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PAVEL GERTLER AND
ROMAN HORVÁTH

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www.nbs.sk

Imricha Karvaša 1

813 25 Bratislava

research@nbs.sk

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Market Reading of Central Bankers Words. A High-Frequency Evidence.¹

Pavel Gertler² and Roman Horváth³

Abstract

This paper examines the financial market impact of intermeeting communication of the members of the European Central Bank's Governing Council (GC) using high frequency data in the period 2008–2013. Constructing a rich dataset of GC members' public statements (speeches, conference discussions and media interviews) between monetary policy meetings allows us to investigate a detailed pattern of market responses to the ad-hoc communication of central bankers. Using least squares and quantile regressions, we document the impact of policymakers' public statements on interest rates and the stock market with very little or no impact on exchange rates. In general, we find little evidence that the timing, sequencing or content of communication matters in immediate response. On the contrary, the results suggest that the market concentrates on the communication of key members of the committee.

JEL classification: C1, E5, G21.

Keywords: central bank, communication, European Central Bank.

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² National Bank of Slovakia, email : pavel.gertler@nbs.sk

³ Charles University, Prague, Czech Republic, email: roman.horvath@gmail.com



1. INTRODUCTION

From the ivory tower to the forefronts of the media coverage, central banking has come a long way and transformed immensely over the past quarter century. In these days, press conferences of major central banks are among the most scrutinized events in world media. Every word from the mouth of the authority and each change in semantics and tone are thoroughly monitored, and sentiments thereof are reflected in the market.

Because the pace of events with reach to the economy is quicker than the interval of policy meeting rounds, demand for new information and guidance from central bank officers is ever increasing.

Verbal communication has been a traditional tool of central banks, but since the global financial crisis, central banks' verbal communication has exhibited some novel features. First, central banks have started to communicate financial (in)stability issues more intensively. Second, given the implementation of unconventional monetary policy measures, the content of verbal communication has also broadened. Third, financial markets have become much more complex and integrated with non-negligible international spillovers. In addition, fourth, given the limited fiscal space in the global economy, more attention has turned to central banks to combat the crisis. Thus, the communication of central banks, both official and ad-hoc, has become an important pillar of monetary policy framework since the outburst of global financial crisis.

Worldwide research assessing the effects of central bank communication on the financial market is quite rich (Blinder et al., 2008). It assesses the impact of different sources of communication — official publications, press conference communication, data releases, verbal interventions and others. It also looks at different segments of the market that are affected — asset prices, foreign exchange markets and interest rates. In terms of data, some approach the issue with daily data; some expand to higher frequency.

The aim of this paper is to explore a rich dataset of all verbal statements of the European Central Bank (ECB) Governing Council (GC) members and by matching them with the high-frequency financial market data to assess an immediate impact of ad-hoc communication made between the GC policy meetings on interest rates, stock prices and exchange rates.



We examine the verbal statements of members of the central bank committee, known for its collegial decision-making (Ehrmann and Fratzscher, 2007b). Under this type of decision-making, the content of individual communication events might be similar. This potential similarity of the content of communication might be amplified by a high number of committee members, which is several times greater than the size of a typical monetary policy committee. Therefore, the effect of central bank communication on financial markets might be weaker in such an institutional setting.

We cover the verbal communication regarding standard and non-standard policy measures and focus on a wide set of financial markets: interest rates, exchange rate and stock market. We are not aware of any empirical study that examines the effect of verbal central bank communication on financial markets using high-frequency data. We revisit previous evidence regarding the timing, sequencing and content of verbal interventions of central bank policymakers, including issues such as home bias or tenure effect in the communication.

We find that financial markets are affected by verbal intermeeting communication of GC members, especially the interest rates, even once we control for excess liquidity, uncertainty, pre-communication changes in the value of financial assets, releases of macroeconomic news and other specific features. Despite working with high-frequency series, we also address a number of eventual remaining endogeneity issues. Although we find much noise in the communication that may come from the size of the committee, its management style, means of operation and members' decision-making principles, some patterns are visible. One of the interesting patterns that deserves further attention is that markets learn and adjust their response over time and listen and respond to news selectively.

The paper is organized as follows. Section 2 discusses the related literature on central bank communication. Section 3 introduces our dataset. Section 4 presents our empirical strategy to evaluate the effects of central bank communication on financial markets. We provide the results in section 5 and conclude in section 6.



2. RELATED LITERATURE

Research examining the effects of central bank communication on financial markets dates back to the mid-1990s, when central banks around the world started shifting towards inflation targeting regimes and in general towards greater transparency in communicating their objectives. We refer the reader to Blinder et al. (2008) and Reis (2013) for surveys on central bank communication or central bank governance literature.

Monetary policy has become increasingly forward looking, and expectations regarding the future course of policy have played an even more prominent role. In the early days, verbal interventions were targeted towards the foreign exchange markets. This legacy remained in place in the early years of the euro area. Policymakers' remarks on the exchange rate were the focus of Fratzscher (2006), who finds that such remarks have both short- and long-term effects on the actual exchange rate even if the communication is not accompanied by action. De Haan and Jansen (2009) also look back on the first decade of the euro area by providing an overview of communication practices of the ECB.

More related to our research focus, i.e., studying verbal communication of the policy makers and assessing its immediate financial market impact, are De Haan and Jansen (2005, 2007), who examine the effect of verbal interventions of the ECB on the euro-dollar exchange rate, using daily and intraday data. They do not find that these interventions affect the exchange rate using daily data. However, using the intraday data, the interventions matter, but their effect is short-lived and economically small. Also for the U.S., Rosa (2011) finds a swift response of the US dollar nominal exchange rate to the communication of FOMC members.

Reeves and Sawicki (2007), Ranaldo and Rossi (2009) and Wongswan (2009) also use intra-daily data and focus on written and scheduled monetary policy announcements. Ranaldo and Rossi (2009) examine speeches and interviews in Switzerland, but speeches and interviews represent only a small part of the unscheduled communication of central bankers.

Siklos and Bohl (2007) conclude that deeds are still more powerful than words, although they note that construction of the communication coding is essential. The coding that we use in our paper therefore follows the standard applied in this area, which was first used by Ehrmann and Fratzscher (2007).



