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Does central bank communication signal future monetary policy in a (post)-crisis era? The case of the ECB ☆

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ABSTRACT

We examine the European Central Bank's ad-hoc communication and explore how it informs future monetary policy decisions. Using the rich dataset of the inter-meeting verbal communication by the members of the European Central Bank's Governing Council between 2008 and 2016, we construct a measure of communication evaluating its inclination towards easing, tightening or maintaining the monetary policy stance. We find that this measure provides useful additional information about future monetary policy decisions, even when we control for market-based interest rate expectations and lagged decisions. Our results also suggest that, in particular, communication related to conventional measures and/or by the ECB President explain the future ECB rate changes well. All aforementioned results hold also in the environment of the zero lower bound. Overall, these results point to the importance of transparent communication in understanding the future course of monetary policy.

1. Introduction

Central banks currently use a wide set of communication tools to manage financial markets' expectations, and the use of these tools has become more intensive during the financial crisis (Blinder et al., 2017). Many central banks started operating in ultra-low interest rate environments and complemented their conventional monetary policy with several unconventional measures, such as asset purchases and forward guidance. As a result, the content of central bank communication has broadened, and central banks have started regularly communicating their views about asset purchases, liquidity conditions or interest rate commitments when referring to the stance of monetary policy.

In this paper, we examine whether central bank communication contributed to better monetary policy predictability in the (post)-crisis period (2008–2016) using detailed data on the European Central Bank's (ECB) verbal communication.[1] To

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[1] See de Haan and Jansen (2010) for an overview of ECB communication practices.

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our knowledge, this is a novel examination because the empirical literature investigating the effect of communication on monetary policy predictability has largely focused on examining how the voting records and minutes from monetary policy meetings are informative about the future course of monetary policy (Gerlach-Kristen, 2004; Horvath et al., 2012; El-Shagi and Jung, 2015; Jung, 2016). This body of literature almost unanimously finds that voting records improve monetary policy predictability, regardless of whether voting records are attributed.[2]

However, voting records are not available for the ECB, so there is no official record capturing the attitude of the individual members of the Governing Council (GC). We, therefore, collect all relevant verbal communication of the ECB's GC members, i.e., the speeches and interviews between policy meetings,[3] and compute a simple indicator of ad-hoc GC members' communication based on whether they were dovish, hawkish or neutral statements over time. Then, controlling for financial market expectations and past monetary policy decisions, we examine whether this indicator (labeled *comm*) is informative about future monetary policy decisions.

We examine several policy-relevant issues regarding the effect of verbal communication on the predictability of monetary policy. First, we focus on how central bank representatives' verbal communication predicts the future course of monetary policy. Second, we separately measure the effect of communication referring to unconventional measures. Third, we examine how informative verbal communication is for horizons longer than just an upcoming monetary policy meeting. Fourth, we shed light on whether the timing of central bank communication matters, i.e., whether verbal communication shortly before a monetary policy meeting is more informative. Fifth, we examine whether statements of specific policy members, specifically the ECB President, provide clearer messages and/or better inform markets about future policy changes. Sixth, we examine the monetary policy predictability under the zero lower bound by considering the verbal communication also during the period when the main refinancing operations rate was very close to zero (and/or deposit facility rate below zero). Seventh, we analyze the effect of other ECB's communication indicators. Eighth, we check the robustness of our results using a shadow policy rate instead of the monetary policy rate.

Our results suggest that ECB's ad-hoc verbal communication is relevant for the future course of monetary policy. This result also holds when controlling for interest rate expectations, which suggests that part of the communication is received well and is priced-in by market participants, while other parts still add information value to the policy change at a policy meeting to come. Verbal communication focuses largely on the next monetary policy meeting, but it helps predict monetary policy for longer than the upcoming meeting, to a certain extent. We also find that the communication of the ECB President is highly informative about the future course of monetary policy, including the President's communication regarding unconventional policy issues. Finally, our results hold regardless of whether we include the period characterized by zero lower bound, i.e. transparent communication improves monetary policy predictability even at the zero lower bound.

The paper is organized as follows. Section 2 provides a brief literature survey. Section 3 introduces the data, and Section 4 presents the empirical analysis. We conclude in Section 5. Additional figures and details on the coding of central bank communication events are available in the Appendix.

2. Related literature

We provide a brief literature survey in this section and focus largely on empirical studies that examine the effect of central bank communication on the predictability of monetary policy.[4]

Gerlach-Kristen (2004) introduces a framework analyzing whether voting record is relevant to predicting future monetary policy. Using the voting record of the Bank of England's Monetary Policy Committee (MPC), Gerlach-Kristen (2004) develops an indicator (*skew*) and defines it as the difference between the mean and the median of the policy rate voted for by the individual MPC's committee members. In case of consensus, the mean and median coincide, and the *skew* is equal to zero. A positive (negative) value of *skew* suggests that some MPC members prefer higher (lower) rates than the majority. Gerlach-Kristen (2004) finds that *skew* is informative for future monetary policy. This finding suggests that some committee members receive signals about an "optimal" monetary policy rate (and vote accordingly) sooner than other committee members do. This result is also obtained by El-Shagi and Jung (2015) for the UK MPC using data from 1998–2014. Riboni and Ruge-Murcia (2014) also find that *skew* is significant but fail to find evidence that the seniority of MPC members matters.

Similarly to Gerlach-Kristen (2004),Horvath et al. (2012) assess the predictive power of the voting records of five inflation-targeting countries: the Czech Republic, Hungary, Poland, Sweden and the UK. Their results show that voting records are informative in all these countries. For the identical group of central banks, Horvath and Jonasova (2015) examine whether voting records are predictive of monetary policy two and three meetings ahead. While the voting records were informative up to three periods ahead prior to the financial crisis, the predictability horizon has shortened during the crisis, and the *skew* is now significant only for the next monetary policy meeting. This result is in line with the theoretical prediction of Horvath et al. (2016), who show that heightened volatility may blur the signal that the voting record typically provides.

[2] Horvath et al. (2012) find that even a simple release of the voting ratio from monetary policy meetings helps predict future monetary policy in the Czech Republic.

[3] This is effectively any time other than on the days of monetary policy meetings.

[4] We refer the reader to Blinder et al. (2008, 2017) for surveys regarding central bank communication.

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The theoretical literature (Riboni and Ruge-Murcia, 2014; Horvath et al., 2016) examines the conditions under which *skew* is likely to be significant. The literature shows that the individual committee members must be heterogeneous (either having different preferences and information sets or different signals) and that the decision-making process regarding the monetary policy votes must allow for some degree of dissent. In addition, the votes must be non-strategic (i.e., each member casts a vote that, according to her/his opinion, maximizes the welfare of the economy, thus not giving a false signal to influence the deliberations of other committee members). The simulations of the model developed in Horvath et al. (2016) also suggest that the predictive power of *skew* increases with committee size (up to some reasonable size observed in real-world central bank committees) but worsens in more volatile economic environments and when committee members have less precise information about the state of the economy.

For the ECB, given that the voting records are not available, Pesci (2016) develops an alternative measure of future monetary policy stance based on the content of articles published by the media in the days around meetings of the ECB's GC (three-day intervals centered on ECB's monetary policy decisions). His measure is based on a script that searches articles for predefined combinations of words and counts their aggregate intensities. Each presence of any sequence is given a score of 1, −1 or 0, reflecting, respectively, a hawkish, dovish or neutral policy stance.[5] Pesci (2016) finds that his measure of ECB's monetary policy stance is informative about future monetary policy and that changes in the perception of the ECB's stance are due to the new information conveyed by the ECB president press conference.

Tobback et al. (2017) also develop a content-based indicator of the media's perception of the ECB policies, but in addition to the mechanistic approach of using predetermined words (semantic orientation), they use a classification model to predict the tone of the article to assess the language used at each press conference (using Support Vector Machines method). They find that the latter method produces more reliable results, concluding that such an index could then be used to analyze the terms that are most frequently employed by media in relation to a likely future course of monetary policy. After inserting what they call the HD index to an extended Taylor rule, they find a positive role for ECB communication in enhancing the accuracy of market expectations, with the policy messages being well understood by media watchers. Similarly, Picault and Renault (2017) develop an index of ECB communication based on the press conferences to monetary policy decisions and show the importance of the index for future monetary policy and stock market dynamics.

This paper aims to complement the picture. While pursuing the same goal of shedding more light on how the ECB communication is informative for the future monetary policy decisions, it focuses on ad-hoc communication between policy meetings rather than official communication in and around the meetings, as is the case in the aforementioned studies.

