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Contents

Abstract

In this paper, we examine whether a tone shock derived from ECB communication helps to predict ECB monetary policy decisions. For that purpose, we first use a bag-of-words approach and several dictionaries on the ECB's Introductory Statements to derive a measure of tone. Next, we orthogonalize the tone measure on the latest data available to market participants to compute the tone shock. Finally, we relate the tone shock to future ECB monetary policy decisions. We find that the tone shock is significantly and positively related to future ECB monetary policy decisions, even when controlling for market expectations of economic conditions and monetary policy and the ECB's Governing Council inter-meeting communication. Further extensions show that the predictive power of the tone shock regarding future monetary policy decisions is robust to (i) the normalization of the tone measure, (ii) alternative market expectations about monetary policy and (iii) the macroeconomic variables used in the Taylor-type monetary policy. These findings thus highlight an additional channel by which ECB communication improves monetary policy predictability, and suggest that the ECB may have private information that it communicates through its Introductory Statements.

JEL Codes: E43, E52, E58.
Keywords: Central Bank Communication; European Central Bank; Tone; Forecasts; Taylor Rule.

1 Introduction

Since the seminal paper of Gürkaynak et al. (2005), it is an established fact that monetary policy announcements move long term interest rates following the adjustment of market expectations. Adjustment of market expectations occurs because central bank communication provides information about the strategy of the central bank, changing economic environment, and the respective policy reactions. Following this line of thought, the literature studies the impact of the European Central Bank (ECB) communication on market expectations about future monetary policy. As a case in point, Sturm and De Haan (2011) examine ECB communication within a monetary policy rule, à la Taylor, and find that communication is informative about future monetary policy decisions. Neuenkirch (2013) shows that ECB communication successfully improves the management of expectations about future interest rates and that it improves the efficacy of monetary policy. Finally, Tobback et al. (2017) develop a content-based indicator of the media perception of ECB policies and insert it into an extended Taylor rule. They find a positive role for ECB communication in enhancing the accuracy of market expectations.

Furthermore, a parallel strand of the literature has developed quantitative tools to measure, on a numerical scale, the qualitative information contained in central bank statements. This approach quantifies the tone contained in central bank communication by counting the number of positive and negative words using a pre-defined list of words from the Harvard IV-4 Psychosociological Dictionary or the Loughran and McDonald (2011) (LM) Financial Dictionary. As an illustration, Lucca and Trebbi (2009) analyze the content of the Federal Open Market Committee (FOMC) statements by semantic orientation scores estimated from a large information set obtained through search engines. Hansen and McMahon (2016) study how the FOMC communication about economic conditions and forward guidance affect economic and financial variables. More recently, Hubert and Labondance (2018) find that positive FOMC tone increases interest rates at the one-year maturity. Finally, Schmeling and Wagner (2019) explore whether the tone of ECB communication matters for asset prices. They find that stock prices increase when the tone becomes more positive.

In this paper, we aim to combine these two strands of the literature by testing whether the tone conveyed through ECB communication helps market participants to predict ECB monetary policy decisions. Since central bank communication tone is considered as qualitative information that might be related to signals such as the future path of the policy rate, and that the use of communication became more intensive during the financial crisis (Blinder et al., 2017); market participants pay attention not only to the content, that is, to explicit information about ECB monetary policy decisions, but also to the tone of ECB statements, i.e., to implicit information about the economic outlook or future monetary policy. In this case, ECB communication is meant to make future rates more predictable.

Against this background, we examine how ECB communication tone is related to future monetary policy decisions. For that purpose, we first measure the tone of ECB communication using several dictionaries that converts the qualitative information contained in ECB statements into a quantitative measure. We use the most informative verbal communication of the ECB's Governing Council (GC): the Introductory Statement at the press conference. Second, since the tone of ECB communication is likely to be correlated to the economic and financial conditions, we orthogonalize the tone measure with the latest data available to market participants at the time of the press conference. We consider the residual from this regression to be a tone shock that is orthogonal to economic data. Finally, we investigate how the tone shock is useful for predicting ECB's monetary policy decisions by including it into a forward-looking monetary policy rule à la Taylor. Hayo and Neuenkirch (2010) show that central bank communication variables can enter a Taylor-type monetary policy rule since they complement the information contained in traditional macroeconomic variables.

To our knowledge, this paper offers original contributions on various dimensions. On the one hand, it overcomes the absence of ECB voting records and minutes of the meeting.[1] On the other hand, it analyzes a specific component of ECB communication, a tone shock, that has not yet been used in the literature to assess its informativeness regarding future monetary policy decisions. The closest paper to ours is Picault and Renault (2017), who find that ECB communication helps to explain future monetary decisions. However, our study differs from theirs in many aspects. First, we use monthly real-time Reuters' polls collected from individual forecasters at the time of the ECB Introductory Statement, while Picault and Renault (2017) use quarterly forecasts from the Survey of Professional Forecasters. Second, we use a tone shock to analyze how

[1] The literature uses voting records and minutes of meeting to assess the effect of central bank communication on monetary policy predictability, such as for the Bank of England and the FOMC (see, e.g., Gerlach-Kristen, 2004; El-Shagi and Jung, 2015a; Jung, 2016). Since November 2015, the ECB publishes the account of the monetary policy meeting. The released information, however, is less granular than the minutes published by other major central banks.

ECB communication helps to predict monetary policy decisions, while they use a raw measure of tone that is likely to be correlated to macroeconomic and financial variables. Third, we control for the monetary policy expectations of market participants to check whether ECB communication adds information beyond the information contained in the market expectations. Finally, we use four different dictionaries to compute several tone shocks.

Our results show that the tone shock helps market participants to predict ECB monetary policy decisions even when controlling for (i) market expectations of economic conditions and monetary policy and (ii) the ECB's GC inter-meeting communication. This suggests that the tone shock of the Introductory Statement conveys relevant information for market participants. Further extensions show that the predictive power of the tone shock is robust to (i) the normalization of the tone measure, (ii) alternative market expectations about future monetary policy, and (iii) the horizons of the macroeconomic variables used in the Taylor-type monetary policy rule. However, we find that the predictive power of the tone shock slightly differs when considering other dictionaries. Finally, we provide additional evidence indicating that the results are robust to various estimation methods. The main explanation of these findings is that the ECB may have private information about exogenous shocks to output and inflation that it communicates through its Introductory Statement, which is likely to help market participants to predict ECB monetary policy decisions. Romer and Romer (2000) has established the existence of central bank private information beyond what is known to forecasters for the US Federal Reserve. They conclude that the central bank possesses significantly superior information about the economy since it puts a lot of resources into monitoring the economy. Our results suggest similar evidence for the ECB.

The remainder of the paper is structured as follows: Section 2 describes the tone shock of ECB communication, section 3 describes the data and the methodology, section 4 provides the main results, and section 5 presents further extensions and robustness tests. The last section concludes.

2 The Tone Shock of ECB Communication

We provide different measures of ECB tone shock using the Introductory Statement to the press conference and two different dictionaries. First, we use the LM dictionary which was developed to assess the tone of financial and economic documents and has proven to be relevant in the context of central bank communication (see, for instance, Hansen and McMahon (2016)). The LM dictionary contains 354 (2355) words that convey a positive (negative) tone in financial and economic contexts. Second, Bennani and Neuenkirch (2017) (BN) use speeches of the members of the ECB's GC during the period 1999M1-2014M4 to extract keywords that convey a hawkish and a dovish tone in a monetary policy context. They identify 26 (32) hawkish (dovish) words that can be used as indicators of monetary policy inclination. For instance, phrases such as "the underlying *strength* of the euro area"[2] and "*concerns* about the emergence and intensification of protectionist pressures"[3] convey, respectively, a positive and a negative tone according to the LM dictionary; while phrases like "this will lead to a *strengthening* of the euro."[4] and "annual HICP inflation continued to *decline*"[5] convey, respectively, a hawkish and a dovish tone according to the BN dictionary. We consider that positive (negative) and hawkish (dovish) words have a similar implication in terms of monetary policy predictability; that is, they imply a future restrictive (accommodative) monetary policy.