Most of the research in this field examines either official sources of communication (mostly written and well documented) or communication on policy meeting dates, which provides a regular schedule simplifying the analysis. In contrast, our attention is turned to the communication between meetings, which is often ad-hoc and not pre-announced (with the particular exception of prepared speeches). Rosa (2016) approaches the concept used in this paper, looking distinctively on the not pre-announced communication, and finds only limited (if any) effect of such communication of FOMC members on high-frequency financial market prices in the U.S.

To some extent, this paper is also related to the literature on committee voting. Market sensitivity to the statements members of the board make in public is closely linked to the structure of the committee, its management style and its daily operation. Many different factors may drive policymakers in disclosing their views or revealing their preferences, e.g., effort to reach consensus and downplay diversities (Besley et al., 2008), whether collective or individual accountability is prevailing in the committee (Issing, 2005) or simply degree of transparency (Goodfriend, 2007).

3. DATA

Our dataset is constructed from two main sources of data. First, we collect public statements related to future guidance in conventional and unconventional monetary policy and in economic outlook, which we extracted from speeches and media interviews of all ECB Governing Council members. Second, we collect high-frequency financial market data, namely EONIA swap rates, stock market and exchange rate data. Our dataset is the result of merging these two sources so that each public statement is framed in a window of one hour before and two hours after the timestamp of the message attached to the respective article in the Reuters News.

Our merged dataset hence comprises 1384 public statements (herein also termed communication events) of the ECB GC members between July 2008 and January 2014. In the balanced panel setting, i.e., fitted to the full window of high-frequency financial series, the full dataset corresponds to over a quarter million observations (181 minutes of 1384 communication events) of high-frequency financial series enriched with the number of



attributes related to the member of the GC, specific communication characteristics and most importantly, the coding of the communication events.

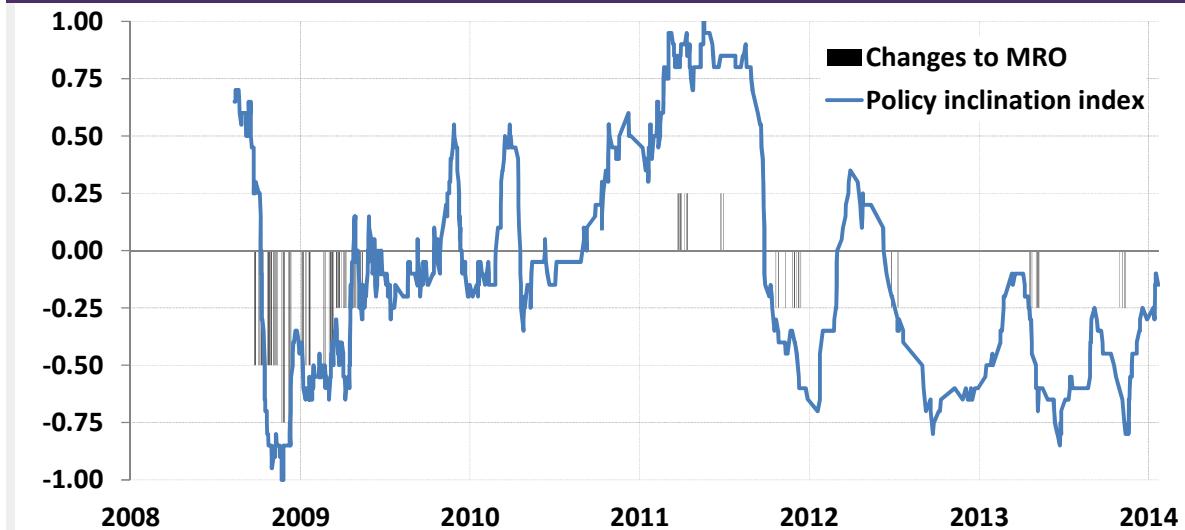
3.1 CENTRAL BANK COMMUNICATION DATA

The source of data is Reuters News of the Thompson Reuters Eikon. We follow the methodology of Ehrmann and Fratzscher (2007a) and filter out all forward-looking statements made by Governing Council members (i.e., all members of the Executive Board and national central bank governors) between the policy decision meetings.

To identify the communication related to economic outlook, we use the following set of terms: economy, economic outlook and recovery. To identify the communication related to conventional monetary policy, we use the terms interest rates, inflation and monetary policy. To identify the communication related to unconventional monetary policy, we use the extended set of terms: liquidity, refinancing operations, unconventional, asset purchases and deposit rate.

Each of the 1384 forward-looking communication items is classified according to the inclination to tightening or easing policies and alternatively according to the positive or negative outlook. The value of 1 is assigned if a central banker talks about the upward risks to price stability, positive economic outlook or future policy tightening, including unwinding unconventional policies. The value of 0 is assigned to those events that imply no future policy change or a neutral economic outlook. The value of -1 is assigned if the central banker warns about downside risks to price stability, promotes further easing policies or sounds alarm of a weaker economic outlook. The coding of communication events was conducted independently by research assistants and one of the authors. It was confirmed and consolidated by the second author.

To justify the construction of the policy inclination code, which despite the plurality of its collection, careful cross-check and consolidation is subjective by nature, we construct a policy inclination index as a moving average of the policy inclination code and plot it with the actual changes to the policy rate over time (Figure 1).

Figure 1 – Policy inclination index and policy rate changes


Source: own computations

Note: The policy inclination index represents the prevailing temper of policymakers' comments calculated as a moving average of 20 previous policy inclination codes attributed to public statements of GC members about monetary policy and economic outlook in intermeeting periods. Changes to the MRO are actual cuts or hikes in the main refinancing rate. The sample runs between July 2008 and January 2014.

Plotting the constructed policy inclination index with actual policy changes goes beyond envisaged cross-checking purposes. It also documents that easing policies have been pursued in a much more abrupt mode than tightening policies, where it took several months of discussions and open tightening sentiments before the two hikes were realized in 2011. On top of that, deeply negative policy inclination index in 2013 reflects that GC members communicate more policy easing above what could be potentially implemented by conventional policy.⁴

We enrich the dataset with number of characteristics that we want to test in the later stage. First, we do a content related classification of communication events. We create a dummy variable (D1) for communication related to unconventional policies, if a central banker talks about excess liquidity, volume of longer-term refinancing operations, security purchases, OMT, collateral rules and possibly other measures. Similarly, we construct a dummy variable to indicate whether communication exclusively relates to real economy considerations (D2).