Certainly, collecting first-hand statements from policy makers could exhibit some different properties than having to rely on media coverage. In this regard, there is also related literature that assesses the ECB communication but does not focus on the monetary policy predictability. Jansen and de Haan (2005) examine the statements of ECB officials and find that these statements affect the conditional volatility rather than the conditional mean of the euro–dollar exchange rate. Jansen and de Haan (2009) estimate various Taylor rules for the ECB and show how written ECB communication helps in understanding how monetary policy rate is set. However, out-of-sample forecasting exercises suggest that central bank communication does not add predictive power to monetary policy rate forecasting based on macroeconomic data. Sturm and de Haan (2011) also examine ECB communication within the Taylor rule. Focusing on various aspects of communication measures based on the ECB President's introductory statement at the press conference, they find that the communication is informative for monetary policy decisions. Hayo and Neuenkirch (2010) examine US Fed verbal communication in 1998–2006 and construct a communication indicator as we do in this paper. Using this indicator, they estimate Taylor rules for the US Fed and find them to be relevant for monetary policy setting. Gertler and Horvath (2018) examine the effect of ECB ad-hoc communication on European financial markets using high-frequency data. The communication has the strongest effect on interest rates and the stock market, but the exchange rate response is weak.

3. Data

We draw from a rich database of verbal statements by the ECB's GC members that have appeared in Reuters News, are forward-looking and refer to monetary policy (either conventional or unconventional), inflation or economic outlook. Therefore, in contrast to many papers in this field, we do not utilize the voting record (given the consensual nature of actual monetary policy decision-making in the ECB, the voting record is not available) but instead construct a central bank communication indicator. This approach is supported by Bennani and Neuenkirch (2017), who suggest the possibility of substituting the voting records of the ECB with speeches made by national central bank governors and Executive Board members to reveal their monetary policy preferences.

More precisely, we employ the ECB's GC communication dataset used in Gertler and Horvath (2018), which contains information on inter-meeting communication by the ECB's GC during the period 2008M06 - 2014M01 and update it in this paper up to 2016M05. We focus only on communication with a forward-looking component, thereby obtaining 1769 policy statements. Gertler and Horvath (2018) classify each communication event into three categories depending on whether the communication event implies monetary tightening or easing (or *status quo*). Then, a value of 1 is assigned to a

[5] Hawkishness is characterized in this paper as the willingness of a central bank to raise its policy rates in the near future, and dovishness represents the willingness to decrease it. A neutral stance represents the *status quo*.

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communication event expressing an upward risk to price stability, positive economic outlook or preference for future policy tightening, including unwinding unconventional policies. A value of -1 is assigned to opposite cases, and a value of 0 is assigned if communication is neutral in terms of the economic outlook, price stability and monetary policy stance. See more in detail about the approach to coding the communication and some specific examples in the Appendix.

We group these data into 89 inter-meeting intervals as follows.[6] Let us denote the communication event as i and the inter-meeting period as τ, where τ is bounded between the monetary policy meetings in time t and $t+1$. The assigned value of the individual communication event is denoted as g_i, where $g_i \in \{-1, 0, 1\}$, and we denote that the value of communication event g_i belongs to time period τ as $g_{i,\tau}$. Hence, the general communication indicator *comm* is defined as

$$comm_\tau = average(g_{i,\tau}) \tag{1}$$

While our baseline estimations use $comm_\tau$, we use several more specific definitions of $comm_\tau$ to examine the predictive power of ad-hoc central bank communication by segments of interest. These specific definitions are summarized in Table 1.

For illustration, in Fig. 1, we present a scatter plot of the $comm_\tau$ indicator vis-a-vis the future monetary policy rate change Δi_{t+1}.[7] Fig. 2 presents the link between $comm_\tau$ and Δi_{t+1} over time. Both figures suggest a positive relationship, namely that higher (lower) values of $comm_\tau$ tend to be associated with rate hikes (cuts) at the upcoming policy meetings. The descriptive statistics are available in Table A1 in the Appendix.

4. Empirical analysis

4.1. The baseline model: does ECB communication signal future monetary policy?

We broadly follow the econometric methodology of Gerlach-Kristen (2004) and Horvath et al. (2012) and use an ordered probit model to assess the significance of the central bank communication ($comm_\tau$) for the policy decision made at the upcoming policy meeting. The dependent variable reflects the changes in the main refinancing operation rate (MRO) and is split into categories depending on the magnitude: large rate cuts (-50 bpts or more), rate cuts (-25 bpts), no change and rate hikes (+25 bpts). Since large-magnitude policy changes rarely happen, all rate cuts larger than 25 basis points are stacked in one category.[8] As a consequence, this reduces the number of categories to 4 in total. The baseline model is defined as follows:

$$\Delta i_{t+1} = a_0 + a_1 \Delta i_t + a_2 comm_\tau + u_{t+1} \tag{2}$$

where Δi_t is the change in the MRO at time t and $comm_\tau$ represents the central bank communication variable obtained from the statements published between monetary policy meetings at t and $t+1$.

Furthermore, it is possible that information included in past communications ($comm_\tau$) has been absorbed into the financial markets expectations. In such a case, central bank communication $comm_\tau$ would provide less additional information for the upcoming monetary policy actions. Following Gerlach-Kristen (2004), we expect financial market expectations to be expressed by the term structure, defined as a slope in the money market curve. We use the Euribor 1-, 3- and 12-month market rates.[9] The term structure for time t is computed for the last trading day preceding the day of the monetary policy meeting held at time $t+1$. The model including the term structure has the following form:

$$\Delta i_{t+1} = a_0 + a_1 \Delta i_t + a_2 comm_\tau + a_3 (i_{t,L} - i_{t,S}) + u_{t+1} \tag{3}$$

where $i_{t,L}$ and $i_{t,S}$ represent a money market rate with a longer and shorter maturity one day before the monetary policy decision.

Given that the zero lower bound environment may have an effect on the importance of communication for future monetary policy (as the zero lower bound may – or may not – decrease the efficacy of monetary policy actions, see Swanson and Williams (2014)) we run regressions based for two different samples. First, we estimate the regressions excluding the period of zero lower bound. These results are available in the Sections 4.1–4.5 below. Second, we additionally include the observations in the years 2014–2016 into our regressions and estimate regressions using data from the 2008–2016 period. Therefore, we address the issue of whether the zero lower bound environment affected the link between communication and monetary policy predictability. The results on the monetary policy predictability under the zero lower bound environment

[6] During the period under scrutiny, the ECB's GC meetings were typically held on Thursdays of the first and third weeks of each month, but the monetary policy itself was assessed only at the first meeting of the month. Therefore, we use monthly frequency in the time series. Modifications of the voting scheme introduced in 2015 apply because our sample ends in 2016 but for the baseline estimations we exclude the period of zero lower bound, i.e. the period from 2014 onwards.

[7] Note that infrequent large policy cuts are stacked into one category in the regression analysis reducing the effect of outliers; more on this in the following section.

[8] No monetary policy hikes above 25 basis points occurred in the observed period. The (infrequent) interest rate cuts smaller than 25 basis points are stacked together with the 25 basis points cuts. The number of categories was set according to the log-likelihood of competing models. The estimates of corresponding thresholds are not presented in the regressions below for the sake of brevity but they are available upon request.

[9] We avoid using the EONIA rate for its observed spikes at the end of each maintenance period prior to 2012. The end of the maintenance period could coincide with the last trading date preceding the policy meeting (the date when the measure of market expectations is calculated); hence, a slope of the money market curve defined with EONIA could be subject to bias.

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Table 1
Specific ECB communication, *comm*, definitions.

Variable	Description
$comm_{\tau}$	*comm* of all GC members
$comm_{\tau.purdah}$	*comm* within 7 days before the GC meeting
$comm_{\tau.non-purdah}$	*comm* excluding all statements within 7 days before the GC meeting
$Pres\_comm_{\tau}$	*comm* of the ECB President alone
$comm_{\tau.conv}$	*comm* related exclusively to conventional monetary policy
$comm_{\tau.unconv}$	*comm* related exclusively to unconventional monetary policy
$Pres\_conv\_comm_{\tau}$	*comm* by the President only about conventional policy
$Pres\_unconv\_comm_{\tau}$	*comm* by the President only about unconventional policy
$Non\_pres\_comm_{\tau}$	*comm* by all members except the President
$Non\_most\_talk\_comm_{\tau}$	*comm* excl. three most talkative members

Notes: "Excl. talkative members" excludes three most frequently communicating members except President.

