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Do as I Do, and Also as I Say: Monetary Policy Impact on Brazil's Financial Markets

ABSTRACT We analyze how Brazilian financial markets, in particular interest rate futures, react to monetary policy in terms of both deeds (that is, changes in the policy rate) and words (that is, central bank communication). Using daily data from 2005 to 2014, we find that interest futures rates react in the expected direction to both the central bank's actions and its words: futures rates rise (fall) after both an increase (decrease) in the reference interest rate and a hawkish (dovish) communication by the Central Bank of Brazil. We also find that the Central Bank's words create noise, since they increase the volatility of futures rates. Our analysis further reveals that the effectiveness of monetary policy communication increased after the 2008 international crisis, as measured by its larger impact on future rates and reduced volatility. At the same time, deeds became less relevant: the effect of changes in the Central Bank's policy rate on futures rates declined.

JEL Classifications: E52, E58, E43

Keywords: monetary policy, communication, interest rates, central banks

Central bank communication became topical due to the increasing liberalization of financial markets and the emergence of inflation-targeting regimes in the last few decades. The management of expectations became quintessential for monetary policy, forcing monetary authorities around the world to increase transparency and improve communication. Central bank communication did not take center stage in monetary policy, however, until central banks in developed countries were compelled to provide "forward

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guidance" in an environment where the room for maneuver for traditional monetary policy was constrained by the zero lower bound.

In the 1990s, numerous central banks started improving their communication, using different means as a function of their target audience, be it the public or financial markets. With respect to the latter, central banks now publish their own assessment of the economic outlook and generally also hint at their future monetary policy actions.[1]

Academic research provides increasing evidence that communication represents a powerful tool for central banks to conduct a more predictable monetary policy, the more so the more developed the financial system in which the central bank operates.[2] The rationale for such a role of communication lies in the final goal of central bank communication: managing financial markets' expectations, which is easier with forward-looking financial markets.[3] Accordingly, central bank communication is closer to an instrument to conduct monetary policy than a means of transparency.

Until a few years ago, studies of central bank communication focused on large developed countries, while the case of emerging economies was somewhat neglected.[4] More recently, however, there has been a boom in this literature, including on Brazil, where an inflation-targeting system has been in place since 1999.[5] Most of the literature about central bank communication in Brazil focuses on the impact of monetary policy on financial markets, especially on interest rate futures.[6] Looking at different periods and using different estimation strategies, this literature shows that in general communication does affect interest rate markets.

Although some papers on Brazil focus only on communication and do not estimate the impact of changes in the Central Bank's policy interest rate (the SELIC rate) on financial markets, those works where this analysis is jointly done show that deeds also matter.[7] The importance of deeds is a finding shared by a related literature, which focuses on the impact of changes in the SELIC rate but ignores the role of communication.[8]

1. BIS (2009); Filardo and Guinigundo (2008).
2. See Blinder and others (2008) for an extensive survey of the literature.
3. Svensson (2004); García-Herrero and Remolona (2008).
4. Blinder and others (2008).
5. See, for example, García-Herrerro and Girardin (2015).
6. Costa Filho and Rocha (2010); Janot and Mota (2012); Caldas Montes (2012); Carvalho, Cordeiro, and Vargas (2013); Chague and others (2013).
7. Costa Filho and Rocha (2010); Janot and Mota (2012); and Carvalho, Cordeiro, and Vargas (2013).
8. Tabak (2004); Tabata and Tabak (2004); Nunes, Holland, and da Silva (2011).

Although the impact of monetary policy communication can, at least in theory, affect both the mean and the variance of the selected financial outcomes, there are few papers that jointly look at these two dimensions—and only two that focus on the case of Brazil.[9] Both show that communication reduces volatility, which contrasts with the findings of at least part of the literature for other countries.[10] In addition, their results suggest that communication does not affect the mean of the selected financial variables as expected. For Costa Filho and Rocha, interest rate futures increase after a piece of communication is released, independently of its content.[11] According to Janot and Mota, the slope of the yield curve is not affected by BCB communication.[12] These results contrast with findings for developed countries and also with other papers about monetary policy communication in Brazil, which, while they do not analyze the impact on volatility, suggest that BCB's words affect the level of interest rate futures and other financial outcomes according to its tone.[13]

The objective of this paper is to assess empirically whether interest rate futures in Brazil react to changes in the SELIC rate and to different pieces of communication released by the BCB. We use daily data from 2005 to 2014, quantify communication in line with Rosa and Verga, and build on a component generalized autoregressive conditional heteroskedasticity (component GARCH or C-GARCH) model that allows us to determine whether changes in the variance of interest rates are permanent or temporary.[14] We show that, in general, interest rate futures increase (decrease) following either a rise (fall) in the reference interest rate or hawkish (dovish) communication by the Central Bank of Brazil. Moreover, the volatility in interest rate futures rises after the release of a piece of monetary policy communication.

Our analysis also reveals that the impact of monetary policy changed significantly after the 2008 international crisis. In line with what has been happening in some developed regions, such as the United States and the euro area, the impact of BCB words changed: its effect on the mean of interest rates increased, while the communication process became less noisy (that is, the impact on volatility became smaller and temporary rather than permanent). However, the effect of deeds declined.

9. Costa Filho and Rocha (2010); and Janot and Mota (2012).
10. For example, Kohn and Sack (2004); Reeves and Sawicki (2007).
11. Costa Filho and Rocha (2010).
12. Janot and Mota (2012).
13. Caldas Montes (2012); Carvalho, Cordeiro, and Vargas (2013); Chague and others (2013).
14. See Rosa and Verga (2007) on the quantification of communication.

From a policy perspective, these results confirm that communication is an increasingly important tool for central banks, which reinforces the need to continue to learn how to use it. Moreover, the evidence provided by this paper shows that the importance of traditional monetary policy (that is, of changes in policy rates) diminished, while communication became more relevant, generating an additional challenge for central bankers: to make communication and deeds work as complementary tools—rather than as substitutes.

The present study contains many innovative features. First, unlike other papers in the literature, it reveals that monetary policy communication in Brazil not only affects interest rate futures by increasing (reducing) them when a hawkish (dovish) tone is employed by the BCB, but also increases volatility (rather than reducing it as previously suggested). Second, it demonstrates that monetary policy in Brazil went through a significant change after the 2008 crisis. Because our analysis also takes into account the impact on volatility, we provide a more general characterization of these changes than is currently available in the literature.[15] Third, it presents an exhaustive measure of the Central Bank's communication covering written and oral statements from 2005 to 2014, indicating whether the monetary authority is willing to tighten, maintain unchanged, or ease monetary conditions (that is, whether the pieces of communication are hawkish, neutral, or dovish). Importantly, our measure includes written statements (press releases on the monetary policy decision, monetary policy meeting minutes, and quarterly inflation reports) and speeches by the president of the monetary authority. In contrast, other studies about central bank communication in Brazil build only on a subsample of written communication (either minutes or statements) and overlook oral communication. Finally, for the first time in the literature on communication, we consider whether communication has a temporary or permanent impact on volatility, thanks to the use of a component-GARCH model.[16] We find that while the impact was permanent for shorter maturities before the Lehman Brothers collapse, it is now only transitory at all maturities.