⁴ Zero lower bound was nominally reached in November 2013, when MRO was cut to 0.25%, and the deposit rate has remained fixed at 0.00%. Because of the presence of excess liquidity, the policy rate (EONIA) has been fluctuating just few basis points above zero.



To test for the effect of the eventual overflow of new information and to search for a pattern of attention that the market follows, we generate a variable measuring duration between two consecutive communication events (A1). Additionally, we generate a variable identifying the sequence of a message with identical content delivered by different policy makers in a short period of time (A2).

In the case of the former (A1), we examine whether the time elapsed between communication events has an effect on the size of the financial market response. We hypothesize that if a central bank communicates with excessive frequency, the impact on financial markets is weaker. A motivation comes from the data on merger announcements, where Giglio and Shue (2014) show that “no news is news”, i.e., that the absence of news and the length of absence of news often contain information.

In the case of the latter (A2), we test the theory proposed by Hess and Niessen (2010), who claim that even a well-established indicator can lose market impact if a similar indicator is launched and released earlier. According to this finding, policy-makers’ communication would attract less attention with an increasing rank of the message with identical content, no matter who talks. We also generate a dummy variable, which takes unitary value, if the communication event occurred less than 10 days prior to a monetary policy meeting (D3). This is motivated by the evidence by Ehrmann and Fratzscher (2007a), who find that central bank communication has a stronger effect on financial markets prior to monetary policy meetings.

The key set of dummy variables is related to who communicates. Therefore, we create dummy variables for the President (D4; note that during our sample period, two different presidents served in the office) to address the hypothesis whether financial markets react more strongly to communication from the chairman of the board. Some previous empirical evidence finds that the chairman (president) plays a major role in central bank committees, being able to influence the interest rate setting decision disproportionately, and markets may respond to him/her with higher intensity (Chappell et al., 2004, Goodfriend and King, 2005). Similarly, a member of the Executive Board may be treated as being better informed as an ECB insider (D5).

Finally, we construct a number of other possibly relevant dummy variables:



- A dummy for overlapping communication events (D6; less than 10% of our sample) and exclude them in one of the robustness checks,
- A dummy for tenure that takes the value of 1 if the central banker has served in the Governing Council for more than 180 days at the day of communication event (D7). This dummy variable captures the effect of learning and conformity, as previous evidence has shown that it takes some time before new central bankers start disagreeing with the majority (Berk et al., 2010). Also Besley et al. (2008) claim that less tenured members may tend to have stronger and less predictable reaction patterns.
- A dummy that takes a value of 1 if the assigned value of previous communication is different from the current value of the communication event (D8) to capture the effect of potential change in the trend,
- A home bias dummy that captures the home bias effect (D9, i.e., whether the central banker communicates systematically differently when in her/his homeland; Frankfurt excluded). Existing literature (Jung and Latsos, 2015) claims that communication language and “home feel” may provoke more open communication.
- A dummy to test whether the communication event occurred in a financial center (D10; London, Frankfurt, NYC, Tokyo, Hong Kong, Singapore, Shanghai and Zurich),
- A dummy indicating whether the policy-maker comes from
 - A founding member country of the euro area,
 - A country under financial stress (e.g., Cyprus, Greece, Italy, Portugal or Spain),
 - Or a core member state of the euro area (Austria, Belgium, Germany, France, Netherlands),
- A dummy for the releases of macroeconomic news⁵, with the value of one on the days when news are released
- A dummy for the Draghi London speech on July, 26, 2012

The rationale for the full set of dummies and control variables is summarized in Table 5 in the results section.

⁵ We collect the dates, when first releases and flash estimates of euro area inflation and GDP have been published by the Eurostat.

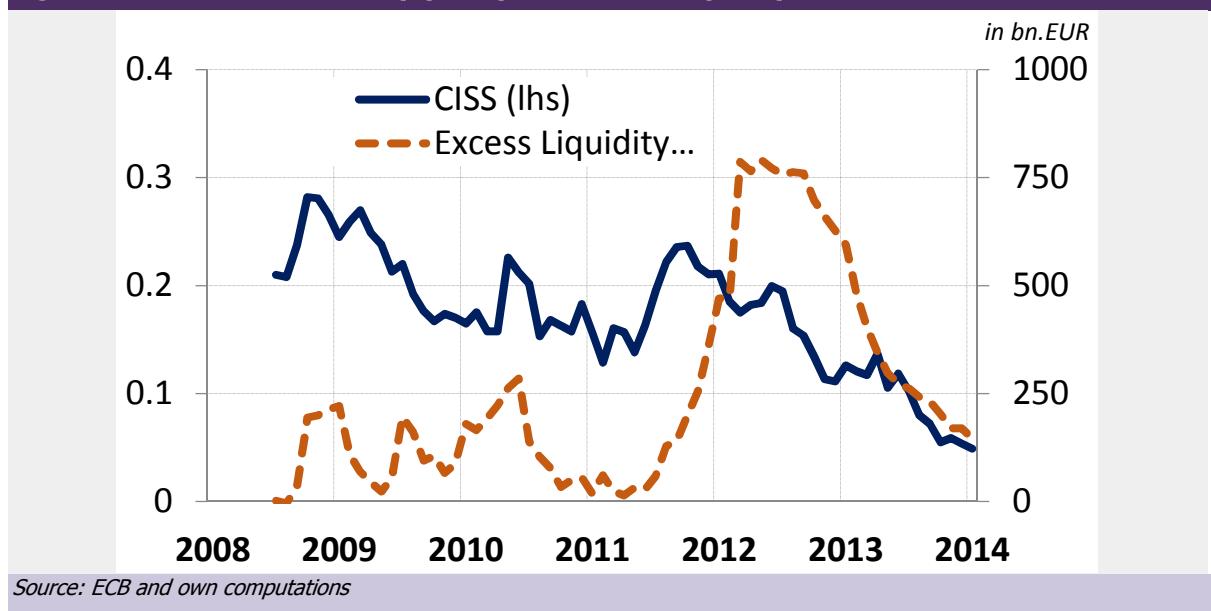
We first estimate the regressions for the full sample and then include these dummy variables to create a restricted sample to assess to what extent the communication effects differ. In addition, we also conduct robustness check, where we include economic policy uncertainty index developed by Baker et al. (2016).

