECB had a

[8] To this date, the Federal Reserve has completed three programs of quantitative easing, compromising of different amounts of bonds, mortgage-backed securities, treasury assets and agency debt.

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threefold strategy in response to the crisis: a series of interest rate reductions to support the economy within its mandate, enhance credit support measures to ensure the liquidity and functioning of the transmission mechanism, and securities purchases to ensure liquidity in dysfunctional market segments (ECB, 2010). In addition to the SMP, other non-standard policy measures were announcements of long term refinancing operations (LTRO) with a maturity of up to six months (May 2008) and later up to one year (May 2009), lengthening the average maturity of open market operations, extending the list of assets accepted as eligible collateral for refinancing operations, and provision of USD liquidity in co-operation with the Federal Reserve in the United States.

The non-standard measures can be understood as temporary measures, which support the functioning of the monetary policy transmission mechanism. At the time of financial turmoil, money market activity decreased rapidly and the fear of the link between the policy rates and the money market rates weakening made central banks act. They wanted to keep the transmission mechanism fully operational in this exceptional environment and therefore introduced non-standard policy measures.

The separation principle is a basis for the outline of the topic in this article, which focuses on the communication of the monetary policy stance. The topics concerning the implementation of monetary policy are excluded, which means that news which include information on the non-standard monetary policy measures or liquidity operations are excluded from the data and only news concerning the topic related to the main refinancing rate (monetary policy stance) are included.

Compared to price stability communication, financial stability communication lacks clear objectives, and has several facets and instruments (Born, Ehrmann & Fratzscher, 2014). This makes the communication on financial stability more complex, which might be a reason for the low amount of studies.

2.2 Monetary policy actions during the crisis

Before the analysis, it is essential to distinguish the words and deeds of monetary policy decision makers. As communication is often seen as a tool for preparing markets for forthcoming changes in monetary policy, it is crucial to briefly introduce the decisions made during the studied time period.

Several studies have concluded that especially unanticipated central bank actions have significant consequences on the market. Bernanke and Kuttner (2005) found that market reactions were larger to surprise cuts in target rate compared

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to hikes. In their research an unexpected 25 basis point reduction in federal funds rate leads to a 1.3 % increase in S&P500 composite index. Bomfim (2003) focused on the intra-day surprise effects for the Fed and found that positive surprises with relation to monetary policy tend to have a larger effect than negative surprises.

Under transparent monetary policy, central bank actions should be predictable. Predictability can be considered to be the ability of market participants to anticipate the upcoming monetary policy decisions. It means that the unexpected component of monetary policy decisions should be low on the meeting days of monetary policy committees. The presumption is that market participants make more efficient decisions when markets can correctly predict central bank actions (Poole, 2001).

Table 1. The monetary policy meetings associated with interest rate cuts in the sample and consensus forecasts at the time.

Federal Reserve

Date	Median forecast	Forecast range	Actual
18.9.2007	4.50%	(3.75%, 5.25%)	4.75%
31.10.2007	4.50%	(3.75%, 4.75%)	4.50%
11.12.2007	4.25%	(3.30%, 4.50%)	4.25%
22.1.2008	3.50%	(2.25%, 4.50%)	3.50%
30.1.2008	3.50%	(2.25%, 4.50%)	3.00%
18.3.2008	2.00%	(1.00%, 3.50%)	2.25%
30.4.2008	1.75%	(1.00%, 2.25%)	2.00%
8.10.2008	1.50%	(0.50%, 2.00%)	1.50%
29.10.2008	1.50%	(0.50%, 2.00%)	1.00%
16.12.2008	0.50%	(0.00%, 1.00%)	0.00%-0.25%