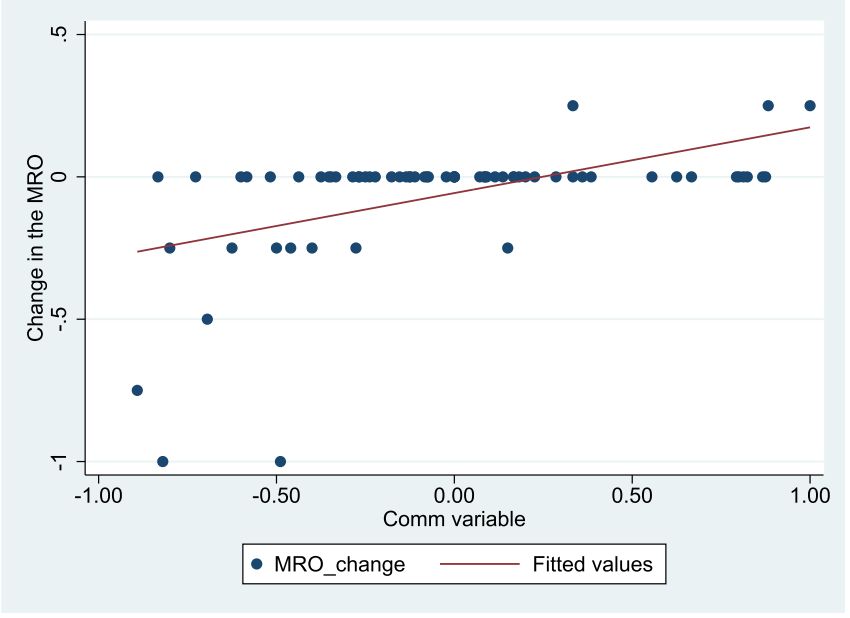

Fig. 1. ECB's communication and changes to monetary policy. Notes: The figure presents the ECB's verbal communication indicator $comm_{\tau}$ and future monetary policy rate change Δi_{t+1}.

are available in Section 4.6. In addition, we employ two alternative central bank communication indexes (Tobback et al., 2017; Picault and Renault, 2017), which are primarily based on the press conference the ECB holds after the monetary policy meetings and check whether they are informative about future monetary policy, too. Finally, we use the shadow policy rate instead of the monetary policy rate to check whether our communication indicator is informative for the alternative indicator of monetary policy stance, too.

We present the regression results in Table 2. Controlling for the lagged changes in the policy rate, the coefficient a_2 (for *comm*) is positive and statistically significant, suggesting that ECB communication in general indeed signals future policy actions well. This result holds, even after controlling for financial market expectations (at various maturities), suggesting that communication adds information value and is not fully priced-in by financial markets. Hence, the baseline result suggests that transparent and clear communication has the capacity to improve monetary policy predictability.

Note that the coefficient a_2 is greater than one, but this does not suggest any potential non-stationarity because an ordered probit is a non-linear estimator. The values of McFadden's pseudo-R^2 are similar to those reported in Horvath et al. (2012). The figures presented in the Appendix provide a visual examination of the relationship between central bank communication *comm*, policy changes and financial market expectations.

4.2. Looking more periods ahead

As shown by Horvath and Jonasova (2015), the dissent that is expressed during a policy meeting may signal a change in the policy rate in the next meeting and for meetings further ahead. The rationale behind is that it may take some time for the

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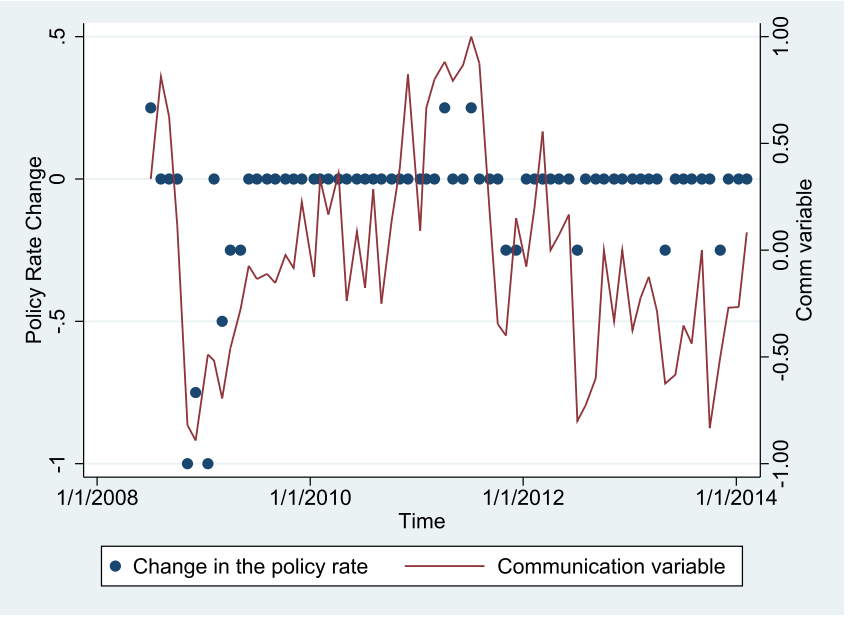

Fig. 2. ECB's communication and changes to monetary policy over time. *Notes*: The figure presents the ECB's verbal communication indicator $comm_\tau$ and future monetary policy rate change Δi_{t+1} over time.

Table 2
Information content of communication for policy decision.

	Base model	*12_3*	*12_1*	*3_1*
Δi_t	0.44 (0.3)	0.35 (0.31)	0.45 (0.3)	0.36 (0.33)
$comm_\tau$	2.51*** (0.72)	2.18*** (0.65)	2.41*** (0.75)	2.54*** (0.73)
Term structure	–	1.78 (1.45)	0.45 (0.97)	−1.17 (2.16)
Log-likelihood	−32.82	−32.15	−32.73	−32.59
Observations	67	67	67	67
Pseudo R^2	0.29	0.28	0.27	0.27

Notes: Robust standard errors are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

majority of central bank board members to receive a new signal about the economy (one of the commonly mentioned possibilities is that it takes time for the so-called early bird central bankers to convince the rest of the board members about the necessity of a policy adjustment, Horvath and Jonasova (2015)). Therefore, we investigate the relation between central bank communication *comm* and changes in the ECB's policy rate more than one meeting ahead. The estimations below cover two and three periods ahead and include the lagged interest rate change and the term structure:

$$\Delta i_{t+n} = a_0 + a_1 \Delta i_t + a_2 comm_\tau + u_{t+n} \tag{4}$$

$$\Delta i_{t+n} = a_0 + a_1 \Delta i_t + a_2 comm_\tau + a_3 (i_{t,L} - i_{t,S}) + u_{t+n} \tag{5}$$

where n stands for the n^{th} period after t.

The results describing the effect of the ECB communication on policy changes two meetings ahead are presented in Table 3. The *comm* variable is statistically significant across the estimated models. Therefore, the results suggest that the ECB ad-hoc communication matters not only for the next policy meeting. In other words, we find that communication matters even at more distant horizons (and therefore a signal does not easily fade out or is overlaid by a flow of other information arriving over time). Therefore, this result does not confirm the findings of the previous literature that most of the ad-hoc verbal interventions are short-lived. For example, Blinder et al. (2017) argue that central banks often speak with too many conflicting voices, which, however, is not typically the case for the ECB in our sample period.

In Table 4, we provide the estimates of the information content of the ECB communication for monetary policy three meetings ahead. The results are consistent with those presented in Table 3. The signal from ad-hoc central bank communication gradually fades down both in terms of size and significance.

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Table 3
Information content of communication, two meetings ahead.

	Base model	*12_3*	*12_1*	*3_1*
Δi_t	0.18 (0.31)	0.06 (0.3)	0.2 (0.31)	0.12 (0.32)
$comm_\tau$	1.65*** (0.51)	1.21*** (0.45)	1.44*** (0.53)	1.71*** (0.55)
Term structure	–	2.58* (1.42)	0.87 (0.8)	−0.94 (1.44)
Log-likelihood	−54.36	−52.37	−53.88	−54.15
Observations	67	67	67	67
Pseudo R^2	0.17	0.18	0.16	0.15

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

4.3. Signal from statements about unconventional policies?

Since the global financial turmoil in 2007, central banks around the world started implementing various unconventional policy measures beyond conventional interest rate adjustments. We follow the methodology of Borio and Zabai (2016) to classify each statement as related to either conventional or unconventional monetary policy.[10] For the two separate classes of statements, we then calculate two measures of central bank communication following the methodology explained above. In doing so, we aim to assess the link between communication about unconventional monetary policy and future changes of ECB's policy rate separately.[11] Therefore, we estimate the following model:

$$\Delta i_{t+1} = a_0 + a_3\Delta i_t + a_2 comm_{\tau,unconv} + a_3 comm_{\tau,conv} + a_4(i_{t,L} - i_{t,S}) + u_{t+1} \quad (6)$$

where $comm_{\tau,unconv}$ represents the communication of unconventional policy measures and $comm_{\tau,conv}$ represents the communication of conventional short-term interest rate policy.