As a first step, we express the tone of each Introductory Statement during the press conference as follows:

$$tone_{t,dic} = \frac{\#pos_{t,dic} - \#neg_{t,dic}}{\#pos_{t,dic} + \#neg_{t,dic}}; \quad (1)$$

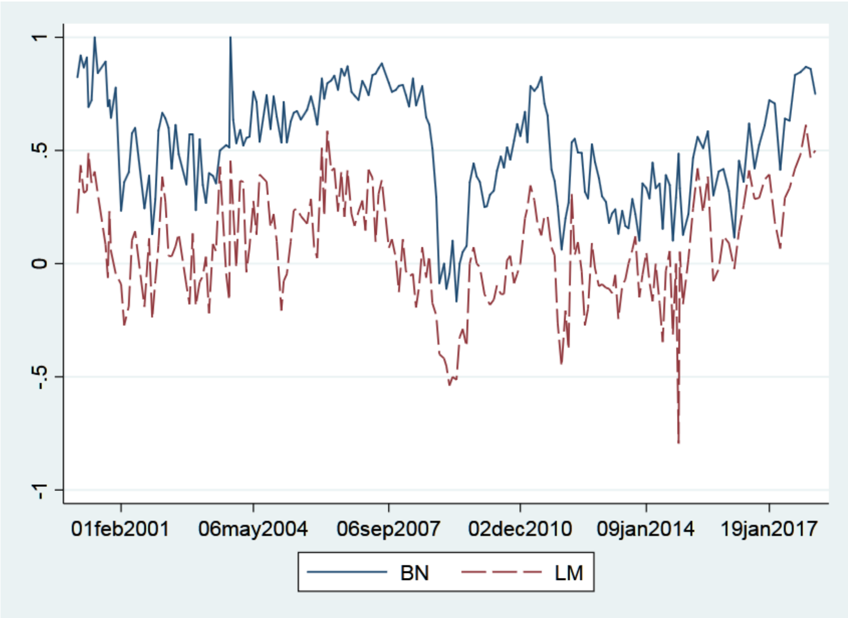
where $tone_{t,dic}$ reflects the tone of the Introductory Statement made at the press conference t when using the dictionary dic (dic: BN or LM). $\#pos_{t,dic}$ ($\#neg_{t,dic}$) denotes the count of words with positive/hawkish (negative/dovish) tone, as categorized in the BN and LM dictionaries. Figures 4 and 5 in the Appendix show the absolute frequency of positive/hawkish and negative/dovish words over time.

Figure 1 shows that both measures of tone computed with the BN and LM dictionaries follow a similar pattern over time and have a high degree of correlation

[2]ECB Press Conference, June 14, 2008.
[3]ECB Press Conference, February 5th, 2009.
[4]ECB Press Conference, February 3, 2000.
[5]ECB Press Conference, February 5th, 2009.

($\rho = 0.75$). Interestingly, the systematically higher value of the BN tone is because the BN dictionary captures more words related to a future restrictive monetary policy than the LM dictionary (see Figures 4 and 5 in the Appendix). Moreover, we find that some events related to the Global Financial Crisis (GFC) and ECB monetary policy are reflected through the level of both tones. For instance, the negative value observed in 2009 for both measures of tone can be related to fears of propagation of the GFC in the euro area, while the minimum value observed for the LM tone on October 2014 might be due to the beginning of the zero lower bound on nominal interest rates.

Figure 1: The tone measures of the ECB Introductory Statement



Since the ECB tone might be endogenous to the business cycle and might contain information about the current and future states of the economy; we compute the tone shocks by orthogonalizing the measures of tone obtained from eq. (1) on a set of macroeconomic and financial variables. Hence, as a second step, we regress $tone_{t,dic}$ on the last macroeconomic and financial data available to market participants at the time of the press conference t. The equation takes the following form:

$$tone_{t,dic} = \alpha + \beta tone_{t-1,dic} + \sum_{i=-1}^{2} \gamma_i \pi_{t,i} + \sum_{i=-1}^{2} \lambda_i y_{t,i} + \sum_{m=1}^{5} \theta_m MP_{t,m} + \quad (2)$$

$$+ \eta Stoxx_t + \psi EPU_t + \varepsilon_{tone_{t,dic}};$$

where $tone_{t-1,dic}$ is the lagged value of the tone meaure. $\pi_{t,i}$ and $y_{t,i}$ represent the values of inflation and real output growth at different horizons. We distinguish among the horizons with the index i, which is between -1 and 2. The numbers -1 and 0 represent the lagged and current values of GDP dynamics and the Harmonised Index of Consumer Prices (HICP), collected from the Euro Area Real-Time Database, respectively.[6] The numbers 1 and 2 represent the expected values of GDP and HICP one-quarter and two-quarters ahead, respectively. Reuters collect these forecasts just before the ECB press conference from individual contributors. We choose forecasts with horizons close to one quarter and two quarters (i.e., two to five months and five to eight months, respectively) and compute the series of average forecasts for each horizon (see Table 3 in the Appendix). $MP_{t,m}$ reflects the euro area monetary policy shock with a maturity m computed by Altavilla et al. (2019). More precisely, the monetary policy shock is proxied by the OIS change in the median quote from the window 14:15-14:25 before the press conference to the median quote in the window 15:40-15:50 after it, for all maturities up to one year.[7] $Stoxx_t$ is the Euro Stoxx 50 index which reflects the volatility of financial markets in the euro area, and EPU_t is the euro area Economic Policy Uncertainty index as measured by Baker et al. (2016). Hence, we consider that past, contemporaneous and future economic and financial conditions could affect the ECB tone (for summary statistics, see Table 4 in the Appendix). Finally, $\varepsilon_{tone_{dic,t}}$ is the tone shock, which is orthogonal to the set of macroeconomic and financial variables used in eq. (2).

Bloomberg has monthly

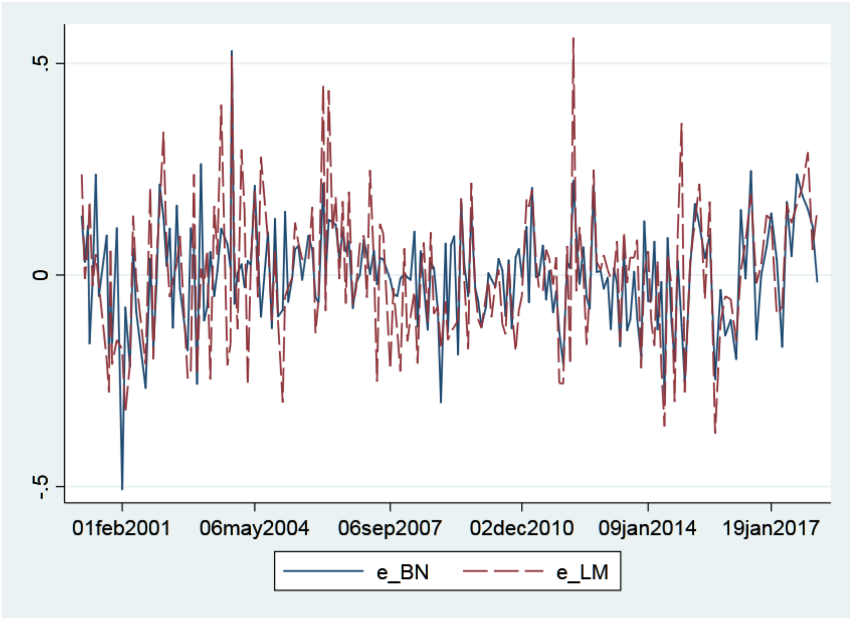
Does BBG have this?