European Central Bank

Date	Median forecast	Forecast range	Actual
3.7.2008	4.25%	(4.00%, 4.25%)	4.25%
7.8.2008	4.25%	(4.25%, 4.25%)	4.25%
4.9.2008	4.25%	(4.25%, 4.25%)	4.25%
2.10.2008	4.25%	(4.25%, 4.25%)	4.25%
8.10.2008			3.75%
6.11.2008	3.25%	(3.00%, 3.50%)	3.25%
4.12.2008	2.75%	(2.25%, 3.00%)	2.50%
15.1.2009	2.00%	(2.00%, 2.50%)	2.00%
5.3.2009	1.50%	(1.25%, 1.75%)	1.50%
2.4.2009	1.00%	(1.00%, 1.50%)	1.25%
7.5.2009	1.00%	(1.00%, 1.00%)	1.00%

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Table 1 shows the forecasts and actual decisions of changes in the ECB main refinancing rate and the Federal Funds rate, the main instruments of monetary policy. Predictability consists of two measures: the first is that market participants can forecast the change in target rates in scheduled meetings. The second, emphasised especially in times of crisis, is that market participants can expect future changes. In this study, predictability is based on the median and range of market forecasts of target rates before monetary policy decisions. Predictability improves if consensus expectations are equal to actual decisions concerning target rates and if the difference in expectations is as low as possible.

In forecasts in table 1, median and range represent the expectations of market participants. Predictability is measured by first comparing the expectations, i.e. median consensus forecasts before the target rate decisions, to actual rate decisions. Secondly, the range of the forecast is included to find out if there is deviation among the consensus expectations[9].

The key conclusion from table 1 is that in this simple comparison of market expectations and realised monetary policy decisions it seems that the financial crisis had negative effects on the predictability of monetary policy decisions. In the pre-crisis period, market forecasts were equal to actual target rate decisions and there was no range in expectations, i.e. the monetary policy was very predictable in this context. The situation changed rapidly in 2007 when the Fed began its target rate reductions, followed by the ECB in 2008. In the euro area, the period with increased range of forecasts lasted one year until July 2009, and after that, actions were again predictable with no policy surprises or ranges in forecasts. The crisis period included two monetary policy surprises and one unscheduled interest rate decision, which was made in October 2008.

This analysis indicates that monetary policy decisions were less predictable during the financial crisis as compared to the pre-crisis time. In both areas policy was very predictable during the pre-crisis period, but the level diminished as uncertainty in the market grew. Decreased predictability of monetary policy decisions indicates that there was a substantial change in the communication environment, and market participants had incomplete information about the future changes in monetary policy.

[9] Forecast-figures were collected from The Wall Street Journal Economic Forecasting Survey for the United States and from the biggest commercial banks in the euro zone. The number of participants was approximately 55 for the U.S. and 80 in the euro area.

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2.3 Central Bank communication

This article uses central bank communication strategy as a framework for communication analysis. In this context communication strategy includes all the official and unwritten rules which policymakers follow when communicating to the public. This paper considers communication to include all the conventions and habits, which are applied to external communication with the central bank's interest groups and internal communication within central bank personnel.

For central banks, the amount of published written communication is usually greater than the amount of oral communication. Usage of written texts is usually high in highly specialized institutions, where the knowledge must be stored in some fashion. According to Smart (2006, p. 201), "a written genre (text) can be viewed as a communal rhetorical strategy encompassing texts, composing processes, reading practices, and social interactions, a strategy that allows a professional organization to regularise writer/reader transactions in ways that ensure (or at least encourage) the reliable, consistent production of specialised knowledge". Written communication is the central bank's main tool to convey specialised information about monetary policy to the public. Although the amount of published oral communication is still low, it will most likely expand in the future, as technological improvements and central banks' increased interests towards improving transparency make new communication channels, for instance live webcasts of policy makers' speeches, easily available to the public.