The paper is structured as follows. The next section discusses methodological and data issues, with particular attention to the construction of our measure of central bank communication. The paper then displays and discusses our empirical results, including some robustness analyses. Finally, we draw some conclusions.

15. Carvalho, Cordeiro, and Vargas (2013).
16. Ding and Granger (1996); and Engle and Lee (1999).

Data

Brazil's monetary policy framework has gradually gotten close to that of major central banks in the world, in terms of both its monetary framework and its communication. The country has operated an inflation-targeting system since 1999. The Central Bank's Monetary Policy Committee (COPOM) is in charge of setting monetary policy and defining the reference interest rate, the SELIC rate. The COPOM currently meets ten times a year, approximately once every forty days, to determine the SELIC rate. Until 2005, during the so-called maturation period of the inflation-targeting system in Brazil, COPOM meetings were held monthly.

The COPOM uses three main communication instruments: press releases of the monetary policy decision issued right after the COPOM meetings, containing the announcement of the decision and usually a very brief assessment of the situation; the minutes of the monetary policy meetings released one week after the announcement of the policy decision, with a detailed assessment of the economic environment, including the drivers of the monetary policy decision and the outlook for monetary policy; and inflation reports released at the end of every quarter, containing the outlook and forecasts for the factors weighing on COPOM decisions. In addition to written documents, the BCB has increasingly relied on oral communication, in line with trends observed in other countries.

To construct a measure of BCB communication, we take into account all four types of communication, as financial markets are potentially affected by each one.[17] Thus, our BCB communication sample includes eighty-three press releases, eighty-three minutes, and thirty-nine inflation reports, all released between 3 January 2005 and 6 November 2014, as well as twenty-four speeches by the BCB president.[18]

In line with other papers in the literature, we follow Rosa and Verga by codifying the available BCB communication into an index ranging from –2 to +2.[19] The index identifies whether there is a very clear intention to

17. By including all forms of communication used by the BCB to increase transparency and manage expectations, we are able not only to construct a more comprehensive communication index, but also to benefit from having a larger sample for our econometric exercises than those used in previous studies on central bank communication in Brazil.

18. The speeches considered are available at the BCB webpage. Speeches by members of the COPOM other than the BCB president are also potentially relevant, but they are not available and thus were not included. We also excluded speeches with no references to any factor potentially weighing on COPOM decisions.

19. Costa Filho and Rocha (2009, 2010); Rosa and Verga (2007).

TABLE 1. Examples of BCB Communication and Index Codes

Code	*Meaning*	*Example of communication*	*Excerpts*
+2	Very hawkish	Speech, 10 July 2008	"It is up to the monetary authorities to adopt contractive measures"; "BCB will not wait to combat inflationary pressures"; "do not accept complacency"
+1	Hawkish	Inflation report, 27 June 2013	"Inflation shows an upward trend"; "the balance of risk is unfavorable"; "monetary policy is vigilant"
0	Neutral	Minutes, 28 Oct 2010	"Inflation consistent with the goals"; "deceleration of activity"; "robust domestic demand"
−1	Dovish	Minutes, 7 Dec 2006	"Benign trend"; "parsimonious flexibilization"; "lower interest rates in real terms"
−2	Very dovish	Press release, 18 Apr 2012	"Risk to the inflation trajectory remains limited"; "given the fragility of the goal economy, the contribution of the external sector has been disinflationary"

Source: Central Bank of Brazil and BBVA Research.

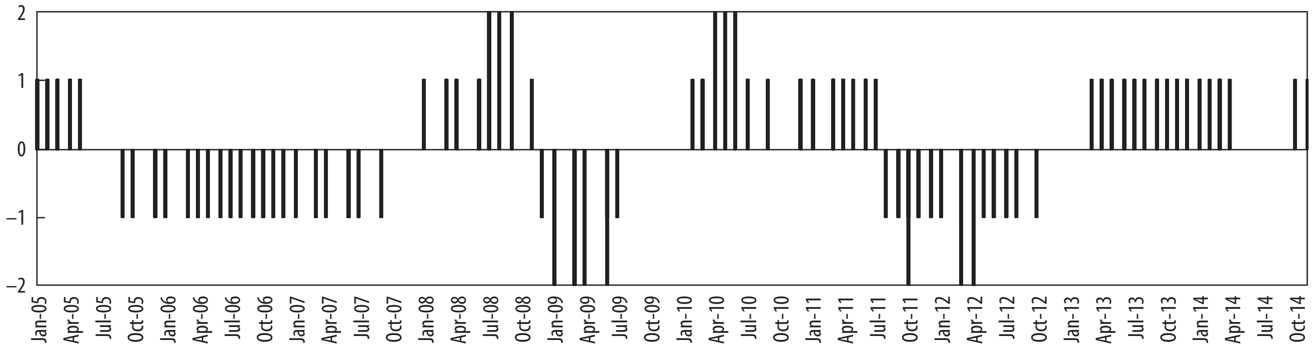
loosen monetary policy ahead (a very dovish tone: −2), a mild intention to loosen monetary policy (a dovish tone: −1), an intention to maintain monetary conditions unchanged (a neutral tone: 0), a mild intention to tighten monetary policy (a hawkish tone: +1), or a very clear intention to tighten monetary policy (a very hawkish tone: +2). Table 1 presents some examples of pieces of communication released by the BCB, together with its index code. Figure 1 displays times series with the scores of all the communication included in our sample.

Financial Markets: Interest Rate Futures

Like most of the literature on the impact of central bank communication, we focus on the effect on interest rate markets. More precisely, we use Brazilian swaps (also known as Pre X DI swaps). This type of swap exchanges a fixed rate (Pre) for an accrued floating interest rate (DI) over an agreed period.[20] These swaps are traded on the BM&F BOVESPA Exchange, and the time series are available on the BCB webpage. Due to the high liquidity of these markets, Brazilian swaps are commonly used not only by the literature on central bank communication, but also by studies on the term structure of interest

20. The floating rate is the average overnight interbank deposit rate, which is calculated exponentially on a 252-business-day basis. This floating rate is known as the CDI or overnight DI (*depósito interbancário*) rate. It is annualized and calculated daily by the Clearinghouse for the Custody and Financial Settlement of Securities (CETIP). This swap has only one payment at maturity.