We present the results in Table 5. The results show that the communication of conventional monetary policy $comm_{\tau,conv}$ is statistically significant in all regression specifications and therefore helps predict the future changes in the ECB's policy rate. On the other hand, $comm_{\tau,unconv}$ is statistically insignificant in all specifications. However, this result should not come as a surprise.

The results convey a message that policy rate changes could be explained by the tone of ad-hoc communication about monetary policy, but not by the communication of unconventional policies. The coefficient on the communication of unconventional policies is positive but the standard errors are large. The communication of unconventional monetary policy often deals with wide arrays of complex topics and does not typically focus directly on the implications for the monetary policy rate decisions. Unconventional policy measures are known to exhibit more uncertain transmission mechanism, which may complicate the communication further (Blinder et al., 2017).

4.4. The effect of the Purdah period

Central banks typically abstain from major statements prior to monetary policy meetings to avoid the risks of excessive volatility in financial markets. The term purdah was coined for this phenomenon (Ehrmann and Fratzscher, 2009). The ECB follows a 7-day purdah period prior to monetary policy meetings.[12] We present a histogram in Fig. 3, which documents this policy in action showing indeed considerably fewer policy related statements made in the week before a policy meeting (i.e., in the purdah period).

The motivation comes from Ehrmann and Fratzscher (2009), who provide evidence showing that there is a link between US interest rates' volatility and purdah communication. Following this line of thought, we aim to test the effect of ad-hoc communication recorded just a few days prior to policy meetings, since these (in the US case) "*have a large effect on US interest rates, about three to four times larger than those in the intermeeting period outside the purdah*" (Ehrmann and Fratzscher, 2009). Unlike in the latter study, where authors measure market response of communication, we address the signaling effect communication has on the policy rate. The effect in purdah period could be comparable to non-purdah if the rule is not properly followed, larger if it is often being violated and new information revealed indeed shortly before the meeting, and smaller or even insignificant if new information reaching the market during purdah is either none or less informative.

To test the importance of purdah communication, we distinguish two groups of communication: statements that occur during the purdah period and statements outside purdah. We assess the effect of both of these communication variables separately on the predictability of future ECB's policy rate. We estimate the following equation:

$$\Delta i_{t+1} = a_0 + a_1\Delta i_t + a_2 comm_{\tau,non-purdah} + a_3 comm_{\tau,purdah} + a_4(i_{t.L} - i_{t.S}) + u_{t+1} \quad (7)$$

[10] Borio and Zabai (2016) consider balance sheet policies, forward guidance and negative policy rates as unconventional measures.
[11] Note that we exclude those communication events that include statements related to both conventional and unconventional policy simultaneously.
[12] In 2016, the ECB released a statement and defined this policy at their website. The statement refers that the policy has been in use also prior 2014.

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Table 4
Information content of communication, three meetings ahead.

	Base model	*12_3*	*12_1*	*3_1*
Δi_t	0.23 (0.27)	0.13 (0.26)	0.25 (0.27)	0.15 (0.28)
$comm_\tau$	0.9** (0.44)	0.5 (0.42)	0.73 (0.46)	0.98** (0.47)
Term structure	–	2.29* (1.36)	0.65 (0.69)	−1.08 (1.44)
Log-likelihood	−69.50	−67.67	−69.18	−69.17
Observations	67	67	67	67
Pseudo R^2	0.05	0.07	0.05	0.05

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

Table 5
Communication of conventional and unconventional measures separately.

	Base model	*12_3*	*12_1*	*3_1*
Δi_t	0.45 (0.29)	0.34 (0.3)	0.46 (0.29)	0.36 (0.32)
$comm_{\tau.conv}$	2.28*** (0.61)	2.11*** (0.59)	2.18*** (0.64)	2.4*** (0.7)
$comm_{\tau.unconv}$	0.25 (0.4)	0.04 (0.39)	0.23 (0.41)	0.16 (0.38)
Term structure	–	2.38 (1.47)	0.67 (0.98)	−1.4 (2.36)
Log-likelihood	−32.87	−31.77	−32.69	−32.59
Observations	67	67	67	67
Pseudo R^2	0.27	0.27	0.25	0.25

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, 3_1 denote maturities in months of the appropriate money market curve.

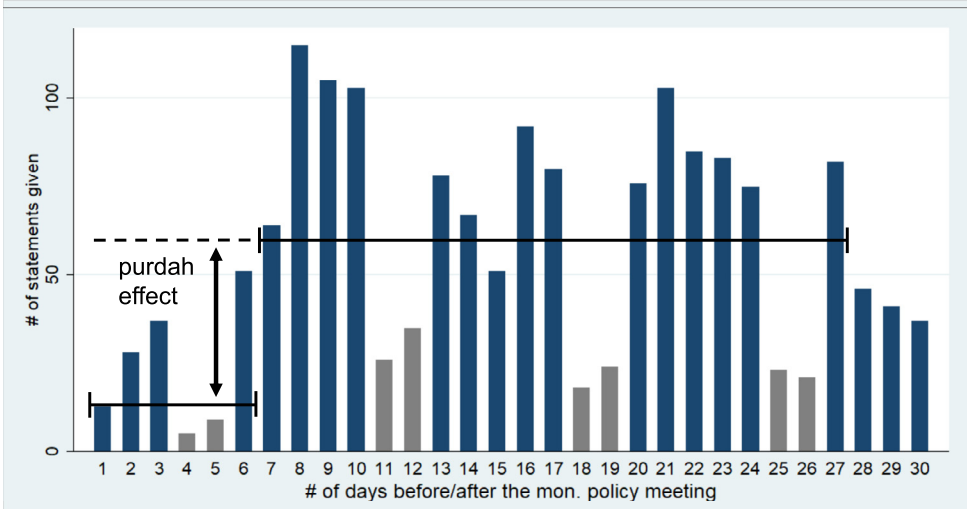

Fig. 3. Frequency of ECB ad-hoc communication between policy meetings. *Notes*: Purdah effect represents the difference between the average of statements in the non-Purdah vs. Purdah period, except the statements made during the weekend. The weekend statements are in grey color, the statements during working days are in black. The Purdah period is defined as the communication in less than 7 days prior to monetary policy meeting.

Table 6 shows the results of the estimations. Ad-hoc communication shortly before monetary policy meetings is informative for policy changes in all specifications, but less than over the rest of the month. This means that communication in the purdah period reveals some additional information, but limitations arising from the ban are visible, to a certain extent. In other words, ad-hod communication that is revealed continuously between press conferences informs future policy changes but due to the constraint placed on the policy-makers not to speak up shortly before the press conference, the signal is not so strong. Our finding that we still do see significant effect may be related to the fact that quiet period has been officially adopted only in 2016, and observed only unofficially prior to this date. As a matter of fact, this can be also tracked in the data. While there have been 9 relevant verbal interventions 5 and fewer days before the press conference in 2014 and 7 in 2015 (and 7 annually on average over 2010–2013), there was none in 2016.

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Table 6
Timing of communication: The effect of Purdah.

	Purdah omitted	*12_3*	*12_1*	*3_1*
Δi_t	0.33 (0.3)	0.22 (0.3)	0.34 (0.3)	0.29 (0.34)
$comm_{\tau\_purdah}$	0.91*** (0.32)	0.93** (0.36)	0.93*** (0.34)	0.91*** (0.31)
$comm_{\tau\_non-purdah}$	1.76** (0.69)	1.43** (0.7)	1.63** (0.76)	1.76*** (0.68)
Term structure	–	2.18 (1.49)	0.92 (1.08)	−0.55 (2.2)
Log-likelihood	−32.46	−31.51	−31.14	−32.41
Observations	67	67	67	67
Pseudo R^2	0.30	0.28	0.28	0.26

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

4.5. The role of the ECB President

As outlined earlier, large heterogeneity among the decision making body may introduce some noise into ad-hoc communication, which makes it more difficult for market agents to price in their expectations about future policy changes. In such environment, market participants tend to identify the key players of the discussion. The President is obviously such a figure in this debate. It is therefore worthwhile to see how informative the ad-hoc communication of the President is separately.