EXPLANATORY VARIABLES

We gather two additional explanatory variables. First, we calculate weekly series of excess liquidity (EL) in the Eurosystem in bn EUR.⁶ We expect that shocks may generate a larger financial market response in the environment of high excess liquidity. Ignoring the liquidity variable, we could overestimate the effect of central bank communication (see Jiang et al., 2011, and Mayordomo et al., 2011, who show how liquidity effects matter in evaluating the impact of macroeconomic news on price discovery in financial markets).

Second, we use a weekly measure of market uncertainty, the so-called CISS, developed by Hollo et al. (2012). Our assumption is that higher uncertainty is likely to be associated with higher volatility in financial markets, and as we work with high-frequency data, volatility could play an important role in our analysis.

Figure 2 – Market Uncertainty (CISS) and Excess Liquidity



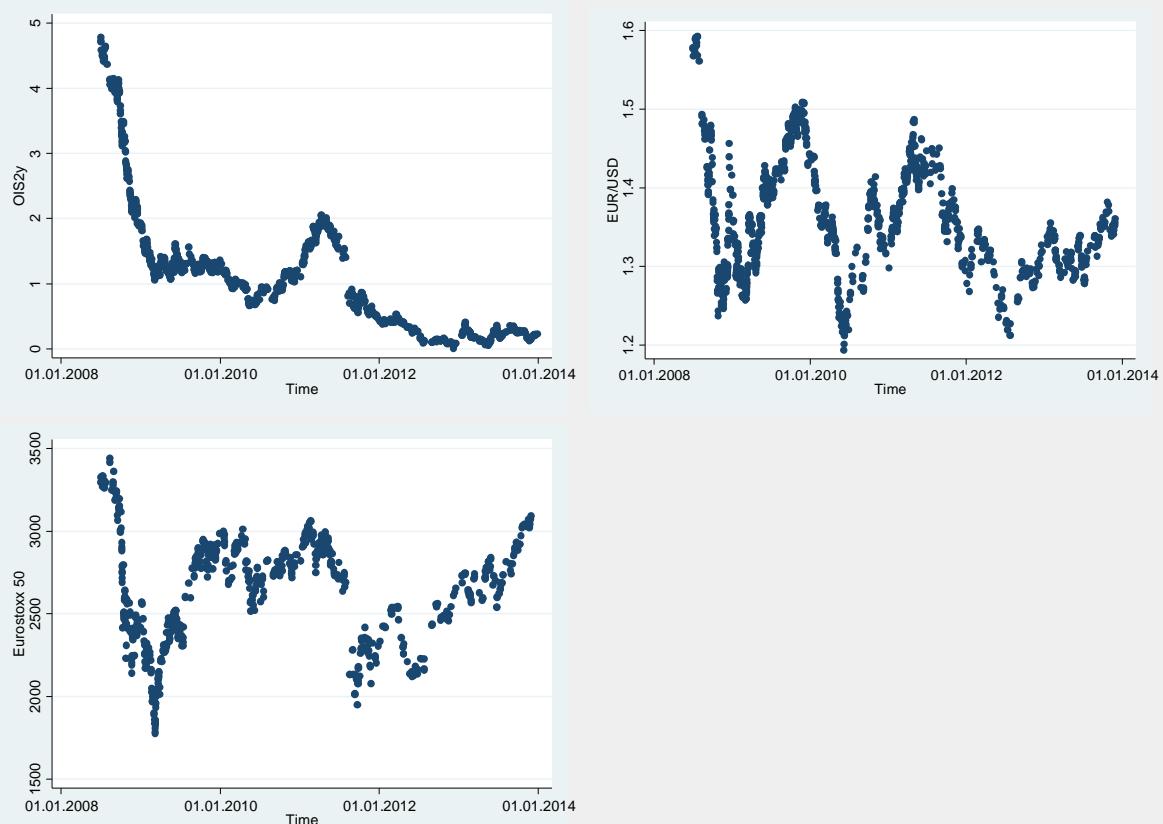
⁶ Excess liquidity is calculated as deposits at the deposit facility net of the recourse to the marginal lending facility, plus current account holdings in excess of those contributing to the minimum reserve requirements (Monthly Bulletin, January 2014, page 69).

We always use the most recently known weekly value of CISS and EL prior to a policy-maker's statement. The series for the two explanatory variables are presented in Figure 2.

3.2 FINANCIAL MARKET DATA

We use high-frequency historical series of interest rates, exchange rate and stock market data to provide a comprehensive assessment on the effect of central bank communication on financial markets. For interest rates, we use several maturities on the overnight indexed swap (OIS) curve, namely 1-month, 3-month, 6-month, 1-year, 2-year and 3-year interest rate swaps. Next, we collect EUR/USD rate and Eurostoxx50 index to capture exchange rate and stock market developments in the euro area. The source of our data is Thomson Reuters Tick History database. For illustration purposes, we present 2 years maturity swap rate, exchange rate and stock market prices over our sample period in Figure 3.

Figure 3 – OIS 2-years, EUR/USD exchange rate and Eurostoxx 50



Source: Thompson Reuters



3.3 DESCRIPTIVE STATISTICS ON COMMUNICATION AND PRELIMINARY ANALYSIS

Central bank communication data, as described in section 3.1, and high-frequency financial market data, as described in section 3.2, are merged into one master dataset using the common identifier, i.e., the date and time of the communication. The master dataset is a balanced panel comprising 1384 communication events, each within the time window of 60 minutes prior and 120 minutes after the time of the associated article's first appearance in Reuters News. We present the basic summary statistics of the master dataset in Table 1.

Table 1 – Summary Statistics

	Mean	St. dev.	Min	Max
Communication news	-0.080	0.833	-1	1
Communication climate	-0.085	0.068	-1	1
CISS	0.190	0.063	0.035	0.289
OIS 2Y	0.010	1.384	-10.137	9.325
EUR/USD	0.0203	0.261	-1.281	1.909
STOXX	-0.0283	0.597	-5.341	3.874

Source: own computations

Note: The excess liquidity data are not reported because of their confidentiality. OIS 2Y, EUR/USD and STOXX are in the first differences taken as 60 minutes after and 15 minutes before the communication event.