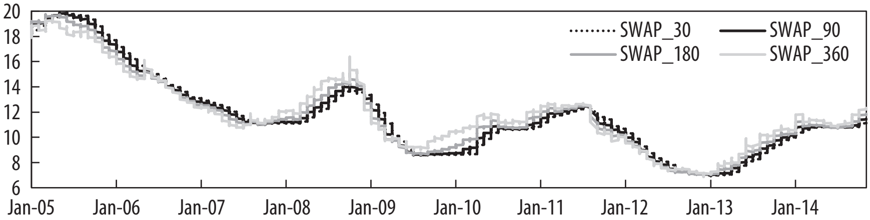
FIGURE 1. BCB Communication Index[a]



Source: BBVA Research.

a. The index ranges from −2 (very dovish) to +2 (very hawkish). The sample includes eighty-three press releases, eighty-three minutes, thirty-nine inflation reports, and twenty-four speeches by the BCB president, from 3 January 2005 to 6 November 2014.

FIGURE 2. Brazilian Swaps for 30, 90, 180, and 360 days



Source: Central Bank of Brazil and BBVA Research.

rates and the impact of monetary policy.[21] Moreover, these swaps are traditionally used by the BCB as in input for interest rate futures in its econometric models and overall analysis. We focus on some of the most relevant maturities: 30, 90, 180, and 360 days (see figure 2 and appendix A for some basic statistics).

SELIC Rates and Other Macroeconomic Variables

The daily changes in Brazilian swaps, our financial market of interest, are the dependent variable in our econometric exercises. Our main explanatory variable is the BCB communication index, ranging from −2 (very dovish) to +2 (very hawkish). In addition, we also include in our quantitative analysis the daily changes of the SELIC interest rate set by the COPOM at its monetary policy meetings (see figure 3), global risk aversion proxied by the CBOE Volatility Index (VIX), and the U.S. dollar interest rate swap.

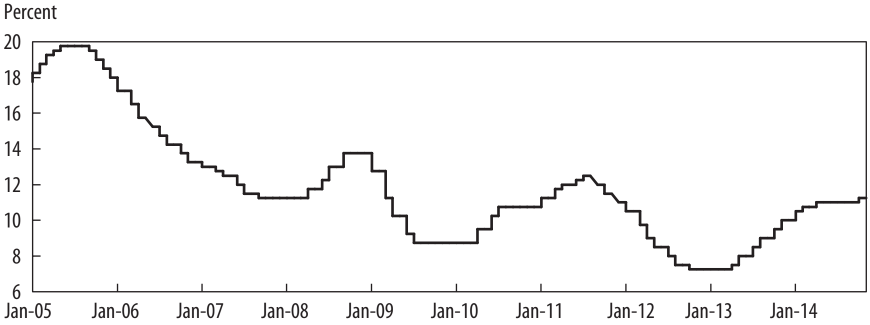
Methodology

To evaluate the impact of BCB communication on Brazil's interest rate futures markets, we adopt an encompassing approach in the spirit of Ehrmann and Fratzscher, using joint estimates of the mean and the volatility of interest rate futures.[22] With regard to the former, we analyze empirically whether swap

21. See Lima and Issler (2003); Tabak and Tabata (2004); Minella and Souza-Sobrinho (2013).

22. Ehrmann and Fratzscher (2007).

FIGURE 3. SELIC Interest Rate Set by the COPOM



Source: Central Bank of Brazil and BBVA Research.

markets understand the Central Bank's words by examining whether speeches and written statements move mean interest rates in the intended direction, that is, as indicated by our BCB communication index. With respect to the volatility, the most logical hypothesis is that the volatility of asset returns should be higher on days of central bank communication, everything else equal, because such signals contain news.[23] However, a reduction in volatility could also be a response to central bank communication, insofar as the situation prior to such news was very uncertain and the communication helped calm the markets.[24]

We use a conditional volatility model, namely, a component GARCH (C-GARCH) model that distinguishes between long-run and short-run volatility.[25] In contrast with a classical GARCH model, a C-GARCH model allows us not only to analyze the effect of communication (and other independent variables) on both the mean and the volatility of interest rate futures, but also to determine whether communication has a permanent or temporary impact on volatility.[26] In other words, we explicitly acknowledge that communication may have more elaborate effects than allowed by a standard GARCH model.

23. Kohn and Sack (2004); Connolly and Kohler (2004); Reeves and Sawicki (2007).

24. Geraats (2002).

25. More precisely, we employ the C-GARCH model of Engle and Lee (1999) and Ding and Granger (1996).

26. Prior tests implied that a standard GARCH model did not eliminate heteroskedasticity from the residuals. In addition, conditioning variables can have a negative effect on short-run volatility, while negative effects are not possible in a standard GARCH model.

Indeed, it may have either very temporary effects, and thus only affect short-run volatility, or more permanent effects, which alter the persistent component of volatility. In addition, communication may reduce volatility, which can be allowed in the short-run component, while a GARCH model is subject to the positivity constraint.

The model is thus composed of two parts. Equation 1 analyzes how communication and the other specified variables affect mean interest rates, while equations 2 and 3 specify the volatility of the changes in the swap rates and how communication and the other variables affect it.

$$\text{(1)} \qquad \Delta \text{SWP}_{jt} = a_1 + \sum_{k=1\ to\ 10} a_{2k} \Delta \text{SWP}_{jt-k} + a_3 \text{COM}_t + a_4 \Delta \text{SEL}_t + a_5 \Delta \text{VIX}_t + a_6 F_t + a_7 M_t + a_8 \Delta \text{USSWAP}_t + (h_t)^{1/2}\, \varepsilon_t;$$

$$\text{(2)} \qquad q_t = \omega + \rho(q_{t-1} - \omega) + \phi\left[(\varepsilon_{t-1})^2 - h_{t-1}\right] + \lambda \text{ACOM}_t;$$

$$\text{(3)} \qquad (h_t - q_t) = \alpha\left[(\varepsilon_{t-1})^2 - q_{t-1}\right] + \beta\left[h_{t-1} - q_{t-1}\right] + \mu \text{ACOM}_t.$$