Table 5 in the Appendix shows the estimated coefficients of eq. (2). We find that the smoothing coefficient β related to the lagged value of the ECB tone shock is positive and highly significant. This reflects the persistence of the tone of ECB communication over time. Moreover, both measures of tone are differently affected by economic conditions. The ECB tone computed by the BN (LM) dictionary is affected by inflation (output growth), while higher economic uncertainty is associated with lower BN tone. Figure 2 shows the residuals obtained from eq. (2), which reflect the tone shocks computed with the BN and LM dictionaries. We find that both tone shocks are correlated ($\rho = 0.59$) and follow a similar pattern over time.

[6] Source: https://sdw.ecb.europa.eu/browseExplanation.do?node=9689716.

[7] We use the OIS maturities corresponding to 1-week, 1-month, 3-months, 6-months and 1-year. These maturities are indexed in eq. (2) with 1, 2, 3, 4 and 5, respectively.

Figure 2: The tone shocks of the ECB Introductory Statements



3 Data and Methodology

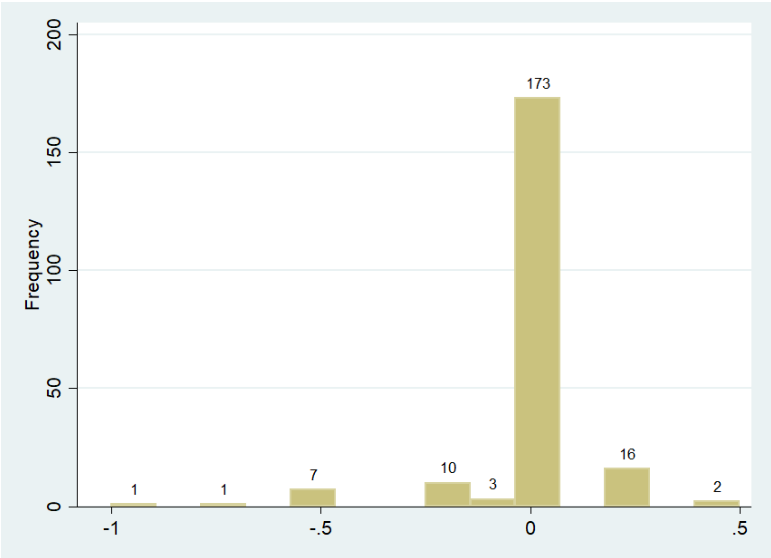
3.1 Data

The data on ECB policy decisions, as well as macroeconomic and financial variables reflecting the current and future states of the economy, are collected from February 2000 until April 2018. We start on February 2000 due to the data availability of Reuters' polls' macroeconomic projections. Since we focus on the predictability of ECB interest rate decisions, the dependent variable, dR_t, is a discrete transformation of the ECB rate change, Δi_t:

$$dR_t = \begin{cases} +1 & \Delta i_t > 0 \\ 0 \quad for & \Delta i_t = 0 \\ -1 & \Delta i_t < 0 \end{cases} ; \tag{3}$$

The transformation expresses the direction of the policy change but does not consider the size of the change. This approach does not lead to a large loss of information since the ECB leaves its rate unchanged or adjusts it by exactly 25 bp (in absolute value) most of the time (see Figure 3).[8] We do not consider more categories, for instance, interest rate changes higher than 25 bp and those not exceeding 25 bp, as this would result in categories with very few observations.

Figure 3: Distribution of the ECB rate decisions (2000M02-2018M04)



[8]As a robustness test, we consider the ECB rate change in level as a dependent variable. The results are qualitatively and quantitatively similar to those of the baseline model. Results are available upon request.

Regarding the independent variables that we include in the empirical analysis, we consider the Reuters' forecasts of euro area HICP and GDP two-quarters ahead, as well as the two measures of tone shocks, $\varepsilon_{tone_{t,BN}}$ and $\varepsilon_{tone_{t,LM}}$, computed from eq. (2). Finally, it is possible that the information conveyed by the tone shock is already included in the monetary policy expectations of market participants. In such a case, the tone shock would not be helpful for predicting monetary policy decisions. Hence, we need to control for market expectations regarding future monetary decisions to check whether the tone shock provides additional information. Following Gerlach-Kristen (2004), we express market expectations about future monetary policy decisions using the term structure of market rates. More precisely, we use the difference between the Euribor 3- and 12-month market rates.

3.2 Methodology

The baseline specification is in the form of a monetary policy rule à la Taylor (1993), augmented with interest rate smoothing (Clarida et al., 2000):

$$i_t = \rho i_{t-1} + (1-\rho) i_t^*; \tag{4}$$

where i_t is the ECB's interest rate and i_t^* is the interest ("target") rate desired by the central bank. Rearranging the terms in eq. (4), we obtain:

$$\Delta i_t = (\rho - 1) i_{t-1} + (1-\rho) i_t^*; \tag{5}$$

We specify the "target" rate, i_t^*, as a linear function of a set of macroeconomic and financial variables. The specification is composed of 3 blocks of variables: (i) information on the future state of the economy, i.e., the two-quarters ahead forecasts of inflation and GDP, (ii) a measure of ECB tone shock computed with the BN or LM dictionaries and (iii) the term structure of market rates, measured as the difference between the long- and short-term Euribor rates. We replace the change in interest rate in eq. (5), Δi_t, with its discrete transformation, dR_t. At $t+n$, this gives:

$$dR_{t+n} = \beta_i i_t + \underbrace{\beta_\pi E_t \pi_{t+k} + \beta_y E_t y_{t+k} + \beta_{\varepsilon,dic} \varepsilon_{tone_{t,dic}} + \beta_{term}(i_{t,L} - i_{t,S})}_{i_t^*} + \epsilon_{t+n}; \tag{6}$$

awesome!!

where the dependent variable dR_{t+n} is the ECB rate change at the press conference $t+n$ ($n = \{1, 2\}$ stands for the n-th subsequent meeting). i_t is the initial ECB policy rate and $\varepsilon_{tone_{t,dic}}$ is the ECB tone shock. $E_t\pi_{t+k}$ and $E_t y_{t+k}$ represent market expectations of inflation and output growth two-quarters ahead ($k = 6$ months), respectively, collected by Reuters after the press conference made at t.[9] $(i_{t,L} - i_{t,S})$ is the term structure of market rates, which represents the difference between the Euribor 12-month and 3-month rates after the press conference. Finally, ϵ_{t+n} is the error term. The objective of the estimation is to test whether the ECB tone shock helps to predict ECB monetary policy decision at $t+1$ and $t+2$, controlling for the adjustment of market expectations following the press conference delivered at time t.

Since the dependent variable, dR_{t+n}, is discrete, we follow the methodology used in the literature (El-Shagi and Jung, 2015b; Jung, 2016) and use an ordered logistic model to estimate eq. (6).

Need to do this.

[9] Two working days after the press conference t at the latest.

4 Empirical Results

4.1 Baseline Model

Table 1 shows the estimated results of eq. (6) for the period 2000M02-2018M04; that is, the predictive power of the ECB tone shock for monetary policy decision at meetings $t+1$ and $t+2$. To ease the concern that we use too many variables and over-fit the model, we include each block of variables progressively in the empirical specification.