3. Data and Methodology

Central bank monetary policy actions during the crisis period were summarised in chapter 2 and the conclusion from table 1 is that changes in the main refinancing rates were predictable before the crisis but the predictability declined substantially during the crisis. This section examines what was the role of central bank communication in explaining the predictability of the target rate decisions. Predictability, which improves communication transparency, belongs to central bankers' interest: "Bouts of economic and financial market turbulence over the past 25 years have shown policymakers that transparency is the best protection against contagion from such events: lucid analysis, speedy action, and consensus between experienced heads will also help minimize contagion." (Trichet, 2007)

Using content analysis is crucial in examining central bank communication patterns because we cannot observe the predictability or effects of monetary policy communication without knowing its content. Content analysis is a method where

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the main goal is to improve the quality of the inferences we make. Neuendorf (2002, p. 10) defines content analysis broadly as "a summarizing, quantitative analysis of messages that relies on the scientific method, and is not limited as to the types of variables that may be measured or the context in which the messages are created or represented". As a scientific method, content analysis must meet some scientific requirements, such as objectivity, reliability, replicability and validity. A special feature of content analysis is that most content analyses start with data which is not intended to be analysed in specific research questions. They are texts which are meant to be read, interpreted and understood by the general public. Interpretation can differ depending on the context. This means that it is crucial to define methods of the research process before the actual analysis in order to ensure the scientific requirements of the results. Neuendorf (2002) uses the term a priori design to ensure scientific sufficiency. She advises researchers to make precise preparations before analysis concerning all measurements of definitions, variables and coding rules. These aspects are the focus of the next section with a detailed description of the data used.

3.1 Data

This research adopts the public's perspective in collecting the information which market participants receive from the central bank. Among possible interest groups, financial market participants actively follow the news concerning central bank events and receive information which immediately drives market reactions, if the released communication is efficient. This study assumes that the financial crisis made central bank communication even more important as an information source for market participants, because economic conditions changed rapidly and new information was desperately needed to reduce the widening information gap between the central banks and market participants. Ehrmann and Fratzscher (2007a) suggest that the response of financial markets to central bank communication is significantly larger under increased uncertainty than in "normal" times.

Speeches and interviews reported by international news agencies provide updated and frequent information and help in narrowing the information gap between monetary policy meetings, which are held monthly in the ECB and eight times a year in normal conditions in the Federal Reserve[10]. News stories produced by

[10] During the crisis period, the Federal Reserve increased the number of policy meetings. The target rate can also be changed between meetings and this was done in both central banks during the studied sample time period.

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news agencies, like Bloomberg and Reuters, can fill some of the information gaps in changing economic environments. Because of their high frequency and real-time content, news items concerning statements of policy-makers are widely followed in financial markets. In this article, the news material was collected from Reuters archive. When content analysis is used as the scientific method, reliability issues are crucial. Reliability answers the question: "How can the quality of data be maximised?" It is a very significant element in content analysis because if one cannot trust the measures, one cannot trust the analysis (Riffe, Lacy & Fico, 2005). To improve reliability in content analysis, it is essential to clearly define the categories and subcategories that are relevant to the goals of the study. Clear definitions enhance the repeatability of the results. Definitions are presented following protocol, which "sets down the rules governing the study, rules that bind the researcher in the way they define and measure the content of interest" (Riffe et al., 2005). The coding protocol is the manual of content analysis: it shows how the analysis was made, what was included in it and which the coding key words were. The elements of the coding protocol of this study are:

Coding of central bank statements

The news story protocol is aimed at assessing the stances of central bankers (Governing Council, Governor, Boards) by Reuters News. It examines the topics discussed and defines central bankers' stances/opinions on these topics. The following definitions are important in selecting and analyzing the content under study.

News Story

News stories are defined as all non-advertising material in a news product. In this study, any news stories from the Reuters archive with comments from central bank governors were included in the sample.

Source

A source is a person, who gives information to news reporters. A source is explicitly identified as such, when news reporters quote or paraphrase information from them in news. A source must be identified in some way, i.e. he/she must have a name. An anonymous source can be considered a source provided anonymity is explicitly granted in the story (for example central bank official, central bank decision-maker, a committee). For example, Hansen and McMahon (2016) study the information released by the Federal Reserve FOMC and whether they have macroeconomic effects. This paper approaches communication by studying identified sources, so all anonymous communication is excluded from the analysis.