In the mean equation 1, we make the observed daily change at time t of interest rate futures of maturity j (ΔSWP_{jt} in our notation) depend on its own lags, as well as on the central bank communication variable (COM) and the observed daily change in the monetary policy rate (that is, the change in the SELIC rate, ΔSEL). In addition, we allow for calendar effects such as the end of the week or the evening before a public holiday (F in our notation) and the beginning of the week or the day after a public holiday (M). Finally, we control for the well-known global risk aversion, proxied by the VIX in first differences (since the level of this variable is nonstationary), and for changes in the U.S. monetary policy stance, proxied by the one-year U.S. dollar interest rate swap rate (ΔUSSWAP).[27]

In line with the C-GARCH structure of our model, equation 1 also includes the time-varying variance of the changes in the swap rates (h_t) and a unit-variance, serially uncorrelated, zero-mean, independent and identically

27. Initially, we controlled for other key data releases, namely, announcements on Brazil's gross domestic product (GDP) and the consumer price index (CPI) (using a dummy that took a value of one on days of GDP growth or inflation releases, and zero otherwise), and U.S. macroeconomic news (with a similar dummy for U.S. GDP or inflation announcements). Since these variables were never significant, we dropped them from the analysis.

distributed (i.i.d.) error term (ε_t), representing the unexpected part of movements in the swap rate.

In the volatility analysis, that is, in equations 2 and 3, the absolute value of the communication variable (ACOM) replaces the BCB communication variable, in line with standard practice.[28] This variable is fundamental for assessing the potential impact of communication on volatility. Equation 2 specifies the long-run volatility dynamics of the swap rates. In this equation, q represents the long-run component of volatility, which converges (usually very slowly) to the long-run time-invariant volatility level, ω, according to the magnitude of ρ. Equation 3 specifies the short-run volatility dynamics, in which volatility (h) moves around the long-run time-varying component (q). Accordingly, the deviation of the current conditional variance from the long-run variance at time t is affected by the deviation of the previous error (ε_{t-1}) from the long-run variance q and the previous deviation of the conditional variance from the long-run variance q. The short-run component can be either positive or negative, since volatility fluctuates around the long-run component.

We also need to allow for the possibility that good news ($\varepsilon_t > 0$) and bad news ($\varepsilon_t < 0$) have asymmetric effects on the short-run conditional volatility, as in the threshold GARCH model.[29] Combined with the C-GARCH model, this replaces equation 3 with equation 4:

$$(4) \qquad (h_t - q_t) = \alpha\left[(\varepsilon_{t-1})^2 - q_{t-1}\right] + \gamma\left[(\varepsilon_{t-1})^2 - q_{t-1}\right]d_{t-1} + \beta\left[h_{t-1} - q_{t-1}\right] + \mu \mathrm{ACOM}_t,$$

where d_{t-1} equals unity if $\varepsilon_t < 0$ and zero otherwise. Therefore, the impact of good news is simply α while that of bad news is $(\alpha + \gamma)$. With a positive γ a leverage effect is present. When γ is different from zero, the impact of news is asymmetric.

Due to the ever-present nonnormality in the residuals, we use the generalized-error distribution suggested by Nelson, which embodies several other distributions depending on the value of the tail-thickness parameter.[30]

28. Since the variance is nonnegative by construction, we follow the standard practice of including only nonnegative potential determinants in the conditional volatility equation, which with our specification could generate problems in the long-run component of volatility.

29. Zakoian (1994); Glosten, Jaganathan and Runkle (1993). The variable ε measures unexpected movements in interest rates and therefore can be interpreted as a measure of news.

30. Nelson (1991).

We estimate restricted versions of this model in two separate steps. First, we examine whether markets understand the BCB by excluding the communication variable COM from the conditional variance equations ($\lambda = \mu = 0$ in equations 2 and 3 or 4). Second, we test whether the volatility of interest rates reacts to the Central Bank's words, by excluding the communication variable from the mean equation ($a_3 = 0$ in equation 1). On the basis of the likelihood, we test whether communication influences either the long-run (λ different from zero) or the short-run (μ different from zero) component of the volatility.

Effects of Interest Rate Changes and Communication on Interest Rate Swap Markets

We focus our analysis on two periods, from 2 January 2005 to 12 September 2008 (the precrisis period) and from 2 January 2009 to 6 November 2014 (the postcrisis period). The intermediate period, from 13 September 2008 to 31 December 2008, was marked by the outbreak of the global financial crisis. We therefore treat it as an outlier and exclude it from our analysis, given the abnormal turbulence in financial markets observed in these few months. The division of the sample into these two subperiods is in line with the evidence that the global crisis structurally changed the management and the impact of monetary policy. Our findings reinforce this claim.

The results of the estimation of our model are presented in tables 2 and 3. Following our two-step estimation strategy, table 2 focuses on the impact of communication and other variables on the mean of the daily changes in the swap rates (assuming communication does not affect volatility), while table 3 contains the results of the impact of communication and other variables on volatility (assuming communication does not affect the mean).

Do Changes in the SELIC Rate Affect Interest Rate Futures?

Table 2 presents the estimation of the mean equation, which incorporates the communication variable COM, the daily change in the SELIC rate, and other control variables. As the table shows, the effect of a change in the monetary policy rate (ΔSEL in our notation), represented by the parameter a_4 in equation 1, is positive and significant for practically all the maturities considered in both

TABLE 2. Impact of Communication and Other Variables on the Mean of Interest Rate Futures[a]

Explanatory variable	Swap maturity and period[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Mean								
Constant	–0.0013**	0.00033	–0.0016***	0.00053	–0.0021***	9.32 E–05	–0.0042**	3.30 E–05
Σ AR	0.82***	0.72**	0.56***	0.63***	0.43***	0.42**	0.150***	0.24***
No. lags	10	9	10	10	10	10	7	9
ΔSEL	**0.078*****	**0.022*****	**0.117*****	**0.124****	**0.143*****	**0.033*****	**0.147*****	**0.056*****
COM	–0.0003	**0.0018**	**0.0024**	**0.0056*****	**0.0037**	**0.0084*****	**0.0011**	**0.0086****
F	–	–	–	–	–		–0.0095**	–
M	–0.0021***	–	–0.0021**	–	–0.0068***	0.0021***	–	–
ΔVIX	0.0019***	–	0.0029***	–0.00043**	0.0059***	–0.0014***	0.0118***	–0.0027***
ΔUSSWAP	–	0.038***	–0.046***	0.0408**	–	0.0081***	–	0.206***
Variance								
χ	0.0005***	0.0017	0.0005***	0.0041	0.002***	0.0083	0.0057***	0.006
ρ	0.992***	0.990***	0.994***	0.993***	0.899***	0.996***	0.881***	0.99***
ϕ	–0.0158*	0.11	–0.003**	0.169*	0.124***	0.113***	0.194***	0.06**
α	0.170***	0.219**	0.096***	0.142**	0.045	0.009**	0.077*	0.084***
γ	–	0.137***	–0.118***	–	–	–	0.132**	–
β	0.325***	0.493***	0.697***	0.733***	–0.718**	0.765***	–0.574***	0.790***
GED	1.08***	0.91***	1.10***	0.864***	1.03***	0.987***	1.23***	1.13***