Following Riboni and Ruge-Murcia (2010), we test whether presidential status in the ECB's GC matters for the prediction of future changes in policy rate. More precisely, we test whether it is sufficient to follow the communication of the ECB President separately to understand the future ECB rate changes. Numerous market commentators and empirical evidence (for example, Gertler and Horvath (2018)) have attributed to the ECB President a critical role in communicating policy and affecting the financial markets. The opinion of the ECB President may receive greater attention because (s)he presides over the discussion in the decision-making body, represents the GC at the question and answer session at the press conference and because in general the President is more likely to communicate the strategic intentions of the central bank. The observed period incorporates 3 years of the presidential term of Jean-Claude Trichet and 3 years of the term of Mario Draghi.

We derive the communication variable based exclusively on the ECB's President's statements between GC meetings and make this subject to the same analysis.

$$\Delta i_{t+1} = a_0 + a_1 \Delta i_t + a_2 pres\_comm_\tau + a_3 (i_{t,L} - i_{t,S}) + u_{t+1} \quad (8)$$

Table 7 shows the results. The ECB President's communication appears to be significantly related to future changes in the central bank's policy rate, as shown by the positive and significant coefficients. At the same time, market expectations also explain future policy better. The results suggest markets can learn about future policy even in case they would only follow the President's communication.

We also split the President's statements into those that relate to conventional policies and those that relate to unconventional policies to replicate the divide that we have observed in the full sample.

We find that despite the markets' absorption of a reasonable amount of information regarding future policy adjustments (as reflected in lower coefficients and significance of the slope parameter), guidance related to unconventional policies has now explanatory power (see Table 8). Therefore, unlike for the case of communication of all GC members, the President's communication of both conventional and unconventional monetary policies matters strongly. We hypothesize that the significance of $Pres\_unconv\_comm_\tau$ reflects the content of the President's major role in communication and therefore, despite focusing on a whole spectrum of often complex issues including more strategic long-term perspective deliberations, the coefficient on the communication of unconventional policies is still significant.

In addition, we distinguish between the communication by the ECB President vis-a-vis other GC members. We provide the results in Table 9. Given the consensual nature of ECB communication, the resulting two communication indexes are collinear but they are still statistically significant suggesting that the communication of the President as well as of other GC members do inform future monetary policy. Finally, we also check for possible qualitatively different market attention to the most frequently communicating central bankers. We opt for a simple strategy and exclude three most frequently communicating central bankers (except for the President, who naturally enjoys a special status). More specifically, we exclude all the media interventions by governors Nowotny and Weber and Executive Board member Stark and estimate the same model. The ECB communication of less quoted GC members turns out to be even more relevant for monetary policy setting (see Table 9). This could mean that markets may perceive too frequent interventions by some GC members to be noisier and with less signal.

4.6. Monetary policy predictability under the zero lower bound

We provide the estimations for the 2008–2016 period in this subsection. Therefore, our sample contains approximately 3 years of the environment of an effective lower bound. We estimate all previous specifications as outlined in the Sections

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Table 7
The effect of ECB President's communication.

	Base model	*12_3*	*12_1*	*3_1*
Δi_t	0.72** (0.29)	0.47 (0.31)	0.7** (0.29)	0.65** (0.31)
$Pres\_comm_\tau$	1.12*** (0.32)	1.06*** (0.38)	1.00*** (0.34)	1.22*** (0.33)
Term structure	–	3.86*** (1.39)	1.5* (0.8)	−1.38 (1.65)
Log-likelihood	−37.90	−34.00	−36.70	−36.55
Observations	67	67	67	67
Pseudo R^2	0.19	0.25	0.19	0.19

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

Table 8
The effect of ECB President by type of communication.

	Base model	*12_3*	*12_1*	*3_1*
Δi_{t-1}	0.43 (0.27)	0.24 (0.26)	0.44* (0.27)	0.34 (0.27)
$Pres\_conv\_comm_\tau$	0.97*** (0.31)	0.89** (0.35)	0.86*** (0.32)	1.06*** (0.29)
$Pres\_unconv\_comm_\tau$	1.26*** (0.3)	1.2*** (0.28)	1.21*** (0.3)	1.29*** (0.3)
Term structure	–	3.64*** (1.37)	1.35* (0.82)	−1.41 (1.62)
Log-likelihood	−33.99	−30.76	−33.08	−33.65
Observations	67	67	67	67
Pseudo R^2	0.25	0.29	0.24	0.23

Notes: Robust standard errors are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote the inclusion of financial market expectations and 1, 3 and 12 denote the maturity of 1, 3 and 12 months, which enter into the term structure.

Table 9
The effect of President vs. other GC members vs. talkative members.

	Base model	*12_3*	*Base model*	*12_3*
Δi_t	0.48 (0.31)	0.39 (0.32)	0.43 (0.34)	0.33 (0.36)
$Pres\_comm_\tau$	0.79* (0.42)	0.83* (0.44)	–	–
$Non\_pres\_comm_\tau$	1.8** (0.77)	1.41* (0.75)	–	–
$Non\_most\_talk\_comm_\tau$	–	–	2.17** (0.85)	1.88** (0.85)
Term $structure_\tau$	–	2.27* (1.36)	–	2.03 (1.49)
Log-likelihood	−32.38	−31.37	−43.03	−43.03
Observations	67	67	67	67
Pseudo R^2	0.30	0.30	0.06	0.12

Notes: Robust standard errors are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3, 12_1, and 3_1 denote maturities in months of the appropriate money market curve.

4.1–4.5 and present all of them in this subsection only for the baseline and the specification with the 12 to 3-months interest rate spread (additional results are available upon request).

Our results for the extended sample to 2016 show that ECB verbal communication signals future monetary policy changes for 1, 2 and 3 periods ahead even if we control for financial market expectations. These results are available in Table 10. Therefore, the results largely support our main finding with a shorter sample.

Next, we examine the effect of Purdah communication ("quiet" period), i.e. communication close to monetary policy meetings when financial markets can react excessively. The results remain largely unchanged and suggest that communication during the purdah period is an important factor for understanding the future course of monetary policy.

We also reassess whether the results change when we examine the effects of communication of conventional and unconventional monetary policy separately. Our results again confirm the importance of conventional monetary policy communication. We present the results for the purdah communication and conventional vs. unconventional monetary policy communication in Table 11.

Finally, we examine the role the ad-hoc communication of the ECB President plays for understanding future monetary policy. Our results again confirm our previous findings and show that the communication of the ECB President matters regardless of whether it concerns the conventional or unconventional monetary policy issues. We provide these results in Table 12.

Overall, our results show that ECB communication is informative for future monetary policy even if we include the zero lower bound period. This is an interesting result especially considering the ECB's adoption of forward guidance in 2013. One could presume that forward guidance is likely to decrease the importance of ad-hoc communication as well as to reduce the sensitivity of financial markets to communication.

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Table 10
Information content of communication for policy decision.

Period ahead	t + 1 *Base model*	t + 1 *12_3*	t + 2 *Base model*	t + 2 *12_3*	t + 3 *Base model*	t + 3 *12_3*
Δi_t	0.65** (0.27)	0.65** (0.28)	0.35 (0.31)	0.34 (0.31)	0.38 (0.26)	0.37 (0.25)
$comm_\tau$	2.03*** (0.49)	2.04*** (0.48)	1.26*** (0.42)	1.14*** (0.42)	0.69** (0.35)	0.59 (0.38)
Term structure	–	−0.05 (1.36)	–	0.56 (1.18)	–	0.47 (1.1)
Log-likelihood	−41.28	−41.28	−68.68	−68.55	−86.18	−86.07
Observations	89	89	89	89	89	89
Pseudo R^2	0.25	0.23	0.13	0.12	0.05	0.04

Notes: Robust standard errors are reported in parentheses. *. **. and *** denote significance at the 10%. 5%. and 1% levels. respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3 denote the inclusion of financial market expectations and 3 and 12 denote the corresponding maturity in months.

Table 11
The effect of Purdah communication and types of conventional and unconventional measures separately.