The mean effect of communication news is slightly negative, which corresponds to the low inflation environment with weak economic activity characteristic of the global financial crisis. According to our classification, the central bankers issued 39% negative comments, 30% neutral comments and 31% positive comments during our sample period.⁷

4. MODELLING APPROACH

Using the dataset described above, we examine financial market impact of central bank communication. The high frequency feature of the dataset reduces simultaneity concerns, i.e., that communication events do not occur at the same time as other events (or news)⁸,

⁷ The distribution of central bank communication events over trading hours is largely uniform (the histogram is reported in the annex).

⁸ In one of our robustness checks we exclude all central bank communication events, which occur at the same day when macroeconomic news are released.



which is typical for working with daily frequency (Gurkaynak and Wright, 2013, Rosa, 2016). As a result, the effect of central bank communication can be estimated more accurately.

We use a framework similar to some previous studies that examine the effect of macroeconomic news on treasury yields (Swanson and Williams, 2014a, Swanson and Williams, 2014b, Moessner et al., 2015). The simplest version of the equation we estimate is the following:

$$\Delta y_{t+s,t-q} = \alpha_0 + \alpha_1 x_t + \varepsilon_t \quad (1)$$

The left hand side variable, $\Delta y_{t+s,t-q}$ represents the response of financial markets, x the value of event, t denotes the time of communication event, $s>0$ and $q<0$. We take $q=-15$, i.e., the value of financial asset 15 minutes prior communication event.⁹ We set $s=15, 30, 60$ or 120 , i.e., examining the value of financial asset 15, 30, 60 or 120 minutes after the communication event. We choose this timing in line with previous literature (see, for example, Bauer, 2015) and prefer $s=60$ in our baseline regression specifications.

We extend the equation (1) to contain the lagged dependent variable and additional control variables. Thus, we estimate the equation (2), where we additionally include a lagged dependent variable and control variable (to keep notation simple and illustrative):

$$\Delta y_{t+s,t-q} = \alpha_0 + \alpha_1 x_t + \alpha_2 \Delta y_{t-q-1,t-q-s-1} + \alpha_3 z_{t-u} + \varepsilon_t \quad (2)$$

where $u>0$. We estimate the equation (2) by ordinary least squares (OLS) to grasp the mean effect of explanatory variables. Nevertheless, we believe it is also worthwhile to estimate the equation (2) by quantile regressions for the two following reasons.

First, the institutional structure of the ECB Governing Council is specific. The number of council members is large, compared to monetary policy committees in other central banks. The council also consists of two types of central bankers: members of the Executive Board residing in Frankfurt and the national central bank governors residing in their respective member states. The council decision-making is largely collegial and, for example, the voting record from monetary policy meeting is not available. Therefore, it is likely that council

⁹ It is a common practice in the related literature (e.g., Ehrmann and Fratzscher, 2007b, p.514) to set the reference time prior to the first release of news through Reuters. Such a buffer relates to the processing time of an event becoming public news. This buffer reflects the upper limit of such processing time that should allow any news to reach the newswire. See also <http://www.reuters.com/info/disclaimer>, which notes that delays in releasing the news may occur.



members will independently deliver an identical message regarding the ECB monetary policy multiple times. As a result, the mean effect of central bank communication is more likely to be close to zero. A similar approach is conducted by Chevapatrakul et al. (2009) when estimating the Taylor rule.

Second, central bank communication may have stronger effect on the markets in those instances, where actual market responses are sizable, i.e. the communication effects can be stronger at high and low conditional distributions of the dependent variable. As a consequence, we propose a quantile regression model to examine the effects of central bank communication on financial markets. For simplicity, let us denote the dependent variable as Y_{t+1} of size $T \times 1$ and depend on the vector of exogenous variables X_t of size $T \times k$, with $k - 1$ exogenous variables and a constant.¹⁰ $\beta(\tau)$ is the $k \times 1$ vector of parameters to be estimated and $\varepsilon(\tau)$ the $T \times 1$ vector of error terms. The τ -th conditional linear quantile regression model is defined as $Y_{t+1} = X_t \beta(\tau) + \varepsilon(\tau)$. The τ -th quantile of the error term conditional on X_t is assumed to be zero. As the quantile regression model is linear, the τ -th conditional quantile of Y_{t+1} can be written as: $Q_\lambda(\tau / X_t) = X_t \beta(\tau)$. The parameters in the quantile regression model are estimated by minimizing the weighted absolute deviations between dependent variable and a linear combination of exogenous explanatory variables. We use the simultaneous quantile regressions with bootstrapped standard errors.

In addition, there is a study on endogenous events (Schultz, 2003) that shows that if events are not exogenous and it is possible to predict them (at least partially) with the financial market returns, the effect of the event on returns will be underestimated. Therefore, we propose a two-step approach, where we regress the communication code (x_t) on excess liquidity and CISS. Next, we save the predicted value of the communication code from this model. We generate the surprise communication as the difference between predicted and actual value of communication code and estimate the equation (2) with surprise communication instead of actual communication. In our opinion, the endogeneity of the content of central bank communication events is an empirical issue. Central banks are forward-looking and typically use communication as the tool for (inflation) expectations management (Blinder et al., 2008). Therefore, if the central bank is fully forward-looking and

¹⁰ Note that when talking about Y and X we simplify notation and use $t+1$ and t for illustrative purposes. Once we estimate our model with actual data using quantile regressions, the subscripts are set as in the Eq. (2).



bases its decision on the expected economic developments, the communication events are unlikely to be endogenous. However, central bank decision making is a subject to uncertainty. If this uncertainty is high, it might be worthwhile to be less forward-looking, and the current (and past) state of the economy may be the most accurate signal about future economic developments.

5. RESULTS

This section provides our results on the impact of communication of ECB Governing Council members on interest rates, exchange rates and the stock market. First, we present our baseline regression results using the full sample and OLS in Table 3, quantile regression in Table 4 and the two-step approach in Table 5. Second, we discuss the robustness checks.