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Story source

Story source is the context from where the story is picked for analysis. Potential story sources in the study were speeches, interviews and other media quotations.

Primary story topic

Monetary policy: the direction of future central bank target rate path or entering further easing programs if effective rates already at 0.0 %.

Primary message of the story

Identify the message of the policy-maker by using classification into "dovish", "hawkish" and "neutral" according to the stance of the policy-makers in the news. Classification of the key message in a story is done by using the following coding. The approach in coding the statements is common in the literature on central bank communication. Similar classification methods are used by Ehrmann and Fratzscher (2007b) and Jansen and De Haan (2009).

+1 hawkish monetary policy stance

0 neutral view of monetary policy

-1 dovish monetary policy stance

Identifying stances in policy-makers statements requires some interpretation. First, the news items were coded as +1 (or -1) if the policymakers tell that they are willing to raise (cut) the monetary policy target rate. Often in these stories there is the word "if" included in the text[11].

Secondly, the same classes (+1 and -1) also describe strongly hawkish or dovish stances. They included policy-makers strong appetite towards the change in monetary policy direction, i.e. raise/lower target rate, and word "want" was often presented in these statements. In addition to that, news classified as +1 or -1 might simply include the information about future monetary policy action[12].

The neutral classification, 0, included stories which referred to appropriate monetary policy level, or that there are no monetary policy changes expected in the economy. The classification included all the statements that included a monetary policy signal and were not classified as hawkish or dovish, or if there was no ex-

[11] For example: "The central bank will lower interest rates if inflation risks diminish."

[12] For example: "The target rate will increase."

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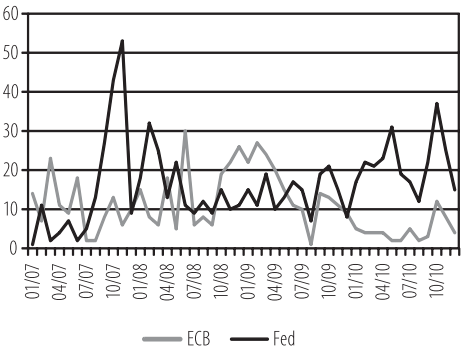
plicit comment on future rates. Some examples of news stories and classifications are listed in Appendix 1.

3.2 Frequency of communication and descriptive statistics

The data collection from the time period 2007–2010 resulted in 537 news stories from policy-makers of the ECB and 795 stories from policy-makers of the Federal Reserve.

As Figure 1 shows, frequencies[13] in the Federal Reserve were highest from late 2007 to mid-2008 when the financial crisis was observed and grew again in 2010 as quantitative easing was planned. In Europe, the highest amounts of communication were in 2008–2009 when the financial crisis hit the real economy. The lowest amount of news in both was posted before the crisis. The highest amounts of monetary policy news are linked to reductions in the main refinancing rate. This indicates that under uncertainty both central banks wanted to be more transparent by increasing the amount of communication. Although both frequency of the news and disagreements among the news were linked to the timing of changes in the main refinancing rate, the communication was mostly neutral.

Figure 1: Frequency of monetary policy statements (2007–2010)



[13] In this study, the frequency and the content of news items is controlled by choosing only one statement concerning monetary policy by each decision-maker per day. In several cases news items were updated during the day and in these cases only the last update was included in the sample. This was done in order to avoid double counting statements.

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Table 2: Classification statistics of monetary policy communication.

	European Central Bank	Federal Reserve
Monetary policy		
mean	0.078	-0.125
median	0	0
variance	0.531	0.943
n	537	795
Classification		
-1	115	176
0	264	478
+1	158	141

Table 2 shows the descriptive statistics and amount of news according to monetary policy stance, in the research period. The neutral stance was dominating during the sample period, and over half of all statements were neutral (classified as 0). Neutral stance is equal to no strong policy signal in the news. They are included in the analysis, because they could have an effect if a positive or a negative signal was anticipated in the market.