	Policy	*Policy 12_3*	*Purdah*	*Purdah 12_3*
Δi_t	0.65** (0.27)	0.63** (0.27)	0.52* (0.28)	0.52* (0.28)
$comm_{\tau.conv}$	1.97*** (0.49)	1.91*** (0.49)	–	–
$comm_{\tau.unconv}$	0.05 (0.36)	−0.02 (0.37)	–	–
$comm_{\tau.purdah}$	–	–	0.96*** (0.36)	0.96*** (0.36)
$comm_{\tau.non-purdah}$	–	–	1.68*** (0.45)	1.68*** (0.5)
Term structure	–	0.62 (1.37)	–	−0.01 (1.53)
Log-likelihood	−41.51	−41.42	−38.50	−38.50
Observations	89	89	89	89
Pseudo R^2	0.23	0.22	0.28	0.27

Notes: Robust standard errors are reported in parentheses. *. **. and *** denote significance at the 10% 5% and 1% level, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3 denote the inclusion of financial market expectations and 3 and 12 denote the corresponding maturity in months.

Table 12
The effect of ECB President's communication - Extended sample.

	President	*12_3*	*President*	*12_3*
Δi_t	0.79*** (0.28)	0.7** (0.28)	0.61** (0.25)	0.57** (0.24)
$Pres\_comm_\tau$	1.02*** (0.27)	0.92*** (0.31)	–	–
$Pres\_conv\_comm_\tau$	–	–	0.81*** (0.28)	0.72** (0.3)
$Pres\_unconv\_comm_\tau$	-	-	1.2*** (0.27)	1.13*** (0.27)
Term structure	–	2.08* (1.16)	–	1.51 (1.19)
Log-likelihood	−45.95	−44.30	−41.02	−40.19
Observations	89	89	89	89
Pseudo R^2	0.17	0.18	0.24	0.24

Notes: Robust standard errors are reported in parentheses. *. **. and *** denote significance at the 10%. 5%. and 1% levels. respectively. The columns 12_3 denote the inclusion of financial market expectations and 3 and 12 denote the corresponding maturity in months.

4.7. Alternative communication indicators: do they matter as well?

Next, we examine the relevance of alternative central bank communication indicators. While we measure the ECB's ad-hoc inter-meeting communication, there is also relevant research assessing the tone of the ECB's press conferences introductory statements. Using textual analysis (semantic orientation) and press conferences introductory statements in 2006–2018, Picault and Renault (2017) develop two indexes: the first one dealing with the economic outlook and the second one assessing the monetary policy (both conventional and unconventional). We use the latter index measuring the monetary policy communication (MP). Next, we also employ the HD index by Tobback et al. (2017). They construct the index assessing the hawkishness/dovishness of media's perception of the ECB's tone at each press conference in 1999–2016. They use two approaches – semantic orientation and (more advanced) Support Vector Machines text classification and argue that the latter provides a more accurate picture of ECB communication.

Fig. 4 compares the $comm_\tau$ index vis-a-vis HD and MP indexes. Visually inspecting the evolution of indexes, it seems that $comm_\tau$ index precedes HD and MP indexes and provides signal regarding future monetary policy earlier. This is evident especially in the mid-2008 and in 2011. To a certain extent, this result may reflect the timing issues. While the HD and MP indexes are based on information at the time of monetary policy meeting (e.g. at time t), $comm_\tau$ index is constructed using the data between t and $t+1$ (e.g. in time period τ).

We estimate our regressions with our measure of communication, $comm_\tau$, and with the HD and MP indexes. We present the results in Table 13. First, we evaluate the effect of alternative communication indicators without controlling for our

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index. We find that HD index matters for understanding the future course of monetary policy. This result should not come as surprise because the HD index is based on the information released during the monetary policy press conferences, i.e. at the time when information regarding the new monetary policy rate is released, too. However, somewhat surprisingly, we fail to find the MP index significant. Next, once we include jointly our indicator, $comm_{\tau}$, with HD and MP indexes, we observe that only $comm_{\tau}$ remains significant suggesting the usefulness of our indicator for explaining the future course of ECB monetary policy.

4.8. Alternative measure of monetary policy stance

Finally, we analyze the robustness of our results by using an alternative measure of the monetary policy stance. Our baseline regressions use MRO to explain actual monetary policy decisions. In this robustness check, we ask a slightly different question; whether central bank communication explains not only monetary policy decisions (changes in MRO) but also monetary policy stance. Before the crisis, MRO largely captures the monetary policy stance. However, since 2008–2009 crisis, monetary policy rates hit the zero lower bound, the set of monetary policy instruments broadened and has been accompanied by various unconventional monetary policy measures. The shadow policy rate has an ambition to provide a single measure of interest rate that would have prevailed had the rates not been subject to the zero lower bound, i.e., shadow rate provides a measure of the monetary policy stance. Typically, shadow rates are derived from the model of the term structure of interest rates, where the long end of the yield curve determines the short term rates in the way that short term rates can become negative.

For our exercise, we need the estimates of the shadow policy rate for the ECB at the daily frequency. To our knowledge, Leo Krippner is the only one who provides the daily estimates of shadow rates for several countries, including for the euro area, and we use them to re-estimate our regressions.[13] Given that shadow rates do not have censored nature (as it is the case for the MRO), we estimate the regressions using the ordinary least squares.

Shadow rates are supposed to proxy the monetary policy stance, but they are estimates rather than actual figures observed in the real world. In addition, Krippner, 2020 shows that shadow rate estimates are sensitive to minor choices regarding their estimation and some other authors such as Bauer and Rudebusch (2016) are skeptical about the use of shadow rates to proxy the monetary policy stance. Most importantly, our paper focuses on explaining actual monetary policy decisions rather than the shadow rate. Having these caveats in mind, we provide the regression results in Table 14. In principle, we estimate the Eq. (2) but the monetary policy rate (MRO) is replaced by the shadow rate. Note that we do not include the term structure (as it is the case for Eq. (3)) because this information is already included in the shadow rate. Therefore, we regress the change in shadow rate in time $t+1$ on the change in the shadow rate in time t and our communication measures.

The results suggest that ECB communication matters for future change in the shadow rate, too. Table 14 presents four representative specifications, the main communication measure, $comm_{\tau}$, as well as its variants separating communication regarding conventional and unconventional policy issues (i.e., $comm_{\tau.conv}$, resp. $comm_{\tau.unconv}$) or separating communication according to the timing of communication (i.e., $comm_{\tau.purdah}$, resp. $comm_{\tau.non-purdah}$). We find that the overall ECB communication, $comm_{\tau}$, matters as well as the communication by the ECB President. To a certain extent, the other communication measures matter, too. Overall, this robustness check suggests the generality of our results because the ECB communication is informative not only for actual monetary policy decisions but also for the measure of the monetary policy stance.

5. Conclusions

We evaluate whether ECB intermeeting ad-hoc communication (verbal communication such as speeches, interviews, statements) is informative for future monetary policy rate changes. We introduce an indicator that measures whether ECB communication is leaning towards tightening, easing or keeping monetary policy unchanged. To appreciate the censored nature of monetary policy rate, we apply an ordered probit model to study the effect of ECB ad-hoc communication on future monetary policy, controlling for lagged monetary policy decisions and financial market expectations.

We contribute to literature that employs voting records and minutes to explain future monetary policy in inflation targeting central banks (Gerlach-Kristen, 2004; Horvath et al., 2012; Jung, 2016). We differ from this body of literature by examining verbal ad-hoc communication (ECB voting records are not available) in a low interest rate environment that is characterized by the implementation of unconventional monetary policy. Therefore, in addition to typical questions, such as the role of governor in shaping the future course of monetary policy, we evaluate the importance of conventional vs. unconventional monetary policy communication in understanding future policy decisions.

We find that monetary policy preferences expressed through ECB officials' communication contribute to a better understanding of the future course of monetary policy. This finding is robust, even when including financial market expectations and lagged monetary policy in the model. Our communication indicator is not only helpful for predicting monetary policy at the next monetary policy meeting, it predicts it at more distant horizons, too.

We also find that the timing of ECB communication is relevant for understanding monetary policy decisions. We make a distinction between communication a week before a monetary policy meeting (i.e., the purdah period) and more than a week

[13] At the time of writing of this article, the shadow rate estimates are available at the Reserve Bank of New Zealand website.