(continued)

TABLE 2. Impact of Communication and Other Variables on the Mean of Interest Rate Futures[a] *(Continued)*

Explanatory variable	*Swap maturity and period*[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Summary statistic								
Adjusted R^2	0.293	0.23	0.227	0.131	0.209	0.072	0.051	0.038
AR(10)	7.65	7.07	7.31	8.24	6.38	12	4.96	9.17
	(0.66)	(0.71)	(0.69)	(0.60)	(0.78)	(0.28)	(0.89)	(0.51)
ARCH	0.116	0.09	1.14	0.26	0.17	0.27	0.003	0.29
	(0.89)	(0.75)	(0.28)	(0.61)	(0.67)	(0.60)	(0.95)	(0.58)

* *Z* statistic is significant at the 10 percent level.
** *Z* statistic is significant at the 5 percent level.
*** *Z* statistic is significant at the 1 percent level.

a. The table reports the results of the estimation of equations 1, 2, and either 3 or 4. The communication variable (COM) is included in equation 1 but not in equations 2, 3, and 4. The dependent variable in the mean equation is the daily change in the swap rate. The independent variables in the mean equation (equation 1) are the five-pronged communication variable (COM); the daily change in the monetary policy rate (the SELIC rate); calendar effects: the end of the week or the eve of a public holiday (*F*) and the beginning of the week or the day after a public holiday (*M*); the VIX in first differences; and the U.S. dollar interest rate swap rate. For the variance equation, see equations 2, 3, or 4 in the text (parameters μ and λ are constrained to zero). The regressions are estimated using a C-GARCH model with generalized error distribution. Below the summary statistic testing for the null of the absence of autocorrelation (AR) and heteroskedasticity (ARCH), the *p*-value is reported in brackets.

b. The precrisis period is from 02 January 2005 to 12 September 2008; the postcrisis period is from 03 January 2009 to 06 November 2014.

TABLE 3. Impact of Communication and Other Variables on the Volatility of Interest Rate Futures[a]

Explanatory variable	*Swap maturity and period*[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Mean								
Constant	−0.001	0.0001	−0.002***	0.0072***	−0.0025***	−0.0001	−0.0044**	0.0002
Σ AR	0.78***	0.79**	0.60***	0.64***	0.43***	0.47**	0.185***	0.23***
No. lags	10	6	10	10	10	10	7	8
ΔSEL	0.07***	0.005	0.0126***	0.0114***	0.143***	0.071***	0.146***	0.058***
F	–	–	−0.0024**	−0.0024**	–		−0.0096**	–
M	−0.0021***	–	–	–	−0.0067***	0.0023***	–	–
ΔVIX	0.0019***	–	0.0026***	−0.0006***	0.0059***	−0.0013***	0.0120***	−0.0028***
ΔUSSWAP	–	0.044***	−0.036**	0.044**	–	0.113***	–	0.206***
Variance								
χ	0.0004***	0.0017	0.0006***	0.004	0.0018***	0.003**	0.006***	0.006***
ρ	0.786***	0.951***	0.535***	0.991***	0.861***	0.979***	0.894***	0.968***
φ	0.34	0.441***	0.782***	0.176**	0.193***	0.104***	0.193***	0.131**
α	−0.224	−0.151**	−0.581*	0.159***	−0.055	0.074*	0.070*	−0.006
γ		0.189**	−0.210***				0.142***	
β	0.891	0.383***	1.12****	0.674***	0.531***	0.46***	−0.599***	0.426***
λ	**0.0008*****	–	**0.0018*****	–	–	–	–	–
μ	–	−0.0001**	–	**0.00046****	**0.0029****	**0.0025*****	−0.0008*	**0.0055*****
GED	1.10***	0.921***	1.14***	0.873***	1.09***	1.02***	1.24***	1.20***

(continued)

TABLE 3. Impact of Communication and Other Variables on the Volatility of Interest Rate Futures[a] *(Continued)*

Explanatory variable	*Swap maturity and period*[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Summary statistic								
Adjusted R^2	0.287	0.209	0.232	0.127	0.212	0.089	0.051	0.039
AR(10)	7.67	11.7	9.36	9.9	5.81	9.16	4.99	13.4
	(0.66)	(0.22)	(0.49)	(0.44)	(0.83)	(0.51)	(0.89)	(0.19)
ARCH	0.08	0.1	0.7	0.35	0.05	0.3	0.001	0.17
	(0.77)	(0.74)	(0.40)	(0.55)	(0.82)	(0.58)	(0.97)	(0.68)

* *Z* statistic is significant at the 10 percent level.

** *Z* statistic is significant at the 5 percent level.

*** *Z* statistic is significant at the 1 percent level.

a. The table reports the results of the estimation of equations 1, 2, and either 3 or 4. The communication variable (ACOM) is included in equations 2, 3, and 4 but not in equation 1. The dependent variable in the mean equation is the daily change in the swap rate. The independent variables in the mean equation (equation 1) are the daily change in the monetary policy rate (the SELIC rate); calendar effects: the end of the week or the eve of a public holiday (*F*) and the beginning of the week or the day after a public holiday (*M*); the VIX in first differences; and the U.S. dollar interest rate swap rate. The communication variable is not included; a_3 is constrained to zero. For the variance equation, see equations 2, 3, or 4 in the text. The regressions are estimated using a C-GARCH model with generalized error distribution. Below the summary statistic testing for the null of the absence of autocorrelation (AR) and heteroskedasticity (ARCH), the *p*-value is reported in brackets.

b. The precrisis period is from 02 January 2005 to 12 September 2008; the postcrisis period is from 03 January 2009 to 06 November 2014.

the pre- and the postcrisis periods. This means that increases (decreases) in the SELIC rate drive swap rates up (down), as expected. However, the magnitude of this effect changes sharply between the pre- and post-Lehman periods, with a marked fall after the bankruptcy. More precisely, it fell from 0.078 to 0.022 in the case of thirty-day swaps, from 0.143 to 0.033 in the case of 180-day swaps, and from 0.147 to 0.056 in the case of 360-day swaps. In the case of ninety-day swaps, the parameter a_4 remained broadly unchanged (0.117 before and 0.124 afterward).[31]

Does BCB Communication Affect the Mean of Interest Rate Futures?