A high amount of neutral signals is expected, as most central bankers must weigh their assessment carefully. Andersson et al. (2006) argue that investors often have neutral monetary policy expectations, because changes in the monetary policy are smooth and therefore most neutral speeches deliver expected monetary policy signals. However, the situation was different during the crisis, when changes in the monetary policy actions were fast and the opinions of policy makers included strongly non-neutral signals.

During the studied time period, the monetary policy statements classified as dovish were more dominating than hawkish statements in the Federal Reserve communication (hawkish 141 vs. dovish 176) whereas in the European Central Bank the hawkish statements dominated (hawkish 158 vs. 115 dovish).

3.3 Econometric analysis

This section examines central bank communication as a forecasting tool during the financial crisis and compares it to the methodology of the interest setting rule introduced by Taylor (1993). Taylor's simple monetary policy rule has become very popular among researchers, and the formula has been applied to evaluate the monetary policy behaviour of several central banks. Jansen and De Haan

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(2009) focused on the Taylor rule with communication as an additional variable in the regressions in the case of the European Central Bank. To evaluate the predictive power of communication for target rate changes, three different regressions are estimated for both central banks, and some of them include Taylor-type variables. One model is done with forward-looking macroeconomic indicators, one with communication and lagged target rate and the third with macroeconomic indicators and communication combined. The goal is to compare Taylor-type and communication variables and to study if there are differences in the performance of the communication variable and more traditional Taylor-type variables in predicting future changes in the target rate in uncertain times. The regressions are estimated by using non-linear ordered probit regressions.

In formulating Taylor-type macroeconomic variables real-time data is used. The macroeconomic data was published in the end of the particular month, so policymakers had updated and fresh data available at their meetings. The data sets are also forward-looking, which means that they reflect the expectations of different groups: households and firms. Advantages of forward-looking data series are introduced by Orphanides (2001) and, for example, Jansen and De Haan (2009) compared the backward- and forward-looking Taylor-rule and concluded that forward-looking rules have the best explanatory power. They use survey data to describe the expectations in price developments π_t^e and output gap expectations yt and this paper takes a similar econometric approach.

Jansen and De Haan (2009) use the euro area the Economic Sentiment Indicator (ESI) to measure the output gap. It is computed and published monthly by the European Commission, and is derived from surveys made to the consumer sector, the industrial sector, the service sector, construction firms and the retail traders about the current economic situation as well as expectations of future developments. This data is not available for the United States, so in order to make the results between the ECB and Federal Reserve comparable, this paper builds a similar indicator from OECD's Consumer confidence indicator. To proxy output gap expectations, this confidence index was used to calculate the difference of a particular month to its long-term average of the data set. Inflation expectations were studied with OECD's data on Consumer price expectations.

The output gap and inflation expectations are basic Taylor variables, but one extra variable is needed to describe the explanatory power of central bank communication. Therefore, the third variable in the regression is *comm*, which is the median of all the decision-makers' stances over the period between two monetary policy meetings. Negative values for the variable describe a dovish stance, i.e. signalled

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decreasing target rate before the monetary policy meetings and positive values hinted to target rate increases.

After adding the third variable and the lagged variable i_{t-1} to capture interest rate smoothing in one regression, the three sets of rules were ready, with i_t^* being the latent variable and representing changes in the main refinancing rate:

$$i_t^* = \beta_1 \Delta(\pi_t^e) + \beta_2 \Delta(y_t) + \epsilon_t \quad (1)$$

$$i_t^* = \alpha i_{t-1} + \gamma_1 (comm) + \epsilon_t \quad (2)$$

$$i_t^* = \beta_1 \Delta(\pi_t^e) + \beta_2 \Delta(y_t) + \gamma_1 (comm) + \epsilon_t \quad (3)$$

