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Abstract

We analyze how Brazilian financial markets, in particular futures interest rates, react to monetary policy both in terms of deeds, i.e. changes in the policy rate, and words, i.e. central bank communication. Using daily data from 2005 to 2014, we find that the futures interest rates react in the expected direction to both the central bank's actions and words, namely futures rates do increase (decrease) after both an increase in the reference interest rate and a hawkish (dovish) communication by the Banco Central do Brasil (BCB). We also find that BCB words create more "noise", since they generate an increased volatility of futures rates. Our analysis also reveals that monetary policy communication has increased its effectiveness – measured by its larger impact on future rates and a reduced volatility- after the 2008 international crisis. At the same time, the deeds became less relevant as the effect of the changes in the SELIC rate on future rates has declined since then.

Keywords: monetary policy, communication, interest rates, Brazil, COPOM, central bank.

JEL: E52, E58, E43.

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1 Introduction

Central bank communication became topical due 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. More recently, the attempts by central banks in developed countries to provide “forward guidance”, in an environment where the room of maneuver for “traditional” monetary policy was constrained by the zero lower bound, helped central bank communication to take centre stage in monetary policy.

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 to their future monetary policy action (BIS, 2009; Filardo et al., 2008).

Academic research has provided 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 where such monetary policy is conducted (Blinder et al. 2008 provides an extensive survey of the literature). 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 (Svensson, 2004 ad García-Herrero and Remolona, 2008). Accordingly, central bank communication gets closer to an instrument to conduct monetary policy than a proof of transparency.

Up to few years ago, the case of emerging economies has been relatively neglected compared with the extensive studies for large developed countries (Blinder et al. 2008). However, in the most recent years, there has been a boom in this literature (see Garcia-Herrerro and Girardin (2015), for example), including on Brazil, where an inflation-targeting system has been in place since 1999.

Most of the literature about central bank communication in Brazil focuses on the impact of monetary policy on financial markets, especially on futures interest rates (Costa Filho and Rocha, 2010; Janot and Mota, 2012; Caldas Montes, 2012; Carvalho, Cordeiro and Vargas, 2013; Chague et al. 2013). Looking at different periods and using different estimation strategies, this literature shows that in general communication does impact interest rate markets.

Although some papers in the literature regarding Brazil focus only on communication and do not estimate the impact of changes in the policy interest rate (the SELIC rate) by the BCB on financial markets, those works where this analysis is jointly done show that deeds also matter (Costa Filho and Rocha, 2010; Janot and Mota, 2012; and Carvalho, Cordeiro and Vargas, 2013). 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 (Tabak, 2003; Tabata and Tabak, 2004; Nunes, 2011).

Even though the impact of monetary policy communication can, at least in theory, affect both the mean and the variance of the selected financial outcomes, to our knowledge there are few papers, two regarding the Brazilian case, that jointly look at these two dimensions (Costa Filho and Rocha, 2010; and Janot and Mota, 2012). Both show that communication reduces volatility, which is in contrast with the findings of at least part of the literature (for example, Kohn and Sack, 2004; Reeves and Sawicki, 2005). In addition, their results suggest that communication does not impact the mean of the selected financial variables as expected. For Costa Filho and Rocha, 2010 futures interest rates increase after a piece of communication is released, independently of its content. According to Janot and Mota, 2012 the slope of the yield curve is not impacted by BCB communication. These later results are in contrast with those for developed countries and also with other papers about monetary policy communication in Brazil which, even though they do not analyze the impact on volatility, do suggest that BCB's words affect the level of futures interest rates and other financial outcomes according to its tone (Caldas Montes, 2012; Carvalho, Cordeiro and Vargas, 2013; Chague et al. 2013).

The objective of this paper is to assess empirically whether futures interest rates in Brazil react to changes in the SELIC rate and, especially, to different pieces of communication released by the BCB. Using daily data from 2005 to 2014, quantifying communication in line with Rosa and Verga (2007) and building on a C-GARCH model that allows us to determine whether changes in the variance of interest rates are permanent or temporary, we show that in general futures interest rates increase (decrease) following either a rise (fall) in the reference interest rate increases or "hawkish" ("dovish") communication by the Central Bank of Brazil (BCB). Moreover, the volatility in futures interest rates 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, mainly between 2011 and 2014 when the BCB was under the presidency of Alexandre Tombini. In line with what has been happening in some developed regions, such as the US and the Eurozone, the impact of BCB words changed: its effect on the level of interest rates increased and at the same time the communication process became less noisy (i.e. the impact on volatility became smaller and only temporary rather than permanent). However, the effect of deeds declined, in consonance with the perception that the BCB became more tolerant with respect to inflation and therefore started to lose credibility after the global financial crisis (Carvalho, Cordeiro and Vargas, 2013).