The estimation of the mean equation 1 provides a measure of the impact of the communication variable (COM) on swap rates (that is, the parameter a_3 in equation 1) (see table 2). We find that the parameter a_3 is in general positive, meaning that swap rates react to oral and written communication by the BCB in the intended direction: they increase following hawkish pieces of communication and decrease following dovish pieces of communication. Nonetheless, this impact is only significant in the postcrisis subsample.

These results reinforce the diganosis of changes in the impact of monetary policy after the 2008 crisis: not only did the effect of deeds become smaller, but the effect of words became stronger.

Does BCB Communication Affect the Volatility of Interest Rate Futures?

We now turn to the second stage of our estimation procedure, namely, the estimation of the effects of communication in volatility equations. To do so, we exclude the communication variable from the estimation of the mean equation while including its absolute value (ACOM) in the estimation of equation 2 and equations 3 or 4.

We test the hypothesis that the volatility of the changes in the swap rates moves in a statistically significant way right after the release of a BCB communication. More specifically, we analyze whether communication is immediately reflected in swap rates, thus affecting only the short-run component

31. Table 2 also shows that changes in the VIX, and in the U.S. swap, lagged daily changes in swaps, and calendar effects (variables *M* and *F*), are, in general, significant and display the expected sign.

of volatility, or whether it has persistent effects on volatility, as picked up by movements in the long-run component.

With regard to the expected sign, the existing literature has long preferred to rationalize increases in volatility in response to communication as a confirmation that markets listen to central bank communication.[32] The underlying justification is that messages from central bankers convey new information, which tends to move markets. Another view interprets a fall in volatility as an indication that central bank communication is able to calm markets.[33] This explanation relies on the presence of a degree of uncertainty before the central bank speaks, as well as on the clarity of the speech. According to Geraats, central banks can sometimes confuse markets (increasing volatility) rather than clarify the situation (reducing it).[34] The novelty of our analysis consists in ascertaining whether such an impact on volatility is transitory or persistent.

The estimation of the parameter μ (the parameter in the short-term volatility equation) in table 3 confirms, for practically all swap maturities, the hypothesis that the volatility in swap markets increases significantly in the short term following the release of BCB communication, indicating that the BCB words do convey information that markets perceive as relevant. In line with the structure of the model, the parameter λ in the long-term volatility equation is always positive.[35]

A comparison of the pre- and postcrisis periods in table 3 shows that with the exception of the 360-day maturity, the impact on volatility is lower after 2008. In other words, the noise generated by the release of monetary policy communication declined after the global crisis. Taken together with the previous results, which showed that the impact of communication on the mean of swap rates increased after the crisis, these results suggest that since 2009, the monetary authority has been able to better manage its communication as a policy instrument.

In addition, the C-GARCH model reveals that while the precrisis impact of communication on the variance of swap rates was permanent in some cases (the thirty- and ninety-day maturities) and temporary in others (180- and 360-day maturities), the postcrisis impact was temporary at all maturities. This reinforces the claim that communication became less noisy after the 2008 crisis.

32. See, for example, Kohn and Sack (2004); Reeves and Sawicki (2007).
33. Geraats (2002).
34. Geraats (2002).
35. This is in line with Fleming and Remolona (1999) and Ehrmann and Fratzscher (2007).

Robustness Analysis: Focusing on Surprising Changes in the SELIC Rate

It could be argued that we should focus on the impact of a surprising change in the SELIC rate rather than on the actual change in interest rates by the BCB. Kuttner shows that interest rate futures respond more sharply to the surprise component of the U.S. Federal Reserve's target than to changes in the target itself.[36] We therefore reestimated our mean model, substituting the observed change in the SELIC rate (ΔSEL) with the unexpected change in the policy rate (ΔSURP) in equation 1. To build the latter, we compare the market consensus for each monetary policy decision to the actual output of each BCB decision.[37] If the observed SELIC rate after the BCB monetary policy meeting is higher (lower) than expected by markets, then ΔSURP will be positive (negative). If the BCB decision matches expectations, then ΔSURP will be zero.

The results are presented in table B1 in appendix B. By considering surprising changes in the SELIC rate, we confirm that the impact of deeds declined after the Lehman Brothers crisis. Moreover, a comparison of table B1 and table 2 shows that the impact of unexpected changes in the policy rate (ΔSURP) on interest rate futures is considerably larger than the effect of changes in the observed policy rate (ΔSEL). This implies that, in line with Kuttner's results for the United States, it is the unexpected part of changes in the policy rates that is driving the effects on swap rates in Brazil.[38]

Finally, when we control for unexpected SELIC changes, the impact of communication on the mean of swap rates (table B1) is similar to that displayed when using changes in the observed SELIC rate (table 2).

All in all, using unexpected rather than observed changes in the SELIC rate confirms our main results, namely, that the impact of deeds on interest rate futures declined after the 2008 crisis, while the impact of BCB communication increased.

Robustness Analysis: Using Different Communication Variables

As described above, our baseline analysis uses a five-pronged communication variable, but this is not the only way to capture the effects of BCB communication. For a robustness check, we redo our analysis using two

36. Kuttner (2001).
37. For the market consensus we use the survey conducted by the BCB with local analysts.
38. Kuttner (2001).

BCB communication dummy variables as our main explanatory variables: a hawkish dummy variable that is equal to one when the communication index is equal to +1 or +2 (that is, when the communication is considered hawkish or very hawkish) and zero otherwise; and a dovish dummy variable that is equal to one when the communication index is equal to −1 or −2 (that is, when the communication is considered dovish or very dovish) and zero otherwise.[39]

For this estimation, we rewrite equations 1 to 4 as follows:

$$(1') \qquad \Delta \text{SWP}_{jt} = a_1 + \sum_{k=1 to 10} a_{2k} \Delta \text{SWP}_{jt-k} + a_3 \text{HAWK}_t + a_4 \text{DOVE}_t + a_5 \Delta \text{SEL}_t + a_6 \Delta \text{VIX}_t + a_7 F_t + a_8 M_t + a_9 \Delta \text{USSWAP} + \left(h_t\right)^{1/2} \varepsilon_t;$$

$$(2') \qquad q_t = \omega + \rho\left(q_{t-1} - \omega\right) + \phi\left[\left(\varepsilon_{t-1}\right)^2 - h_{t-1}\right] + \lambda_1 \text{HAWK}_t + \lambda_2 \text{DOVE}_t;$$

$$(3') \qquad \left(h_t - q_t\right) = \alpha\left[\left(\varepsilon_{t-1}\right)^2 - q_{t-1}\right] + \beta\left[h_{t-1} - q_{t-1}\right] + \mu_1 \text{HAWK}_t + \mu_2 \text{DOVE}_t;$$

$$(4') \qquad \left(h_t - q_t\right) = \alpha\left[\left(\varepsilon_{t-1}\right)^2 - q_{t-1}\right] + \gamma\left[\left(\varepsilon_{t-1}\right)^2 - q_{t-1}\right] d_{t-1} + \beta\left[h_{t-1} - q_{t-1}\right] + \mu_1 \text{HAWK}_t + \mu_2 \text{DOVE}_t.$$