The changes in the interest rate are coded with +1 for a rate hike, 0 represents unchanged monetary policy and -1 is a rate cut. In ordered probit model, the changes in the main refinancing rate occur only if the value of the index function is below the lower threshold value 1 or above the upper threshold value 2. Both thresholds are unobservable. Finally, the residuals ϵ_t follow standard normal distribution, and we can write the probabilities of different outcomes (hawkish, neutral or dovish monetary policy) in the following way:

$$\Pr[i_t^* = -1 | z_t] = \Phi(\tau_1 - z_t'\beta) \quad (4)$$

$$\Pr[i_t^* + 0 | z_t] = \Phi(\tau_2 - z_t'\beta) - \Phi(\tau_1 - z_t'\beta) \quad (5)$$

$$Pr[i_t^* = +1 | z_t] = \Phi(\tau_2 - z_t'\beta) \quad (6)$$

here φ denotes the cumulative standard normal distribution and z_t' is a vector of explanatory variables. The three ordered probit models are estimated using maximum likelihood and the unobserved threshold variables τ_1 and τ_2 are estimated at the same time with the vector β.

3.4 Results

In this section, results of the different models are presented for both central banks. The first regressions are estimated with forward-looking macroeconomic variables (π_t^e, y_t). In the second regressions, only lagged target rate decisions and communication were used as explanatory variables, and the third model is a combination with both macroeconomic indicators and communication as explanatory variables.

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Three major differences between the two central banks should be noted when analysing the results. First, as noted in chapter 2, the European Central Bank followed an explicit inflation targeting regime during the crisis period whereas the Federal Reserve did not. Second, the crisis was first observed in the United States, so the European Central Bank had more information available about the features of the crisis for its monetary policy. Third, during the studied time period, the Federal Reserve only made rate cuts whereas the ECB also hiked its target rate.

Table 3: Estimation results, ordered probit, European Central Bank (Huber-White robust estimates of variance are used in all cases)

Model	(1)	(2)	(3)
Previous target rate decision i_{t-1}		1.356***	
		(0.493)	
Δ Output gap y_t	0.797		0.642
	(0.896)		(0.991)
Δ Inflation expectations π_t^e	0.133**		0.101*
	(0.056)		(0.060)
Communication variable		1.525***	1.501***
		(0.551)	(0.448)
LR statistic	5.9	23.3	18.7
Log-likelihood	-27.5	-18.8	-21.1
Pseudo-R^2	0.10	0.38	0.31

Table 3 lists the estimation results for the European Central Bank. When using the pseudo-R^2 as an indicator, the joint model (2) has the best fit in ordered probit-model (0.38) whereas model (1) with forward-looking macro variables as explanatory variables is least explanatory (0.10).

Table 4: Estimation results, ordered probit, Federal Reserve (Huber-White robust estimates of variance are used in all cases)

Model	(4)	(5)	(6)
Previous target rate decision i_{t-1}		0.016	
		(0.772)	
Δ Output gap y_t	5.645***		2.590
	(1.607)		(2.458)
Δ Inflation expectations π_t^e	0.645		-0.313
	(0.516)		(0.774)
Communication variable		3.404***	3.712**
		(1.054)	(1.527)
LR statistic	14.2	24.8	27.1
Log-likelihood	-14.3	-9.0	-7.9
Pseudo-R^2	0.33	0.58	0.63

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Table 4 lists the estimation results for the Federal Reserve. When using the pseudo-R^2 as an indicator, model (6) has the best fit in ordered probit-model (0.63) whereas model (4) with the changes in output gap and inflation expectations as explanatory variables is least explanatory (0.33).

Inflation expectations have a significant coefficient in two regressions for the ECB and the coefficient for output gap is only significant in the macro variables model for the Federal Reserve. The results suggest that under the crisis, the large shocks to the economy received more attention in the monetary policy decision-making process in the Federal Reserve while the ECB concentrated on inflation expectations. According to Gerlach and Schnable (2000), central banks react to the output gap because it contains information about future price pressures. This along with the low inflation rate in the U.S. might be one explanation to the Federal Reserve basing its decisions more on the output gap.