Table 1: Baseline results (2000M02-2018M04)

BN tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.07	0.38**	-0.09	-0.06	0.27
	(0.17)	(0.18)	(0.18)	(0.17)	(0.19)	(0.17)
β_π	0.24	0.18	-0.41	0.09	0.02	-0.46
	(0.34)	(0.38)	(0.43)	(0.34)	(0.36)	(0.41)
β_y	0.61***	0.64***	0.90***	0.5***	0.5***	0.69***
	(0.16)	(0.17)	(0.19)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{BN}}$		4.09***	3.47**		1.90	1.07
		(1.25)	(1.39)		(1.41)	(1.37)
β_{term}			6.16***			4.58***
			(1.27)			(1.1)
Pseudo-R^2	0.084	0.11	0.24	0.052	0.057	0.14
χ^2	17.86	24.39	41.90	13.94	14.49	30.77
Obs.	212	199	199	212	199	199

LM tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(7)	(8)	(9)	(10)	(11)	(12)
β_i	-0.11	-0.06	0.39**	-0.09	-0.02	0.31*
	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)	(0.17)
β_π	0.24	0.16	-0.42	0.09	-0.04	-0.53
	(0.34)	(0.36)	(0.41)	(0.34)	(0.37)	(0.42)
β_y	0.61***	0.6***	0.88***	0.5***	0.5***	0.7***
	(0.16)	(0.16)	(0.18)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{LM}}$		1.16	0.79		2.6***	2.52**
		(1.05)	(1.16)		(0.98)	(1.03)
β_{term}			6.34***			4.64***
			(1.26)			(1.1)
Pseudo-R^2	0.084	0.087	0.23	0.052	0.072	0.16
χ^2	17.86	18.86	46	13.94	17.39	29.43
Obs.	212	199	199	212	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

The results show that the GDP growth forecasts help to predict the move of the ECB policy rate. More precisely, an increase in the GDP growth forecast is associated with an increase in the policy rate at different meeting horizons. Interestingly, the inflation forecasts of market participants are not useful for predicting the ECB rate decisions, regardless of the meeting horizon considered in the analysis. Moreover, market expectations of future monetary policy are positively and significantly related, at the 1% level, to future monetary policy decisions. This finding shows that market expectations of monetary policy are consistent with future ECB policy decisions. Finally, the coefficients related to the ECB tone shocks computed with the BN and LM dictionaries, $\beta_{\varepsilon_{BN}}$ and $\beta_{\varepsilon_{LM}}$, provide relevant insights. We find that the BN tone shock helps to predict the ECB rate decision at $t+1$, while the LM tone shock is more helpful for predicting the ECB rate decision at $t+2$. Hence, the results suggest that the BN tone shock is more useful to predict the ECB rate at a shorter horizon than is the LM dictionary. This might be because the BN dictionary directly reflects the monetary inclination of the Introductory Statement, while the LM dictionary is more general and captures the economic and financial outlooks of the statement. The LM dictionary is thus more likely to be helpful for predicting the ECB rate at the medium-term horizon.

Table 7 in the Appendix shows the marginal effects of the tone shock; i.e., the change in the probability of rate hike, unchange, and cut, following a one standard-deviation (S.D.) increase in the ECB tone shock. We find that a one S.D. increase in the BN tone shock increases (decreases) the probability of a rate hike (cut) by 3.4% (4.3%) at $t+1$. Similarly, a one S.D. increase in the LM tone shock increases (decreases) the probability of a rate hike (cut) by 3.2% (4%) at $t+2$. Hence, the ECB tone shock has symmetric effects on the probability of a rate hike and cut; that is, these effects are similar in absolute values.

Overall, the results show that the qualitative signal provided by the Introductory Statement, which takes the form of a tone shock, helps market participants to predict ECB monetary policy decisions beyond the information provided by market expectations about future economic and financial conditions.

4.2 Controlling for the ECB's Governing Council Inter-Meeting Communication

Bennani et al. (2019) find that inter-meeting verbal communication among the members of the ECB's GC provides useful information about future ECB monetary decisions. Hence, to control for any additional information provided by the ECB's GC between two meetings in the empirical estimation, we use macroeconomic forecasts collected by Reuters *just before* the Introductory Statement at $t+1$, instead of using the macroeconomic forecasts collected *just after* the Introductory Statement at t as in the baseline model. The inflation and GDP growth forecasts collected just before the statement at $t+1$ are likely to include any additional information provided by the ECB's GC between two meetings.

Table 2 shows the estimated results of eq. (6) using the Reuters' forecasts collected just before the Introductory Statement at $t+1$ for the period 2000M02-2018M04. We update the term structure of market rates accordingly.

I don't think we can do this.

... but we should.

Table 2: Controlling for the ECB's GC Inter-Meeting Communication (2000M02-2018M04)

BN tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.23	-0.18	0.27	-0.16	-0.13	0.37**
	(0.17)	(0.18)	(0.19)	(0.17)	(0.19)	(0.17)
β_π	0.68*	0.57	0.03	0.27	0.21	-0.43
	(0.35)	(0.37)	(0.41)	(0.34)	(0.36)	(0.42)
β_y	0.72***	0.71***	0.94***	0.62***	0.6***	0.88***
	(0.2)	(0.19)	(0.2)	(0.17)	(0.17)	(0.19)
$\beta_{\varepsilon_{BN}}$		3.64***	3.07**		1.44	0.48
		(1.24)	(1.33)		(1.52)	(1.47)
β_{term}			5.34***			6.06***
			(1.23)			(1.21)
Pseudo-R^2	0.135	0.158	0.25	0.08	0.008	0.21
χ^2	19.15	28.56	40.44	18.06	18.19	46.94
Obs.	211	198	197	211	198	197

LM tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(7)	(8)	(9)	(10)	(11)	(12)
β_i	-0.23	-0.20	0.25	-0.16	-0.1	0.40**
	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)	(0.17)
β_π	0.68*	0.61	0.06	0.27	0.18	-0.47
	(0.35)	(0.37)	(0.4)	(0.34)	(0.37)	(0.43)
β_y	0.72***	0.7***	0.93***	0.62***	0.59***	0.88***
	(0.2)	(0.2)	(0.19)	(0.17)	(0.17)	(0.19)
$\beta_{\varepsilon_{LM}}$		0.57	-0.16		2.26**	1.83
		(1.09)	(1.19)		(1.01)	(1.11)
β_{term}			5.51***			5.96***
			(1.22)			(1.14)
Pseudo-R^2	0.135	0.137	0.237	0.086	0.101	0.222
χ^2	19.15	19.95	47.35	18.06	20.57	47.66
Obs.	211	198	197	211	198	197

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Extention:
Is there a comparison between information in the Minutes and information in the Statements?

Table 2 shows that the ECB tone shock is positively and significantly associated with monetary policy decisions at $t + 1$ when using the BN dictionary, and $t + 2$ when using the LM dictionary. However, when we add market expectations of future monetary policy in the specification, the LM tone shock is no longer significant. Hence, even when controlling for the ECB's GC inter-meeting communication in the empirical specification, the ECB tone shock still provides additional information to market participants about future monetary policy. The rest of the results are in line with the baseline model: GDP growth forecasts and market expectations about future monetary policy have a positive and significant relationship with future ECB monetary policy decisions.