5.1 BASELINE RESULTS

Given that all possible combinations of explanatory variables and different market response windows (note our discussion in section 3 on how we obtain the restricted samples) lead to more than 3000 estimates, we present only the baseline justified by previous literature findings and economic common sense. Regarding the OIS rates, we present the results for 2-year maturity because it largely coincides with the monetary policy horizon of central banks. Regarding the window size, we opt for the market response within one hour from the communication event, i.e., 75-minute window (including 15 minutes before the communication event).¹¹ In terms of quantiles, one has to keep in mind that monetary policy has been on the easing mode for the large part of our sample period. Therefore, we limit ourselves to presenting only the results for the 10th quantile.¹²

¹¹ We are motivated by the approach and findings presented in previous studies. For instance, Gurkaynak et al. (2006) claim that "*by shrinking the event-study window down to an hour or less, it becomes much less likely that any other significant events took place within this narrow window that might have influenced asset prices, thereby increasing the precision of our estimates*". Further to this, Rosa (2011) finds that "*equity indices tend to incorporate FOMC monetary surprises within 40 min from the announcement release*". Moreover, he confirms his findings in his later paper (Rosa, 2016), where he examines financial market impact of FOMC communication and documents that most of the market response is over by 60 minutes after a communication event.

¹² Results for the 90th quantile are broadly similar and are available upon request.



Although the correlations among some explanatory variables are statistically significant, the levels suggest that multicollinearity is unlikely to affect the results (the higher correlation of 0.51 is not surprisingly between the communication news and communication climate).

We find that central bank communication matters especially for interest rates and stock markets and less so for exchange rates. The positive and statistically significant coefficient for the public statements at the 10th quantile (as well as for OLS) implies that communication of easing policies or bleak economic outlook are followed by a decrease in stock market prices and interest rates. Our results regarding the communication hold even after controlling for excess liquidity, prevailing communication climate, level of market uncertainty and lagged dependent variable.

The lagged dependent variable is statistically significant in all specifications. The coefficient on the lagged dependent variable is positive but far from one, reflecting that financial market prices have on average behaved differently before and after the communication event. Uncertainty and excess liquidity matter more at the 10th quantile. This is in line with our expectations that liquidity and uncertainty effects propagate more strongly under exceptional conditions. Higher market uncertainty (as proxied by the index of financial market stress, CISS) is associated with greater downfalls in interest rates at the 10th quantile. Communication of easing policies and negative outlook in the presence of higher excess liquidity causes an additional reduction in interest rates and a larger depreciation of domestic currency. Communication climate seems to matter only marginally.

5.2 ROBUSTNESS CHECKS

We exploit the rich dataset and conduct extensive robustness checks on our baseline findings. We have explored number of attributes to search whether specific pattern of market responses was driven by any particular characteristics of communication.¹³ The robustness checks are split into two blocks. In the first block, we use the available attributes of the dataset (outlined in Table 2) and engage in a sub-sample analysis.

¹³ Full results are available upon request.



Table 2 – Robustness checks and their rationale

Attribute	Rationale for the robustness check
D1 Non-standard monetary policy measures	Communication on the topics other than inflation or interest rate hikes and cuts is less regular in nature, wording tends to be more fluid and variable. Therefore, market participants may perceive such communication in a different manner.
D2 Real economy considerations	Similarly to the above, communication events regarding economic outlook may have different properties than communication events on monetary policy and inflation.
A1 Duration between two communication events	Excessive frequency of communication may weaken the impact on financial markets (Giglio and Shue, 2014)
A2 Sequence of communicating specific message	Those communication events, which go opposite the previous direction in terms of hawkishness / dovishness or do carry some new information may have attract more attention than the rest.
D3 Less than 10 days to next GC meeting	Central bank communication may have stronger effect on financial markets shortly before monetary policy meeting (Ehrmann and Fratzscher, 2007a)
D4 ECB President	The role of the ECB President may prove decisive for market attention. Being a chairman of the GC gives more opportunities to stir discussion and therefore his voice may be more listened to.
D5 ECB Executive Board	An Executive Board member may be treated more as an insider by the markets since (s)he resides in Frankfurt and is likely to be better informed.
D6 Non-overlapping communication events	Some communication events in the database occur within the window of a previous communication event. Regression using only those events that do not interfere with any other communication within their window provides for results that may clear additional concerns about endogeneity.
D7 More experienced central bankers	It may require some time until newcomers at the ECB Governing Council learn the whereabouts of their new role. Also, messages from senior members may be perceived differently by the market.
D8 Code change (Hawk/Dove)	Different orientation of policy communication may capture the effect of potential trend change
D9 Communication in home countries	Governors of the NCBs and ECB Executive Board members are more likely to talk in their home countries and also may feel more freedom in their expression (especially if communication is delivered in national language). So called "home bias" has also been documented in the literature (Jung and Latsos, 2015).
D10 Communication in financial centers	Alternative to "home bias", communication events in main financial centers, in proximity to major trading floors, may be more attended and more closely monitored than communication in more remote locations.
D11 NCB governor of a founding member of the	Although the Treaty on the Functioning of the European Union stipulates in the Article 121 that "Member States shall regard their economic policies as a matter of common concern...", the nationality of an NCB governor or affiliation to EB may serve as a prerequisite for some typical views and opinions that shall be tested. Similarly, it may matter whether the representative is from the country experiencing financial stress.
D12 NCB governors of member states in	
D13 NCB governors of core member states	
D14 Draghi London speech	We exclude the Draghi London speech from July, 26, 2012, where he stated that: "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." This communication event had long-lasting effect on financial market. This exceptional event conveyed the commitment of the ECB as a lender of last resort rather than signaled the view about the future monetary policy.
D15 Macroeconomic news	We exclude the central bank communication events on the days, when macroeconomic news are released. We consider the following macroeconomic news: the euro area consumer price index (HICP) and gross domestic product (GDP) releases, including the releases of their flash estimates.
D16 Global environment – uncertainty	Global factors such as heightened uncertainty may matter in addition to measures of the euro area systemic stress. As an additional explanatory variable, we use the US Daily News Economic Policy Uncertainty Index developed by Baker et al. (2016) to proxy for global uncertainty. The source of this data is http://www.policyuncertainty.com .