The results also show that the coefficient of previous target rate decisions is significant in the euro area. It is insignificant for the rate decisions of the Federal Reserve, which suggests that the assumption of interest rate smoothing does not always hold under highly uncertain economic times. The coefficient of communication variable is significant in all models, which suggests that we can reject the null hypothesis where communication variables are jointly zero. This indicates that communication adds information about the future policy changes in uncertain times. It should be noted that inflation levels were generally very low in both areas during the studied time period and especially the policy-makers in the Federal Reserve were constantly more concerned with the chance of deflation rather than inflation. This is a possible reason for the insignificance of inflation expectations in the estimations.

To analyse the predictability, more specifically the changes of the independent variables to the explanatory variables, marginal effects are calculated by following way:

$$\frac{\partial[P(y_i=-1)]}{\partial(x_{ji})} = \Phi(\tau_1 - x_i'\beta)\beta_j \tag{7}$$

$$\frac{\partial[P(y_i=0)]}{\partial(x_{ji})} = -[\Phi(\tau_2 - z_i'\beta) - \Phi(\tau_1 - z_t'\beta)]\beta_j \tag{8}$$

$$\frac{\partial[P(y_i=+1)]}{\partial(x_{ji})} = \Phi(\tau_2 - z_t'\beta)\beta_j \tag{9}$$

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Table 5: Average marginal effects, European Central Bank

	$Pr[\Delta i_t = -1]$	$Pr[\Delta i_t = 0]$	$Pr[\Delta i_t = +1]$
Model (1) macro variables			
Δ Output gap	-0.161	0.063	0.098
Δ Inflation expectations	-0.027**	0.011	0.016*
Model (2) communication			
Previous target rate decision	-0.160***	0.022	0.138**
Communication	-0.180***	0.025	0.155**
Model (3) macro variables + communication			
Δ Output gap	-0.097	0.033	0.065
Δ Inflation expectations	-0.015	0.005	0.010
Communication	-0.227***	0.076	0.151**

Table 5 presents the average marginal effects of ordered probit estimations for the ECB. They show that in the joint model, the communication variable has the greatest effect: a one-point increase in the median of statements increases the probability of a rate hike by 15.1 % whereas it lowers the probability of a rate cut by 22.7 %. According to the results in table 3 and 5, in the euro area a change in inflation expectations was a better predictor for rate changes than the output gap.

The effect on interest rate smoothing is only significant in the second model for the ECB. The marginal effects show that a decision to increase the target rate in the previous meeting increases the probability of a rate hike by 13.8 % and decreases the probability of a rate cut by 16.0 %.

Table 6: Average marginal effects, Federal Reserve

	$Pr[\Delta i_t = -1]$	$Pr[\Delta i_t = 0]$
Model (1) macro variables		
Δ Output gap	-0.943***	0.943***
Δ Inflation expectations	-0.108	0.108
Model (2) communication		
Previous target rate decision	-0.002	0.002
Communication	-0.362***	0.362***
Model (3) macro variables + communication		
Δ Output gap	-0.240	0.240
Δ Inflation expectations	0.029	-0.029
Communication	-0.344***	0.344***

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Table 6 presents the average marginal effects for the Federal Reserve. The effects for a rate hike could not be studied as only rate cuts and unchanged rates were observed in the sample. The results show that in the joint model, the communication variable has the greatest effect: a change in the median of statements increases the probability of a rate cut by 34.4 %.

If the communication of the two central banks during the crisis period was compared, the communication from the Federal Reserve seemed to match the deeds more consistently. This result gives empirical support to the results of the financial market survey of Hayo and Neuenkirch (2015) where the Federal Reserve was ranked to have the most credible communication followed by the Bank of England, the ECB, and the Bank of Japan.