4.3 The Tone Shock and the Unconventional Monetary Policy Announcements

Following the Global Financial Crisis, the use of interest rate policies in the euro area has been accompanied by balance sheet policies, such as an expansion of the list of assets eligible as collateral, longer-term liquidity provisions, and outright purchases of specific securities. The aggravation of the financial and sovereign crises in mid-2011 forced the ECB to become a last-resort lender for the banking system in the euro area. The ECB decided on an extension of the maturities of long-term refinancing operations that took the form of asset purchase programmes. We thus introduce the ECB's unconventional policy measures in the empirical analysis.[10] We first construct a control variable for unconventional monetary policy (UMP_t) that takes the value of one when a UMP event is announced during a press conference (according to Cieslak and Schrimpf (2019)) and zero otherwise. Second, we interact the UMP control variable with the ECB tone shock to test if the latter has a stronger or a weaker predictive power when UMP measures are announced during a press conference. The equation is as follows:

$$dR_{t+n} = \beta_i i_t + \beta_\pi E_t \pi_{t+k} + \beta_y E_t y_{t+k} + \beta_{\varepsilon,dic} \varepsilon_{tone_{t,dic}} + \beta_{UMP} UMP_t + \tag{7}$$

$$+ \beta_{\varepsilon,dic,UMP} (\varepsilon_{tone_{t,dic},UMP} \cdot UMP_t) + \beta_{term}(i_{t,L} - i_{t,S}) + \epsilon_{t+n};$$

The value of the coefficient $\beta_{\varepsilon,dic,UMP}$ allows knowing whether the ECB tone shock has a stronger or a weaker relationship with future ECB monetary policy decisions when a UMP is announced during a press conference. Table 8 in the Appendix shows the estimated results of eq. (7) for the period 2000M02-2018M04.

The results depicted in Table 8 suggest that the ECB tone shock has the same predictive power regardless of whether an UMP is announced during a press

[10] We do not consider the Wu and Xia (2016)'s shadow rate as a proxy of the unconventional measures and thus, as a dependent variable in the estimation. Indeed, the latter does not necessarily correspond to explicit ECB monetary policy decisions, but rather reflect market perceptions of ECB monetary policy.

conference or not. This is shown by the non-significant value of the coefficient related to the interaction term, $\beta_{\varepsilon,dic,UMP}$. Nevertheless, although the coefficient interacting the UMP dummy variable with the ECB tone shock computed with the LM dictionary is negative, it is significant at the 10% level only. This finding is in accordance with Bennani et al. (2019), who show that ECB policy rate changes cannot be explained by the communication of unconventional monetary policies.

4.4 Alternative Dictionaries

To check whether the findings highlighted in Table 1 are robust to the choice of the dictionary used to compute the tone measure, we use two different dictionaries: (i) the dictionary developed by Picault and Renault (2017) (PR) and (ii) the dictionary developed by Apel and Blix-Grimaldi (2014) (ABG). These dictionaries use word-combinations, unlike the BN and LM single-word lexicons. The findings show that the predictive power of the tone shock is sensitive to the dictionary used to compute it. Hence, we find that a tone shock computed with the PR dictionary is useful for predicting ECB rate moves at the medium-term horizon (i.e., at $t + 2$), while the tone shock computed with the ABG dictionary is more helpful for predicting the ECB policy decisions at a shorter horizon (i.e., at $t + 1$).

4.4.1 The Picault and Renault (2017) Dictionary

Picault and Renault (2017) (PR) develop a field-specific weighted lexicon designed to assess the tone of ECB communication. They include 34052 n-grams with assigned probabilities reflecting hawkish/dovish (positive/negative) monetary policy (economic outlook) tone. The probabilities were provided based on the manual classification of sentences from the ECB Introductory Statements into three inclinations, and the number of occurrences (frequencies) of n-grams in each inclination context.[11] Following Picault and Renault (2017), we compute the ECB tone as follows:

$$tone_{t,PR} = P_{MP,pos} - P_{MP,neg}; \tag{8}$$

[11] For instance, the following 10-gram sentence conveys a dovish tone according to the PR dictionary: "a cross-check of the outcome of the economic analysis with the signals coming from the monetary analysis confirmed the need for an ample degree of monetary accommodation to secure a sustained return of inflation rates." ECB Press Conference, April 26, 2018.

where $P_{MP,pos}$ ($P_{MP,neg}$) expresses positive (negative) and hawkish (dovish) probabilities, respectively. We follow the steps related to eq. (2) to compute the PR tone shock and to eq. (6) to assess the predictability of the PR tone shock regarding ECB monetary policy decisions. Table 9 in the Appendix provides the results of the estimation for the period 2000M02-2018M04.

The results show that the PR tone shock is positively and significantly related to future ECB monetary policy decisions in the medium-term only (i.e., at $t+2$), unlike the GDP growth forecasts and the term structure of market rates, which are significantly related to future ECB rate decisions in $t+1$ and $t+2$.

4.4.2 The Apel and Blix-Grimaldi (2014) Dictionary

Apel and Blix-Grimaldi (2014) (ABG) construct two quantitative measures, hawk and dove, by an automated search on each set of the Riksbank's minutes from the 82 monetary policy meetings that were held from January 2000 to February 2011. They design a context-specific list that consists of combinations of a noun and an adjective such as "higher inflation" and "lower growth". They obtain 55 hawkish and dovish two-word combinations. For instance, phrases like "The main risks relate to the possibility of a renewed *increase in oil prices*"[12] and "While the period of *slow growth* has been relatively long"[13] convey, respectively, a hawkish and a dovish tone according to the ABG dictionary. We follow Apel and Blix-Grimaldi (2014) and use these combinations to measure the monetary inclination of the ECB Introductory Statement as follows:

$$tone_{t,ABG} = \frac{\#haw_{t,ABG} - \#dov_{t,ABG}}{\#haw_{t,ABG} + \#dov_{t,ABG}}; \tag{9}$$

where $\#haw_{t,ABG}$ and $\#dov_{t,AGB}$ are the number of hawkish and dovish combinations in the Introductory Statement delivered at meeting t, respectively. We compute the ABG tone shock by replicating the steps related to eq.(2) and eq.(6). Table 10 in the Appendix shows the result of the estimation, including the ABG tone shock for the period 2000M02-2018M04.

Although the results shown in Table 10 highlight the usefulness of the GDP growth forecasts and market expectations to predict the moves of the ECB rate, the tone shock computed with the ABG dictionary provides a nuanced picture about its predictive power. More specifically, we find that the coefficient $\beta_{\varepsilon_{ABG}}$ is positive and significant at $t+1$ when excluding market expectations of monetary

[12]ECB Press Conference, March 8, 2007.
[13]ECB Press Conference, October 7, 2004.

policy, but non-significant when including market expectations. However, the ABG tone shock is not useful to predict ECB rate decisions at $t + 2$. These results might be due to the fact that the ABG dictionary is constructed from the Risksbank's minutes and hence, is not appropriate to predict future ECB monetary decisions.

These findings show that the predictive power of the ECB tone shock slightly differs according to the dictionary used to compute it. More specifically, we find that the tone shock computed with the PR dictionary is useful for predicting monetary policy at the medium-term horizon, while the ABG dictionary provides a tone shock with additional information at a shorter horizon.

5 Further Extensions and Robustness Tests

5.1 The Tone Shock and the Current-Looking Taylor-Rule

The baseline results (Table 1) show that with two-quarters ahead macroeconomic projections, the GDP growth forecasts help to predict the move of the ECB rate while this is not the case for the inflation forecasts. Moreover, the predictive power of the BN and LM tone shocks regarding ECB policy decisions might be conditional on the forecast horizon of the macroeconomic variables used in the Taylor-type monetary policy rule. Therefore, we test if these results hold with a different horizon of the macroeconomic variables, notably for a horizon corresponding to the current quarter. We re-estimate eq. (6) with k=0 (current-looking Taylor rule).[14] Table 11 in the Appendix shows the results of the estimation for the period 2000M02-2018M04.