Table B2 in appendix B shows that the parameter a_5, which relates observed daily changes in the policy rate (ΔSEL) and daily changes in interest rate futures, is always positive, as expected, meaning that a monetary tightening (easing) generates an upward (downward) adjustment in swap rates. Moreover, the parameter is significant in all the periods and for all the maturities considered. As in the previous analyses, the impact of changing the SELIC rate is higher in the precrisis period.

With respect to the impact of BCB communication, the results show that it increased after the Lehman Brothers crisis only for some maturities and

39. We thank an anonymous referee for suggesting this specification.

always in the case of dovish communication. In contrast, hawkish pieces of communication became less important in the postcrisis period.

Finally, as in the previous analyses, the effect of communication on volatility declined after the crisis and was more often temporary rather than permanent.[40]

Conclusions

This paper provides evidence of the ability of the Brazilian Central Bank (BCB) to affect interest rate markets by using either deeds, that is, changes in the SELIC interest rate, or words, that is, written and oral statements. We show that from January 2005 to November 2014, interest rate futures generally react to both words and deeds: swaps rates increase (decrease) following either a rise (fall) in the SELIC rate or the release of a hawkish (dovish) piece of communication by the BCB. Moreover, the volatility of swap rates generally increased following the release of a monetary policy communication by the BCB.

When we break our sample period into a precrisis subperiod (2005–08) and postcrisis subperiod (2009–14), we find that the impact of changes in the SELIC rate declined after the global financial crisis, while the impact of words on swap rates increased. In addition, the effects of communication on volatility declined after 2008 and, in many cases, became temporary rather than permanent. This latter finding reinforces the evidence of a better management of communication as a policy instrument in the recent years.

Our study shows that in the postcrisis period, a new balance emerged in terms of monetary policy management in Brazil: words became more relevant, while the importance of deeds declined. The former is a positive evolution, which is in line with a trend observed in developed economies, and could be the result of the longer experience of the BCB in managing an inflation-targeting system. The latter is potentially a problem, as it reveals that the power of traditional monetary policy to affect interest rate futures has diminished. The challenge for the BCB, as well as for central banks in other countries, is to incorporate communication into its toolkit in such a way that words and deeds complement, rather than substitute for, each other.

40. These results are available on request.

Appendix A: Descriptive Statistics and Unit-Root Tests

TABLE A1. Descriptive Statistics on Swap Rate Change

Maturity and statistic	*02 Jan 2005 to 12 Sep 2008*	*03 Jan 2009 to 06 Nov 2014*
30 days		
Mean	−0.0046	−0.0015
Standard deviation	0.029	0.031
Skewness	0.0037	−2.51
Kurtosis	11.95	32.65
90 days		
Mean	−0.00468	−0.00110
Standard deviation	0.037	0.039
Skewness	0.965	−1.740
Kurtosis	18.69	31.91
180 days		
Mean	−0.00438	−0.00058
Standard deviation	0.054	0.053
Skewness	1.45	−0.96
Kurtosis	19.22	21.34
360 days		
Mean	−0.00360	0.00010
Standard deviation	0.084	0.071
Skewness	1.319	−0.308
Kurtosis	21.83	9.61

TABLE A2. Unit-Root Tests[a]

Maturity	*02 Jan 2005 to 12 Sep 2008*	*03 Jan 2009 to 06 Nov 2014*
Swap rate		
30 days	0.9	−0.075
90 days	0.909	0.097
180 days	1.03	0.021
360 days	0.362	−0.223
Swap rate change		
30 days	−3.32	−9.39
90 days	−7.02	−11.76
180 days	−11.69	−12.62
360 days	−10.02	−15.71

a. The table reports the DF-GLS test statistic (Elliott, Rothenberg, and Stock, 1996). With constant and trend. Null hypothesis: series has a unit-root. DF-GLS statistics critical values are: −3.48 (1%), −2.89 (5%), −2.57 (10%).

Appendix B: Robustness Analysis Results

TABLE B1. Impact of Communication and Other Variables on the Mean of Interest Rate Futures, with Unexpected Changes in the Policy Rate[a]

Explanatory variable	*Swap maturity and period*[b] *30 days* *Precrisis:*	*30 days* *Postcrisis:*	*90 days* *Precrisis:*	*90 days* *Postcrisis:*	*180 days* *Precrisis:*	*180 days* *Postcrisis:*	*360 days* *Precrisis:*	*360 days* *Postcrisis:*
Mean								
Constant	–0.0035***	0.0003	–0.002***	0.0006	–0.0033***	4.51 E–05	–0.0054***	–0.0004
Σ AR	0.60***	0.75**	0.59***	0.66***	0.33**	0.40**	0.195***	0.27***
No. lags	5	6	10	10	5	9	10	9
ΔSEL	**0.531*****	**0.304*****	**0.587*****	**0.353*****	**0.683*****	**0.328*****	**0.52*****	**0.237*****
COM	**0.0033***	**0.0012**	**0.0027**	**0.0053*****	**0.0063***	**0.0085*****	**0.0054**	**0.0084***
F	0.0027**	–	–		–	–	–0.010**	–
M	–	–	–0.0018**		–0.007***	0.0021***	–	0.0030*
ΔVIX	0.0016***	–0.0003*	0.0027***	–0.0005**	0.0059***	–0.0017***	0.0124***	–0.0029***
ΔUSSWAP	–	0.042**	–0.045***	0.040***	–	0.094***	–	0.215***
Variance								
χ	0.0005***	0.0007	0.0005***	0.0027	0.0026***	0.009	0.005***	0.006*
ρ	0.999***	0.977***	0.991***	0.991***	0.848***	0.996***	0.994***	0.991***
ϕ	–0.007*	0.081	–0.003*	0.143*	0.274***	0.106***	–0.007***	0.062**
α	0.124***	0.264**	0.121***	0.138**	0.013	0.087***	0.283***	0.079**
γ	–	–	–	–	–	–		–
β	0.609***	0.525***	0.542***	0.745***	–0.595	0.761***	0.289***	0.792***
GED	1.13***	1.05***	1.02***	0.889***	1.00***	0.987***	1.197***	1.144***