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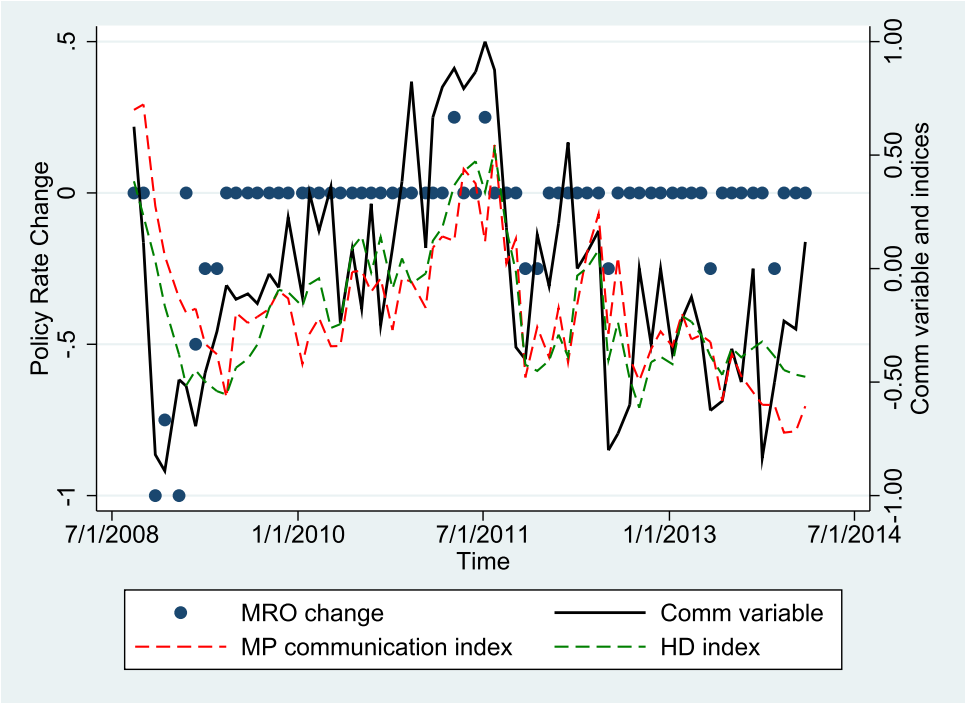

Fig. 4. Alternative communication indicators.

Table 13
The effect of alternative communication indicators.

	HD index	*HD and comm*$_\tau$	*MP index*	*MP and comm*$_\tau$
Δi_t	0.26 (0.33)	0.33 (0.34)	0.42 (0.32)	0.41 (0.36)
HD index$_\tau$	1.53∗ (0.8)	0.69 (0.90)	–	–
MP index$_\tau$	–	–	0.02 (0.49)	−0.87 (0.59)
comm$_\tau$	–	2.57∗∗∗ (0.93)	–	2.73∗∗∗ (0.87)
Term structure	4.5∗∗ (1.79)	2.13 (1.75)	4.71∗∗∗ (1.62)	2.05 (1.80)
Log-likelihood	−38.05	−27.34	−40.79	−26.89
Observations	66	66	66	66
Pseudo R^2	0.12	0.44	0.06	0.45

Notes: Robust standard errors are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% levels, respectively. Pseudo R^2 represents adjusted Mc Fadden pseudo R^2. The columns 12_3 denote the inclusion of financial market expectations and 3 and 12 denote the corresponding maturity in months. HD index is from Tobback et al. (2017). The source of MP index is Picault and Renault (2017). *comm*$_\tau$ is our communication index.

Table 14
ECB Communication and Shadow Rates.

	$\Delta Shdrate_{t+1}$	$\Delta Shdrate_{t+1}$	$\Delta Shdrate_{t+1}$	$\Delta Shdrate_{t+1}$
$\Delta Shadowrate_t$	0.34∗∗∗ (0.10)	0.33∗∗ (0.12)	0.34∗∗ (0.12)	0.27∗∗ (0.11)
comm$_\tau$	0.15∗∗ (0.06)	–	–	–
comm$_{\tau.conv}$	–	0.13∗ (0.08)	–	–
comm$_{\tau.unconv}$	–	0.03 (0.06)	–	–
comm$_{\tau.purdah}$	–	–	0.04 (0.04)	–
comm$_{\tau.non-purdah}$	–	–	0.11∗ (0.06)	–
Pres_conv_comm$_\tau$	–	–	–	0.16∗∗∗ (0.05)
Pres_unconv_comm$_\tau$	–	–	–	0.14∗∗∗ (0.04)
Observations	89	89	89	89
Adj. R^2	0.21	0.20	0.20	0.26

Notes: Robust standard errors are reported in parentheses. ∗. ∗∗. and ∗∗∗ denote significance at the 10% 5% and 1% level, respectively.

before the meeting. Communication in the purdah period is also informative for the future monetary policy, but less than communication in other days. Clearly, some additional information is revealed during purdah period, but limitations arising from unofficial agreement to abstain from commenting future policy are noticeable.

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In addition, we show that the statements delivered by the ECB President constitute a sufficient proxy for upcoming monetary policy decisions. The ECB President's communication, regardless of whether it is about conventional or unconventional monetary policy issues, helps predict future monetary policy.

Finally, our results point to the necessity of clear communication under the zero lower bound environment. Even though some previous research has shown that monetary policy efficacy may decrease when interest rates are null (or negative), our results show that verbal communication, both regarding conventional or unconventional policies, is still informative.

Ehrmann and Fratzscher (2007) based on pre-crisis data (1999–2004) serve as a counterfactual for our study (based on 2008–2016 data). They construct the inter-meeting verbal communication indicator for the ECB and examine the effect of the communication on the asset prices using the exponential generalized autoregressive conditional heteroskedasticity model. One of their major findings is that central bank communication matters. Despite the changes in the conduct of communication since the crisis, we also find that communication matters. Therefore, the generalization we draw from these two findings is that communication matters regardless of the economy is in good or bad conditions or using the words of Ehrmann and Fratzscher (2007) that the communication is effective despite different strategies.

Overall, our results are considerably robust in suggesting that the communication of conventional policies has been transparent and that the ECB matches the words with the deeds. The communication of unconventional policies is informative for the near-future policy setting, especially when such communication comes from the President. In general, our article shows that central bank transparency, as manifested by open and clear communication, is critical for monetary policy predictability.

CRediT authorship contribution statement

Hamza Bennani: Conceptualization, Investigation, Methodology, Validation, Software, Writing - original draft, Writing - review & editing. **Nicolas Fanta:** Conceptualization, Investigation, Methodology, Validation, Software, Writing - original draft, Writing - review & editing. **Pavel Gertler:** Conceptualization, Investigation, Methodology, Validation, Software, Writing - original draft, Writing - review & editing. **Roman Horvath:** Conceptualization, Investigation, Methodology, Validation, Software, Writing - original draft, Writing - review & editing.

Appendix A. Examples of policy statements and its coding

Three independent readers have worked through over 20 000 Reuters News articles, carefully filtered to capture only forward-looking statements of the ECB Governing Council members about economy, monetary policy and balance sheet policies. The three sources have been integrated into one consistent dataset containing 1769 observations of ad-hoc inter-meeting communication that took place between June 2008 and May 2016. Below we present randomly selected forward looking statements – hawkish, neutral and dovish, both on the monetary policy and on the economic outlook.

A.1. Monetary policy

A.1.1. Example of coding −1

Mario Draghi (President), 24/9/2014 at 8:36: *Monetary policy will remain accommodative for a long time and I can tell you that the (ECB) Governing Council is unanimous in committing itself to using the tools at its disposal to bring inflation back to just under two percent.* Source: Europe 1 /radio.

A.1.2. Example of coding 0

Ewald Nowotny (AT), 25/9/2012 at 13:09: *"I do not see the need for a change in interest rates currently in the euro zone. In terms of the deposit facility, negative rates would indeed be theoretically possible but in practical terms I would not consider such a view to be either desirable or realistic.*" Source: Die Presse/newspaper.

A.1.3. Example of coding +1

Jurgen Stark (EB), 10/6/2011 at 15:25: *"The ECB is likely to raise rates to 1.5 percent next month. We signalled yesterday the preparedness to take another step, maybe in July. That is a high probability.*" Source: Reuters Insider/TV.

A.2. Economic outlook

A.2.1. Example of coding −1

Lorenzo Bini Smaghi (EB), 13/10/2008 at 21:22: "*. . .with or without recession, it is likely that we will have three or four quarters of very, very limited growth.*" Source: Talk Show in Italy/TV.

A.2.2. Example of coding 0

Jean-Claude Trichet (President), 28/1/2010 at 17:20 "*Now we are in a stage of recovery, we are in black figures, not red figures. I expect, but I'm very cautious and prudent, a modest recovery.*" Source: WEF Davos/TV.