Table 11 show that the results are similar to those of the baseline specification: GDP growth and the term structure of market rates help to predict the move of the ECB rate; while the coefficient related to the inflation forecast, β_π, is not significant and has a counter-intuitive (negative) value when including market expectations of monetary policy. The predictive power of the ECB tone shock is similar to the one in the baseline model: the BN tone shock is helpful for predicting ECB rate decisions at $t+1$, while the LM tone shock is more useful for predicting ECB rate decisions at $t+2$. These findings show that the predictive power of the ECB tone shock is robust to the horizon of the macroeconomic forecasts used in the empirical specification.

5.2 Alternative Expectations about Future Monetary Policy

Table 1 shows that the BN and the LM tone shocks provide information about future ECB policy decisions beyond the information provided by the term structure of market rates. To test whether this result is robust to an alternative proxy of market expectations about future monetary policy, we replace the term struc-

[14] We do not consider forecasts corresponding to four-quarters ahead since the number of individual forecasters submitting forecasts for this horizon is very low.

ture of market rates in eq. (6) with interest rate forecasts collected by Reuters. Eq. (6) becomes:

$$dR_{t+n} = \beta_i i_t + \beta_\pi E_t \pi_{t+k} + \beta_y E_t y_{t+k} + \beta_{\varepsilon,dic} \varepsilon_{tone_{t,dic}} + \beta_i^E E_t i_{t+z} + \epsilon_{t+n}; \quad (10)$$

where $E_t i_{t+z}$ reflects market expectations about future ECB policy rate one-quarter ahead (z=3 months). Table 12 in the Appendix shows the estimated results of eq. (10) for the period 2000M02-2018M04.

Interestingly, even when including the interest rate forecasts of market participants in the empirical analysis, the tone shock still provides additional information to predict ECB monetary policy decisions. More precisely, we find similar qualitative results as in the baseline model: the predictive power of the BN tone shock is significant at $t+1$ and the LM tone shock is significant at $t+2$, although at the 10% level only. However, the coefficient related to the GDP growth forecasts, β_y, is no longer significant. This suggests that macroeconomic forecasts of market participants are not helpful for predicting ECB policy decisions when including interest rate forecasts in the empirical specification.

5.3 Alternative Normalization of Tone

Since the findings shown in Table 1 might be sensitive to the normalization of the tone measure, eq. (1), we specify a different normalization to test the robustness of the results. The alternative tone measure is

$$tone_{t,dic}^{word} = \frac{\#pos_{t,dic} - \#neg_{t,dic}}{\#words_t}; \quad (11)$$

where $\#pos_{t,dic}$ ($\#neg_{t,dic}$) reflects the number of positive/hawkish (negative/dovish) words in the Introductory Statement, and $\#words_t$ is the total number of words. Hence, instead of considering the sum of positive and negative words in the denominator, such as in eq. (1), we consider the total number of words.[15] Once the alternative BN and LM tones are measured, we compute the corresponding tone shocks by re-estimating eq. (2). As a final step, we assess the predictability of the alternative tone shocks regarding ECB policy decisions using eq. (6). Table 13 in the Appendix shows the estimated results of eq. (6) when including the alternative tone shock for the period 2000M02-2018M04.

[15]Hubert and Labondance (2018, p. 7) provide insights on the pros and cons of each of these measures.

Regarding the coefficients related to the macroeconomic and financial variables (β_π, β_y and β_{term}), Table 13 presents similar results as those of the baseline model; that is, the GDP growth forecasts and the term structure of market rates are useful for predicting ECB rate moves, while this is not the case for the inflation forecasts. We also find similar results concerning the coefficients related to the ECB tone shocks, $\beta_{\varepsilon_{BN}}$ and $\beta_{\varepsilon_{LM}}$. More precisely, we find that the BN tone shock helps to predict the ECB rate at $t+1$, while the LM dictionary is useful for predicting rate moves at $t+2$.
All in all, we obtain similar findings in terms of significance as in the baseline model. This shows that our results are robust to the normalization of the tone measure.

5.4 Robustness Tests

Finally, we consider several robustness tests to assess the relevance of our main findings: (i) we estimate eq. (6) using the sample period 2000M02-2014M08 since the ECB hit the zero lower bound on nominal interest rates on August 2014, (ii) we use a raw measure of tone instead of the tone shock in the baseline model (eq. (6)); and (iii) we use the change in the ECB's main refinancing rate in level as a dependent variable instead of the discrete transformation.
The results are qualitatively and quantitatively similar to those of the baseline model (i.e., Table 1), thus showing that our findings are robust to different estimation methods.[16]

[16]To save some space; the results are available upon request.

6 Conclusion

This paper offers original contributions to the literature related to the European Central Bank communication, and more precisely, on its informativeness regarding future monetary policy decisions and its quantification as tone. Using a bag-of-words approach and different dictionaries on the the ECB's Introductory Statement, we derive several tone measures that reflect the degree of positivity/hawkishness and negativity/dovishness of ECB's Introductory Statements. As a second step, we orthogonalize the tone measures on the latest macroeconomic and financial forecasts available to market participants and consider the residual from this regression as the tone shock. Finally, we assess the informativeness of the tone shock regarding future ECB monetary policy decisions. We find that tone shock helps to predict ECB policy decisions even when controlling for the information provided by market expectations of future economic and financial conditions and the ECB's GC inter-meeting communication. Furthermore, several extensions show that the predictive power of the tone shock is robust to (i) the normalization of the tone measure, (ii) alternative market expectations about future monetary policy, and (iii) the horizon of the macroeconomic variables used in the Taylor-type monetary policy rule. However, we find that the predictive power of the tone shock is sensitive to the dictionary used to compute the tone measures. These results thus highlight an additional channel by which ECB communication improves monetary policy predictability, and suggest that the ECB may have private information about exogenous shocks to output and inflation that it communicates through its Introductory Statements.

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Appendix

Figure 4: Absolute frequency of hawkish and dovish words using the BN dictionary

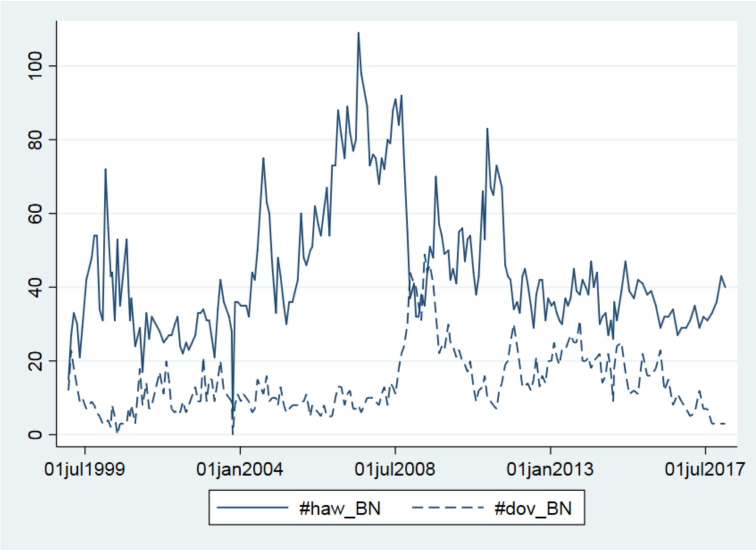

Figure 5: Absolute frequency of positive and negative words using the LM dictionary