Table 3 – Effect of ECB Communication on Financial Markets, OLS

	OIS 2Y				EUR/USD				STOXX			
Communication	0.148 (3.25)	0.166 (3.20)	0.147 (3.32)	0.075 (2.28)	0.003 (0.43)	0.015 (1.50)	0.007 (0.82)	-0.019 (-2.11)	0.054 (1.93)	0.055 (1.96)	0.039 (1.56)	0.010 (0.73)
Communication climate	- 0.058 (-0.61)				- 0.035 (-1.97)			- 0.004 (-0.01)				
CISS		-0.11 (-0.17)				0.23 (1.77)				-0.96 (-0.20)		
Excess liquidity			0.000 (1.34)				0.000 (0.12)			0.000 (-1.22)		
Lagged dev. var.				0.604 (19.3)				0.605 (25.7)			0.688 (16.8)	
No. of observations	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384

Table 4 – Effect of ECB Communication on Financial Markets, Quantile Regressions

	OIS 2Y				EUR/USD				STOXX			
Communication	0.345 (4.90)	0.340 (3.66)	0.165 (2.85)	0.236 (3.03)	0.02 (1.23)	0.02 (1.11)	-0.006 (-0.35)	-0.005 (0.35)	0.155 (3.00)	0.099 (1.74)	0.093 (1.94)	0.062 (2.69)
Communication climate		0.068 (0.42)				-0.019 (-0.67)				0.173 (1.88)		
CISS		-8.06 (-9.09)					-0.95 (-5.26)			-3.65 (-5.48)		
Excess liquidity			0.001 (3.55)					0.000 (2.64)			0.000 (0.60)	
Lagged dev. var.				0.60 (16.93)					0.63 (15.89)			0.718 (17.54)
No. of observations	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384

Table 5 – Effect of ECB Communication on Financial Markets, OLS, Endogenous Events

	OIS 2Y				EUR/USD				STOXX			
Communication	0.114 (2.18)	0.153 (2.78)	0.122 (2.32)	0.034 (0.92)	0.018 (1.95)	0.015 (1.51)	0.016 (1.76)	0.001 (0.19)	0.026 (1.00)	0.041 (1.53)	0.038 (1.46)	0.001 (0.08)
Communication climate		0.169 (1.98)				-0.015 (-0.87)				0.007 (1.20)		
CISS		-0.70 (-1.07)					0.18 (1.40)			-1.13 (-2.43)		
Excess liquidity			0.000 (0.37)					0.000 (0.29)			-0.000 (-1.48)	
Lagged dev. var.				0.605 (34.5)					0.603 (43.9)			0.689 (16.7)
No. of observations	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384	1384

Note: The presented coefficients reflect a market response within 60 minutes from the communication event. T-statistics are in brackets. *, **, *** - denote the significance level at 10%, 5% and 1%, respectively. 10th quantile. Constant is not reported.



In the second block, we investigate the results using different time windows for the financial market response. We alternate the window size and recalculate the results measuring the response in the value of financial asset within 15, 30 and 120 minutes after the communication event (instead of 60 minutes as used in the baseline). The significance of the effects of central bank communication on financial markets does not change dramatically with respect to the different window sizes.

To summarize these results using the restricted sample, communication on non-standard measures seems to affect the financial markets with lower intensity than communication on inflation, output or interest rates. This is likely to be related to more flexible wording and wider scope of policy options. Additionally, non-standard measures from its "non-standard" nature are much more the subject of ongoing discussions — clearly the property that has been extensively exploited by almost all members of the GC in public. Consequently, markets are not as attentive or are selectively attentive; this is also because of the size of the GC and because the capacity to make the difference in policy making is concentrated in select members of the Council.

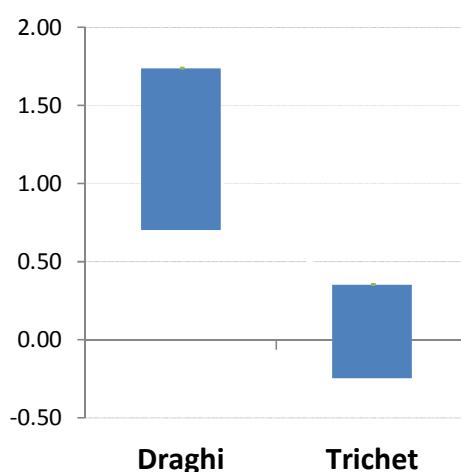
We extend our regression specifications by including a measure of global uncertainty although we use high-frequency one-minute data, which is likely to reduce the concerns about concurrent occurrence of other news and actions from different markets substantially. In addition, we have unscheduled verbal communication, which typically takes place during the day (European time), while most of the largest monetary shocks emanating from US markets come in the evening from the European perspective. We use US Daily News Economic Policy Uncertainty Index to proxy for global uncertainty. The index is based on the US newspaper archives and covers primarily articles regarding policy-related economic uncertainty. We use the value of index lagged by one day to address endogeneity issues (consider also time shift between US and Europe). We re-estimate the specifications in Tables 2-4 additionally including the uncertainty index. The index is often statistically significant in quantile regressions but does not change our results regarding the significance of other coefficients.

However, much of the noise comes with the intensity of communication (mainly from publicly expressing opinion on the future setup of unconventional monetary policies) and its discussion nature. Overall, balance sheet policies make over 20% of all communication episodes in our sample, but their discussion character made the market rather less attentive.



Abstracted for such defined noise and having tested individual policy-makers, we find that there is some pattern in how markets adjust their attention according to who is talking. We estimate the simplest OLS specification (1) (i.e. regress the change in the 2-year OIS rate on communication related to either monetary policy or economic outlook) for every GC member in the list, suing number of control variables described in the Table 5. Among many minor findings, one major pattern stands out. This pattern is presented on the Figure 4.

Figure 4 – Effect of Individual Central Bankers on 2-year OIS Rate



Note: The bars represent one standard deviation (robust errors) around the estimated coefficient a_1 (referring to the equation (1)) for the observations of the two presidents. Observations for President Draghi relate only to his tenure as President, i.e., since November 2011.

We find that markets' responsiveness has been very selective. We find a significant disproportion between how markets respond to the two Presidents in our sample. This also aligns with the style of decision making under the two leaders. While reaching consensus over the entire spectrum of the GC was very important in the former times, the necessity to adopt bolder measures and the wider composition of the GC in recent years coupled with different management styles likely led markets to listen to the President more than to any other single GC member.