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A.2.3. Example of coding +1

Christian Noyer (FR), 8/6/2015 at 16:23: "*The prospects for this year for the euro zone are much bigger. We expect a growth rate of 1–1/2%*". Source: Conference in Montreal/ Reuters News (see Figs. A1–A3 and Table A1).

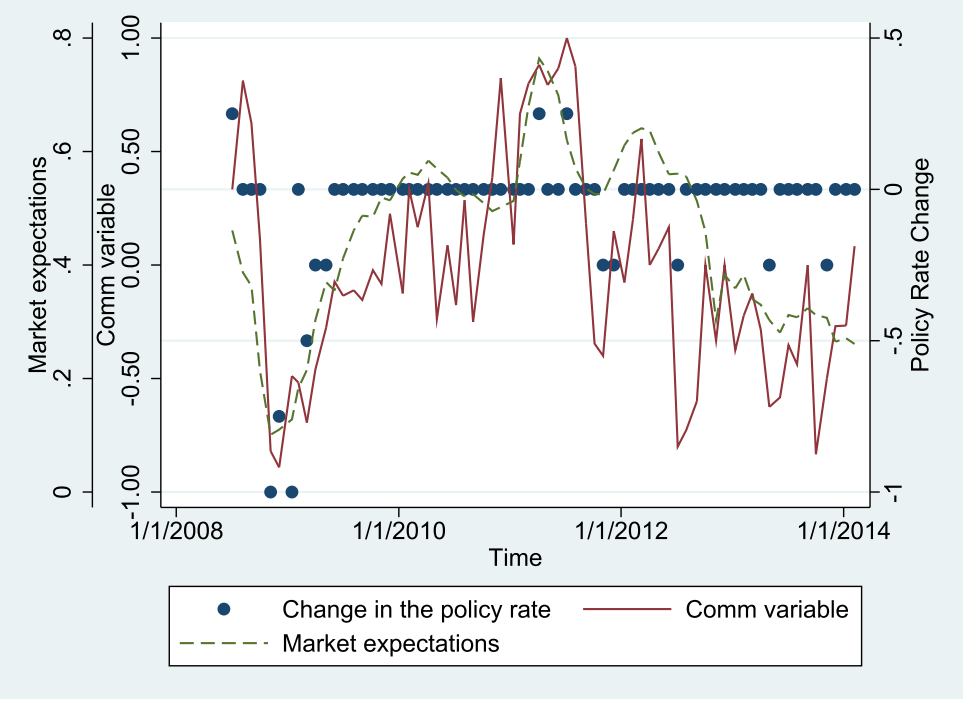

Fig. A1. Informative power of the term structure obtained from the 12-month and 3-month Euribor rates.

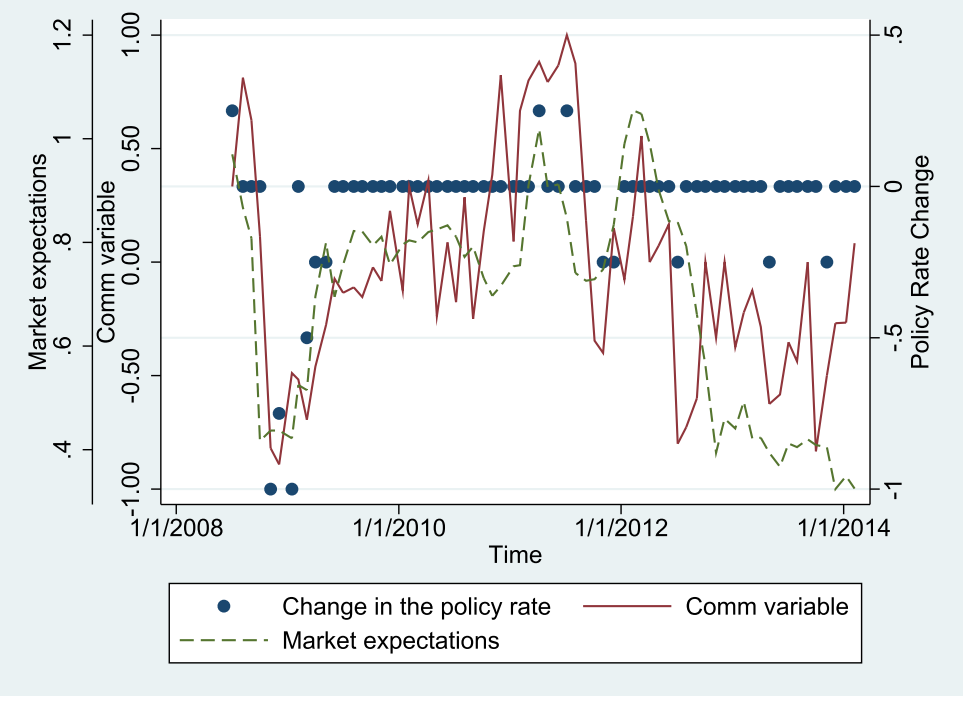

Fig. A2. Informative power of the term structure obtained from the 12-month Euribor and 1-month Euribor.

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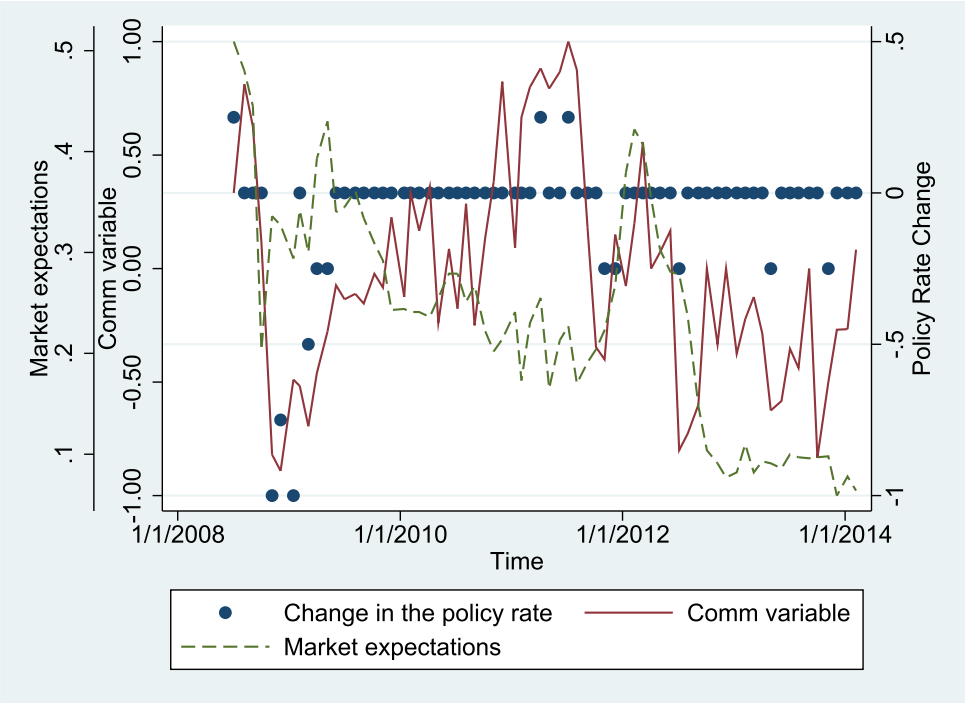

Fig. A3. Informative power of the term structure obtained from the 3-month Euribor and 1-month Euribor.

Table A1
Descriptive Statistics.

Variable	Mean	St.dev.	Min	Max
comm	−0.02	0.47	−0.89	1
Purdah-*comm*	−0.07	0.67	−1	1
Non- Purdah *comm*	−0.02	0.48	−0.88	1
President *comm*	−0.10	0.62	−1	1
Conventional policy *comm*	−0.08	0.49	−1	1
Unconventional policy *comm*	0.03	0.60	−1	1
President - conventional *comm*	−0.12	0.61	−1	1
President - unconventional *comm*	−0.05	0.51	−1	1
Excl. President *comm*	−0.02	0.48	−0.87	1
Excl. talkative members *comm*	−0.05	0.51	−0.96	1
HD index	−0.18	0.29	−0.61	0.55
MP index	−0.17	0.31	−0.72	0.72
$i_{t,12} - i_{t,3}$	−0.17	0.31	−0.72	0.72
$i_{t,12} - i_{t,1}$	0.69	0.21	0.32	1.05
$i_{t,3} - i_{t,1}$	0.24	0.11	0.06	0.51
i_t	−0.17	0.31	−0.72	0.72

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