4. Conclusion

This paper studied central bank communication during highly uncertain economic times. It focuses on the predictability of the target rate changes, which was examined by comparing Taylor-type variables and the median of the published statements and using an ordered probit model.

One of the main tasks of modern central banks is to build credibility by matching its words (communication) to its deeds. This article shows that this object was reached relatively well during the crisis periods, although economic uncertainty grew rapidly. Target rate decisions in the European Central Bank were found to be mostly linked to changes in inflation expectations and central bank communication whereas the Federal Reserve decisions were based on changes in the output gap and communication. Whether this difference is due to the ECB following an explicit, publically announced inflation target or the very low inflation in the United States is an open question and left for future research. The communication variable provided a significant explanation to decisions concerning the main refinancing rate for both central banks and performed better than traditional Taylor-type variables in the estimations.

This paper concentrated specifically on monetary policy signals, but in the future a more general indicator for communication could be constructed to better understand the nature of central bank communication. For example, Jansen and De Haan (2009) include signals for economic outlook, inflation and M3 growth in their indicator. Another possible avenue for future research would be to study the effect of monetary policy signals with dynamic methods, like the dynamic general equilibrium model Melosi (2016) builds to study the signalling effects

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of monetary policy, although he concentrates on the persistence of inflation and inflation expectations.

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Appendix 1: Examples of news items

Coded as +1:

"Hikes will come sooner or later"
"Next rate move is up"
"Raise rates as quickly as possible"
"More tightening may be needed"
"Rate hikes possible"
"rate hike could come sooner or later"
"doesn't rule out rate hikes"

Coded as -1:

"*open minded on need for more rate cuts"*
"gives breathing room for more rate cuts"
"*Weighing needed for more rate cuts"*
"policy outlook leans more to cuts"
"more cuts may be needed"

Classified as -1:

ECB rates are heading down - ECB's Weber, (Reuters News 22.03.2009).

European Central Bank interest rates are "at 1.5 percent and heading down", ECB Governing Council member Axel Weber said on Sunday. Speaking at a conference in Brussels, Weber also said that real interest rates in the euro zone were no different than in the United States.

"The difference you keep forgetting is that whilst rates are at 1.5 percent in the euro area and heading down, short term rates are way below policy rates by now," Weber said.

"Short term rates are below one percent and actually inflation in Europe is just coming down to one percent - it is not at zero like in the United States. So the real rates are no different neither in the short-term nor in the medium-term," Weber said.

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Classified as +1:

Low ECB rates for too long a risk-Stark, (Reuters News 10.10.2010).

Keeping euro zone interest rates low for too long poses serious risks to the economy and price stability, European Central Bank Executive Board Member Juergen Stark was quoted as saying in an interview on Sunday. "We are fully aware that maintaining an accommodative monetary policy stance for too long can pose serious risks to our economy and, ultimately, to price stability over the medium term," Stark said according to the online version of Emerging Markets magazine.

Inflation rates in the euro zone were likely to remain moderate but the risks to the outlook were "slightly tilted to the upside," he added.

Classified as +1:

Fed may boost rates while economy still weak: Kohn, (Reuters News 30.09.2009).

The Federal Reserve may need to begin to pull back its extensive support for the weak U.S. economy before it has healed enough to substantially lower the jobless rate and get factories working again, Fed Vice Chairman Donald Kohn said on Wednesday.

"Tightening (monetary policy) while there's still slack in the economy is something that we have to do every time," he told a monetary policy conference at the Cato Institute.

Kohn said the Fed -- the U.S. central bank -- would base its actions on its forecast for the path of the economy, and would not wait for clear evidence the recovery has taken hold:

"It's incumbent upon us to ... be forward-looking in our story. Yes, there's slack, but it's going away. Yes, people are still unemployed, but people are being put back to work. And the alternative of not tightening and not beginning this process is to create a destabilizing round of inflation. ... If we can't tell that story we shouldn't be tightening."

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