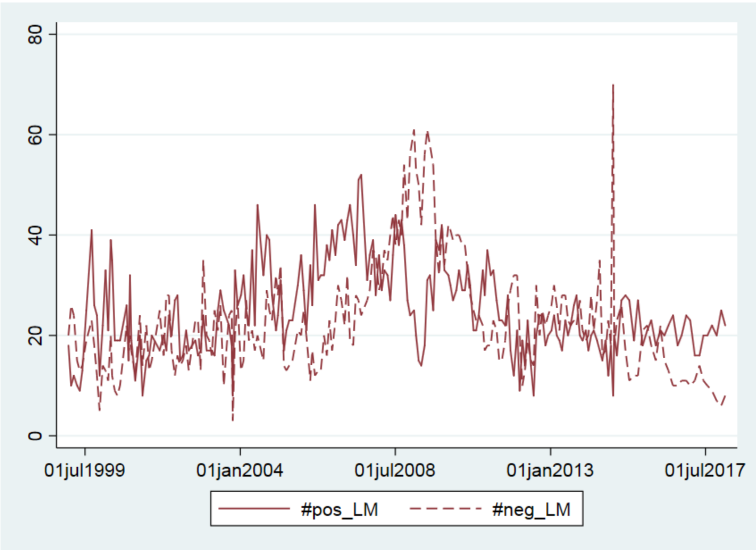

Table 3: Reuters individual data characteristics

Variable	Horizon	Mean	S.D.	Min	Max	Contributors(Min-Max)
i_t	1 Q	1.68	1.48	-0.45	5.25	20-94
	2 Q	1.70	1.50	-0.45	5.50	20-94
	4 Q	1.75	1.47	-0.45	5.50	19-92
π_t	1 Q	1.63	0.90	-1.20	4.30	15-57
	2 Q	1.61	0.74	-1.90	4.20	15-55
	4 Q	1.61	0.45	-1.90	3.40	17-51
y_t	1 Q	1.21	1.45	-6.00	4.20	16-53
	2 Q	1.32	1.28	-5.70	4.30	16-53
	4 Q	1.61	0.87	-3.00	4.30	11-49

Table 4: Summary statistics

Variable	Mean	Min	Max	S.D.
$tone_{t,BN}$	0.52	-0.17	1	0.25
$tone_{t,LM}$	0.06	-0.79	0.61	0.24
$\varepsilon_{tone_{t,BN}}$	0	-0.51	0.53	0.12
$\varepsilon_{tone_{t,LM}}$	0	-0.37	0.56	0.16
π_t	1.75	-0.7	4.1	0.93
y_t	1.08	-4.85	3.72	1.72
$Stoxx$	3270.8	1943.5	5416.3	751.4
EPU_t	141.0	47.7	433.3	64.5
$tone^{word}_{t,BN}$	0.04	-0.01	0.11	0.02
$tone^{word}_{t,LM}$	0.00	-0.04	0.04	0.01
$\varepsilon^{word}_{tone_{t,BN}}$	0.00	-0.03	0.06	0.01
$\varepsilon^{word}_{tone_{t,LM}}$	0.00	-0.02	0.03	0.01
$tone_{t,PR}$	-0.06	-0.76	0.76	0.34
$tone_{t,ABG}$	0.25	-1	1	0.69
$\varepsilon_{tone_{t,PR}}$	0	-0.53	0.48	0.16
$\varepsilon_{tone_{t,ABG}}$	0	-1.58	1.51	0.57
$\theta_{OIS,1W}$	0.21	-19	16.5	3.18
$\theta_{OIS,1M}$	0.34	-19	14.9	3.09
$\theta_{OIS,3W}$	0.17	-17	13.85	2.62
$\theta_{OIS,6M}$	0.15	-16.2	14.1	2.3
$\theta_{OIS,1Y}$	0.2	-15	12.1	2.11

Table 5: First stage regression

Variable	$tone_{t,BN}$	$tone_{t,LM}$
α	0.165*	0.0232
	(0.0875)	(0.116)
$\beta tone_{t-1,BN}$	0.540***	
	(0.0686)	
$\beta tone_{t-1,LM}$		0.452***
		(0.0674)
$\gamma_{\pi,-1}$	-0.104**	-0.0598
	(0.0429)	(0.0563)
$\gamma_{\pi,0}$	0.0453	0.0329
	(0.0536)	(0.0700)
$\gamma_{\pi,1}$	-0.0527	-0.0717
	(0.0626)	(0.0826)
$\gamma_{\pi,2}$	0.157***	0.0792
	(0.0513)	(0.0658)
$\lambda_{GDP,-1}$	-0.0179	-0.00775
	(0.0167)	(0.0221)
$\lambda_{GDP,0}$	0.0563**	0.0508
	(0.0235)	(0.0309)
$\lambda_{GDP,1}$	-0.0412	-0.0767*
	(0.0316)	(0.0416)
$\lambda_{GDP,2}$	0.0324	0.0927**
	(0.0332)	(0.0438)
$\eta_{Stoxx,t}$	8.11e-06	-1.49e-06
	(2.06e-05)	(2.70e-05)
$\psi_{EPU,t}$	-0.000372**	-6.82e-05
	(0.000182)	(0.000241)
$\theta_{OIS,1W}$	0.00537	0.00232
	(0.00515)	(0.00685)
$\theta_{OIS,1M}$	-0.0167*	-0.0150
	(0.00935)	(0.0123)
$\theta_{OIS,3M}$	0.0269	0.0172
	(0.0168)	(0.0222)
$\theta_{OIS,6M}$	-0.00401	0.00693
	(0.0185)	(0.0244)
$\theta_{OIS,1Y}$	-0.00653	-0.00596
	(0.0140)	(0.0185)
Obs.	199	199
R^2	0.743	0.516

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Correlation matrix

Variable	$tone_{t,BN}$	$tone_{t,LM}$	$\varepsilon_{tone_{t,BN}}$	$\varepsilon_{tone_{t,LM}}$
$tone_{t,BN}$	1			
$tone_{t,LM}$	0.75***	1		
$\varepsilon_{tone_{t,BN}}$	0.51***	0.45***	1	
$\varepsilon_{tone_{t,LM}}$	0.34***	0.70***	0.59***	1

*** denotes significance at the 1% level.

Table 7: Marginal effect of tone shock (one S.D.)

	BN tone shock		**LM tone shock**	
	dR_{t+1}	dR_{t+2}	dR_{t+1}	dR_{t+2}
$\Delta Prob(dR_t = 1)$	0.034**	0.017	0.016	0.032**
$\Delta Prob(dR_t = 0)$	0.009	0.004	0.004	0.008
$\Delta Prob(dR_t = -1)$	-0.043**	-0.021	-0.020	-0.040**

Marginal effects are calculated as an average across the sample (AME). The numbers of the columns correspond to the models estimated in Table 1. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 8: Unconventional monetary policy announcements (2000M02-2018M04)

BN tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.08	0.37**	-0.09	-0.06	0.26
	(0.17)	(0.18)	(0.18)	(0.17)	(0.18)	(0.17)
β_π	0.24	0.32	-0.28	0.09	0.1	-0.39
	(0.34)	(0.39)	(0.44)	(0.34)	(0.37)	(0.42)
β_y	0.61***	0.65***	0.93***	0.5***	0.51***	0.69***
	(0.16)	(0.16)	(0.19)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{BN}}$		4.78***	4.12***		2.3	1.39
		(1.31)	(1.44)		(1.47)	(1.44)
β_{UMP}		2.14	2.64		1.41	1.58
		(1.76)	(1.62)		(1.37)	(1.22)
$\beta_{\varepsilon_{BN,UMP}}$		-1.13	0.29		0.43	1.71
		(7.47)	(6.85)		(5.63)	(4.83)
β_{term}			6.19***			4.56***
			(1.31)			(1.11)
R^2	0.08	0.126	0.259	0.05	0.06	0.14
χ^2	17.86	37.83	44.29	13.94	16.98	31.67
Obs.	212	199	199	212	199	199