Our results are broadly in line with Rosa (2016), who studied the financial market impact of FOMC members' communication. The similarities of our findings related to communication of the GC members and his findings related to communication of the FOMC members have several implications. First, the financial market impact of not pre-announced communication of the members of the policy-making body, estimated by least squares is not economically



strong. Second, the average not pre-announced verbal interventions of many FOMC/GC members have negligible impact, and markets tend to listen only to the Chairman of the FOMC or the President of the ECB. Third, if there is any impact of communication, it can be found mainly on the interest rates and asset prices, but the exchange rate market often turns a deaf ear to the ad-hoc communication of central bankers.



6. CONCLUSIONS

We examine the effect of the ECB's verbal communication on financial markets (interest rates, exchange rate and stock market) and provide insight into the patterns of how markets respond to ad-hoc communication. To do this, we use high-frequency financial series from the period between 2008 and 2013, which we couple with verbal statements of ECB Governing Council members.

The ECB's monetary policy committee (Governing Council) comprises a significantly higher number of members than is typical for other central banks' monetary policy committees. The committee is dominated by the national central bank governors. The high number of committee members residing in different European countries may increase the chances that an identical message is communicated to geographically dispersed audiences. As a consequence, it might be more likely that the ECB's verbal communication has, on average, a weaker effect on financial markets, compared to that of other central banks. Therefore, examining the ECB provides a more stringent test of the relevance of ad-hoc central bank communication.

We use least squares and quantile regressions and examine the effect of communication on interest rates, stock market and exchange rate controlling for excess liquidity, lagged dependent variable, previous trend in communication and uncertainty in financial markets. The control variables are critical to identify the effect of communication using high-frequency data. Given that we cover the period after global financial crisis, which has been characterized by higher incidence of interest rate cuts than hikes, we also control for the lagged dependent variable to capture an eventual trend in the financial series. Similarly, controlling for liquidity and uncertainty is critical to avoid misinterpreting the effect of communication for the lack of liquidity or heightened uncertainty. Finally, our results remain unchanged even if we exclude the Draghi London speech as well as the central bank communication events, which coincide with the releases of macroeconomic news.



We believe that assessment of the effect of ad-hoc verbal central bank communication on financial market, which we make in this paper, provides added value in the following areas. First, it is one of the first attempts to assess unscheduled communication rather than written and scheduled central bank communication, which previous literature has mainly dealt with. Second, high frequency allows us to look to a very detailed pattern of the financial market response. Third, empirically, our results show that central bank communication matters systematically for financial markets, especially for interest rates. We find that the effects on exchange rate and stock market are weaker. Last, we provide some evidence that attention to central bank communication is likely to be selective and that the market is capable of learning and adjusting the pattern of attention.

We subject our results to a number of robustness checks and estimate the regressions on various restricted samples, for which we assess the effect of timing, sequencing and the content of verbal communication (such as content regarding the unconventional monetary policy measures). We do not find that the effects of central bank communication are more potent for these various subsamples. In addition, we address the potential endogeneity in the central bank communication events. While the issue of endogeneity is typically ignored in the literature that addresses verbal central bank communication (Born et al., 2014, being an important exemption), the effect of communication may be biased downwards. The results accounting for endogeneity remain broadly in line with our baseline results.



LITERATURE

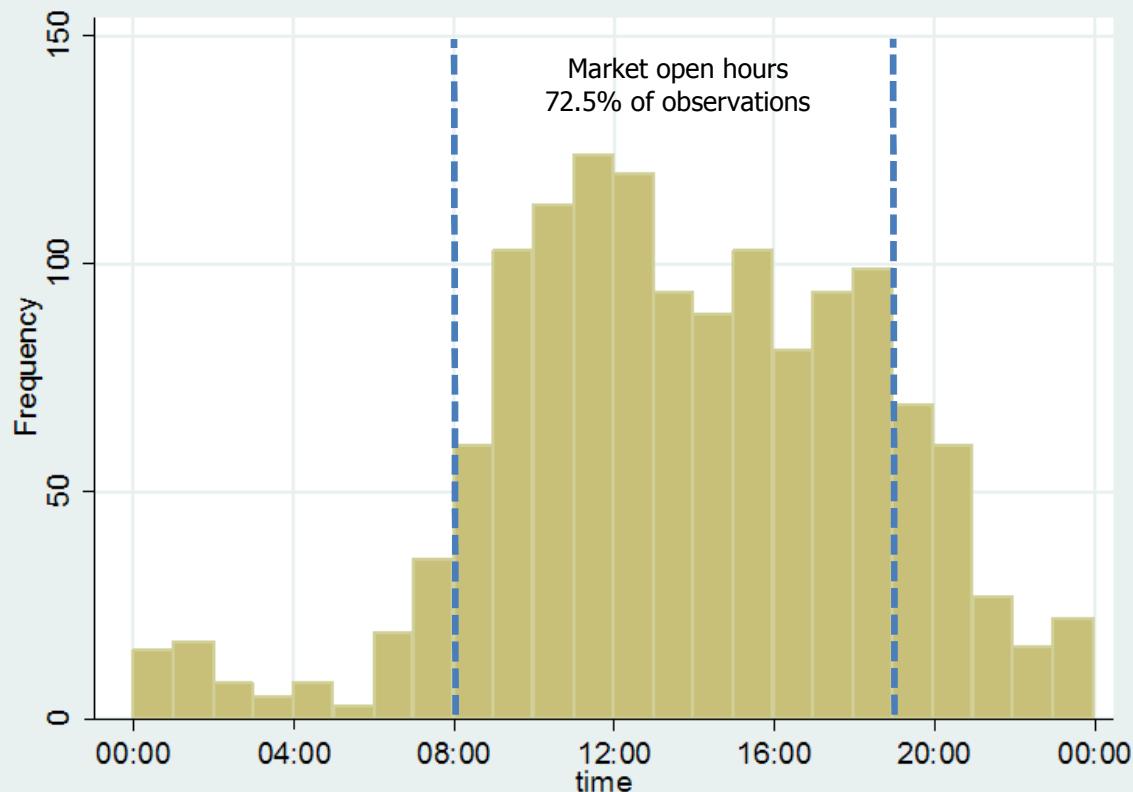
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ANNEX

Figure A1 – Distribution of communication events over daytime



Note: own computations