(continued)

TABLE B1. Impact of Communication and Other Variables on the Mean of Interest Rate Futures, with Unexpected Changes in the Policy Rate[a] ***(Continued)***

Explanatory variable	*Swap maturity and period*[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Summary statistic								
Adjusted R^2	0.308	0.362	0.188	0.207	0.071	0.112	0.044	0.05
AR(10)	12.4	12.2	7.47	6.95	9.22	11.9	1.89	7.12
	(0.25)	(0.27)	(0.68)	(0.73)	(0.51)	(0.28)	(0.99)	(0.71)
ARCH	0.12	0.0002	0.16	0.21	0.25	0.25	0.0001	0.29
	(0.72)	(0.98)	(0.68)	(0.64)	(0.61)	(0.61)	(0.97)	(0.59)

* *Z* statistic is significant at the 10 percent level.
** *Z* statistic is significant at the 5 percent level.
*** *Z* statistic is significant at the 1 percent level.

a. The table reports the results of the estimation of equations 1, 2, and either 3 or 4. The communication variable (COM) is included in equation 1 but not in equations 2, 3, and 4. The dependent variable in the mean equation is the daily change in the interest rate swap rate. The independent variables in the mean equation (equation 1) are the five-pronged communication variable (COM); the unexpected daily change in the monetary policy rate (ΔSURP); calendar effects: the end of the week or the eve of a public holiday (*F*) and the beginning of the week or the day after a public holiday (*M*); the VIX in first differences; and the U.S. dollar interest rate swap rate. For the variance equation, see equations 2, 3, or 4 in the text (parameters μ and λ are constrained to zero). The regressions are estimated using a C-GARCH model with generalized error distribution. Below the summary statistic testing for the null of the absence of autocorrelation (AR) and heteroskedasticity (ARCH), the *p*-value is reported in brackets.

b. The precrisis period is from 02 January 2005 to 12 September 2008; the postcrisis period is from 03 January 2009 to 06 November 2014.

TABLE B2. Impact of Communication and Other Variables on the Mean of Interest Rate Futures, with Different Communication Variables[a]

Explanatory variable	*Swap maturity and period*[b]							
	30 days		*90 days*		*180 days*		*360 days*	
	Precrisis:	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*	*Precrisis:*	*Postcrisis:*
Mean								
Constant	−0.0018***	0.00051	−0.0019***	0.00051	−0.0031***	0.0001	−0.0051**	0.00014
Σ AR	0.67***	0.75***	0.42***	0.64***	0.40***	0.40*	0.19***	0.25***
No. lags	10	9	10	10	10	10*	7	9
ΔSEL	**0.082******	**0.023******	**0.117******	**0.121*****	**0.143******	**0.033******	**0.147******	**0.055******
HAWK	**0.0061*****	**0.0027**	**0.0075******	**0.0061******	**0.0127*****	**0.0081*****	**0.01**	**0.0074**
DOVE	−0.004	−0.0059***	−0.0059	**0.0032**	−0.0106**	**0.015******	−0.01	**0.011**
F					–		−0.0092**	–
M	−0.0019***	–	−0.0017*	–	−0.0064***	0.0021***	–	–
ΔVIX	0.0020***	–	0.0029***	−0.00033	0.006***	−0.0014***	0.011***	−0.0027***
ΔUSSWAP	–	0.034***	−0.040***	0.043**	–	0.0077***	–	0.205***
Variance								
χ	0.0004***	0.00035***	0.0005***	0.0046	0.002***	0.0072	0.0061***	0.0063
ρ	0.990***	0.451***	0.994***	0.994***	0.909***	0.996***	0.888***	0.992***
φ	−0.0182*	−0.114	−0.003**	0.171*	0.108***	0.106***	0.216***	0.061**
α	0.166***	0.251**	0.131***	0.143**	0.039	0.096**	0.07	0.084*****
γ	–	0.200***	−0.154***	–	–	–	0.146**	–
β	0.092	0.278***	0.659***	0.733***	0.768**	0.758***	−0.56***	0.791***
GED	1.09***	1.47***	1.11***	0.857***	1.03***	0.99***	1.21***	1.13***

(continued)

TABLE B2. Impact of Communication and Other Variables on the Mean of Interest Rate Futures, with Different Communication Variables *(Continued)*

Explanatory variable	*Swap maturity and period*[b] 30 days *Precrisis:*	30 days *Postcrisis:*	90 days *Precrisis:*	90 days *Postcrisis:*	180 days *Precrisis:*	180 days *Postcrisis:*	360 days *Precrisis:*	360 days *Postcrisis:*
Summary statistic								
Adjusted R^2	0.293	0.212	0.227	0.13	0.208	0.071	0.048	0.038
AR(10)	8.75	8.58	8.55	7.93	5.29	11.87	5.41	8.6
	(0.55)	(0.57)	(0.57)	(0.63)	(0.87)	(0.29)	(0.86)	(0.57)
ARCH	0.02	0.02	0.39	0.25	0.08	0.27	0.01	0.29
	(0.89)	(0.86)	(0.53)	(0.61)	(0.77)	(0.60)	(0.89)	(0.58)

* *Z* statistic is significant at the 10 percent level.

** *Z* statistic is significant at the 5 percent level.

*** *Z* statistic is significant at the 1 percent level.

a. The table reports the results of the estimation of equations 1′, 2′, and either 3′ or 4′. The communication variables (HAWK and DOVE dummy variables) are included in equation 1′ but not in equations 2′, 3′, and 4′. The dependent variable in the mean equation is the daily change in the interest rate swap rate. The independent variables in the mean equation (equation 1′) are the communication variables (the HAWK dummy variable and the DOVE dummy variable, which respectively identify hawkish and dovish pieces of communication by the BCB); the daily change in the monetary policy rate (the SELIC rate); calendar effects: the end of the week or the eve of a public holiday (*F*) and the beginning of the week or the day after a public holiday (*M*); the VIX in first differences; and the U.S. dollar interest rate swap rate. For the variance equation, see equations 2′, 3′, or 4′ in the text (the parameters associated with the HAWK and DOVE dummy variables are constrained to zero). The regressions are estimated using a C-GARCH model with generalized error distribution. Below the summary statistic testing for the null of the absence of autocorrelation (AR) and heteroskedasticity (ARCH), the *p*-value is reported in brackets.

b. The precrisis period is from 02 January 2005 to 12 September 2008; the postcrisis period is from 03 January 2009 to 06 November 2014.

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