LM tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.07	0.39**	-0.09	-0.02	0.31*
	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)	(0.17)
β_π	0.24	0.24	-0.34	0.09	0.03	-0.46
	(0.34)	(0.37)	(0.42)	(0.34)	(0.39)	(0.43)
β_y	0.61***	0.61***	0.9***	0.5***	0.51***	0.7***
	(0.16)	(0.16)	(0.18)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{LM}}$		1.32	0.92		2.81***	2.69**
		(1.12)	(1.21)		(1.03)	(1.07)
β_{UMP}		1.2*	1.63**		0.83	0.97
		(0.72)	(0.73)		(0.62)	(0.62)
$\beta_{\varepsilon_{LM,UMP}}$		-1.54	-0.89		-2.96*	-2.62*
		(1.83)	(1.82)		(1.52)	(1.44)
β_{term}			6.4***			4.64***
			(1.28)			(1.11)
R^2	0.08	0.09	0.236	0.05	0.07	0.165
χ^2	17.86	22.56	45.91	13.94	18.93	29.67
Obs.	212	199	199	212	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 9: The PR tone shock (2000M02-2018M04)

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.10	0.37**	-0.09	-0.11	0.25
	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)	(0.78)
β_π	0.24	0.19	-0.41	0.09	0.09	-0.45
	(0.34)	(0.36)	(0.41)	(0.34)	(0.37)	(0.42)
β_y	0.61***	0.61***	0.89***	0.50***	0.51***	0.72***
	(0.16)	(0.17)	(0.18)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{PR}}$		0.70	0.71		2.55**	2.7**
		(1.05)	(1.2)		(1.23)	(1.28)
β_{term}			6.4***			4.82***
			(1.23)			(1.14)
Pseudo-R^2	0.0844	0.085	0.23	0.0527	0.07	0.163
χ^2	17.86	17.75	49.38	13.94	15.8	28.72
Obs.	212	199	199	212	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 10: The ABG tone shock (2000M02-2018M04)

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.09	0.37**	-0.09	-0.07	0.27
	(0.17)	(0.18)	(0.17)	(0.17)	(0.18)	(0.17)
β_π	0.24	0.19	-0.41	0.09	0.03	-0.46
	(0.34)	(0.36)	(0.41)	(0.34)	(0.36)	(0.41)
β_y	0.61***	0.62***	0.9***	0.5***	0.49***	0.69***
	(0.16)	(0.16)	(0.18)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{ABG}}$		0.62**	0.5		0.23	0.09
		(0.31)	(0.35)		(0.31)	(0.33)
β_{term}			6.26***			4.65***
			(1.25)			(1.09)
Pseudo-R^2	0.0844	0.0971	0.236	0.0527	0.0526	0.143
χ^2	17.86	21.63	45.95	13.94	13.95	29.9
Obs.	212	199	199	212	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 11: Current-looking Taylor rule (k=0) (2000M02-2018M04)

BN tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	0.15	0.17	0.56***	0.12	0.13	0.41***
	(0.17)	(0.17)	(0.16)	(0.17)	(0.17)	(0.14)
β_π	-0.34	-0.36	-0.78***	-0.31	-0.32	-0.66**
	(0.26)	(0.25)	(0.30)	(0.26)	(0.26)	(0.29)
β_y	0.28***	0.29***	0.52***	0.21***	0.21***	0.36***
	(0.08)	(0.09)	(0.12)	(0.08)	(0.08)	(0.10)
$\beta_{\varepsilon_{BN}}$		3.9***	3.32**		1.87	1.04
		(1.19)	(1.31)		(1.36)	(1.31)
β_{term}			6.05***			4.6***
			(1.12)			(1.01)
Pseudo-R^2	0.03	0.06	0.2	0.018	0.025	0.119
χ^2	11.80	30.83	39.75	7.446	11.49	30.98
Obs.	201	199	199	200	199	199

LM tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	0.15	0.18	0.56***	0.12	0.17	0.46***
	(0.17)	(0.17)	(0.16)	(0.17)	(0.17)	(0.14)
β_π	-0.34	-0.35	-0.78***	-0.31	-0.36	-0.7**
	(0.26)	(0.25)	(0.30)	(0.26)	(0.27)	(0.29)
β_y	0.28***	0.28***	0.51***	0.21***	0.21**	0.36***
	(0.08)	(0.09)	(0.12)	(0.08)	(0.08)	(0.10)
$\beta_{\varepsilon_{LM}}$		1.32	0.91		2.68***	2.52**
		(0.99)	(1.09)		(0.96)	(1.00)
β_{term}			6.17***			4.61***
			(1.12)			(0.99)
Pseudo-R^2	0.0325	0.0379	0.191	0.0188	0.0419	0.136
χ^2	11.80	14.28	42.94	7.446	13.08	31.71
Obs.	201	199	199	200	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 12: Alternative market expectations about monetary policy (2000M02-2018M04)

	BN tone shock		**LM tone shock**	
Variable	dR_{t+1}	dR_{t+2}	dR_{t+1}	dR_{t+2}
β_i	-6.61***	-3.91***	-6.68***	-3.8***
	(1.39)	(0.89)	(1.41)	(0.89)
β_π	0.19	-0.02	0.20	-0.06
	(0.43)	(0.39)	(0.42)	(0.40)
β_y	0.31	0.23	0.27	0.23
	(0.20)	(0.16)	(0.20)	(0.16)
$\beta_{\varepsilon_{dic}}$	3.56**	0.8	-0.08	1.9*
	(1.6)	(1.63)	(1.13)	(1.01)
β_{i^E}	6.64***	3.92***	6.68***	3.84***
	(1.36)	(0.81)	(1.37)	(0.82)
Pseudo-R^2	0.337	0.164	0.320	0.174
χ^2	36.75	43.98	36.47	44.27
Obs.	199	199	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 13: Alternative tone shocks (2000M02-2018M04)

BN tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
β_i	-0.11	-0.08	0.37**	-0.09	-0.06	0.26
	(0.17)	(0.18)	(0.18)	(0.17)	(0.18)	(0.17)
β_π	0.24	0.18	-0.41	0.09	0.02	-0.46
	(0.34)	(0.38)	(0.44)	(0.34)	(0.36)	(0.41)
β_y	0.61***	0.63***	0.89***	0.5***	0.5***	0.69***
	(0.16)	(0.17)	(0.19)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{BN}}$		46.11***	36.14*		29.08	17.85
		(16.19)	(20.58)		(18.16)	(16.13)
β_{term}			6.22***			4.54***
			(1.33)			(1.11)
Pseudo-R^2	0.0844	0.115	0.247	0.0527	0.0632	0.147
χ^2	17.86	23.04	38.28	13.94	16.09	33.07
Obs.	212	199	199	212	199	199

LM tone shock

	dR_{t+1}			dR_{t+2}		
Variable	(13)	(14)	(15)	(16)	(17)	(18)
β_i	-0.11	-0.06	0.38**	-0.09	-0.02	0.31*
	(0.17)	(0.18)	(0.17)	(0.17)	(0.18)	(0.17)
β_π	0.24	0.16	-0.42	0.09	-0.05	-0.52
	(0.34)	(0.36)	(0.41)	(0.34)	(0.38)	(0.42)
β_y	0.61***	0.6***	0.88***	0.5***	0.5***	0.69***
	(0.16)	(0.16)	(0.18)	(0.14)	(0.15)	(0.17)
$\beta_{\varepsilon_{LM}}$		18.85	11.08		45.34***	41.65**
		(18.15)	(18.68)		(17.21)	(17.07)
β_{term}			6.35***			4.62***
			(1.26)			(1.1)
Pseudo-R^2	0.0844	0.0876	0.23	0.0527	0.0743	0.162
χ^2	17.86	18.33	46.06	13.94	18.05	29.64
Obs.	212	199	199	212	199	199

Robust standard errors are shown in between brackets. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

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