The present study contains many innovative features. First, differently from the other papers in the literature, it reveals that monetary policy communication in Brazil not only impacts futures interest rates by increasing (reducing) them when a hawkish (dovish) tone is employed by the BCB but also affects volatility (by increasing it rather than reducing as previously suggested). Second, it demonstrates that monetary policy in Brazil went through a significant change after the 2008 crisis, mainly from 2011 onward during the Alexandre Tombini's tenure as president of the BCB. As our analysis also takes the impact on volatility into account, among other things, we provide a more general characterization of these changes than that provided by the literature (Carvalho, Cordeiro and Vargas, 2013). Third, it presents an exhaustive measure of BCB'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 (i.e. whether the pieces of communication are hawkish, neutral or dovish). Importantly, our measure includes written statements (communiques of the monetary policy decision, monetary policy meeting minutes and quarterly inflation reports) and speeches by the president of the monetary authority. This is in contrast with other studies about central bank communication in Brazil which build only on a sub-sample 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 impacts temporarily or permanently on volatility, thanks to the use of a component-GARCH model (a la Ding and Granger, 1996; and Engle and Lee, 1999), enabling us to show that while after Lehman such impact is only transitory on all maturities, while it was permanent previously for the shorter maturities.

The paper is structured as follows. Section 2 presents the methodology as well as the data compilation, with particular attention to the construction of our measure of central-bank communication, including the BCB documents it builds on. Section 3 shows our empirical results and interpretations, including some robustness analysis. Finally, Section 4 draws some conclusions.

2 Data and methodology

2.1 Data

BCB's communication and its measurement

Brazil's monetary policy framework has gradually gotten close to that of major central banks in the world, not only as regards its monetary framework but also its communication. The country has operated an inflation target system since 1999. The BCB's Monetary Policy Committee (COPOM) is in charge of setting the monetary policy and defining the reference interest rate, the SELIC rate. The COPOM meets to determine the SELIC rate ten times a year, approximately once every 40 days. Previously, during the "maturation period" of the inflation-targeting system in Brazil, until 2005, COPOM meetings were monthly.

The main communication instruments used by the COPOM are: i) the communiques of the monetary policy decision released right after the end of COPOM meetings, containing the announcement of the decision and usually a very brief assessment of the situation; ii) 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 prospects for monetary policy ahead; iii) inflation reports released at the end of every quarter, containing prospects and forecasts for the factors weighing on COPOM's decisions. On top of written documents, the BCB has increasingly relied on oral communication, in line with trends observed in other countries.

For the purposes of constructing a measure of BCB's communication we take into account all these four pieces of communication as financial markets are potentially impacted by each one of them. Therefore, we include in our BCB communication sample the 83 communiques, the 83 minutes, and the 39 inflation reports released from January 3rd 2005 to November 6th 2014. We also include 24 speeches by the BCB president available at the webpage of the monetary authority[2,3].

In line with other papers in the literature (Costa Filho and Rocha, 2009; Costa Filho and Rocha 2010) we follow Rosa and Verga (2007) and codify the available BCB communication to get an index ranging from -2 to +2, i.e. indicating whether there is a very clear intention to loosen monetary policy ahead ("very dovish" tone: -2), just some intention to loosen monetary policy ("dovish" tone: -1), the intention to maintain monetary conditions unchanged ("neutral" tone: 0), some intention to tighten monetary policy ("hawkish" tone: +1) or a very clear intention to tighten monetary policy ahead ("very hawkish" tone: +2).

In Table 1 we present some examples of pieces of communication released by the BCB, together with the code attached to it.

2: The speeches taken into account are those available at the BCB's webpage. The speeches by other members of the COPOM rather than the president of the BCB are potentially relevant. However, they are not available and therefore were not considered. The speeches with no references to any factor potentially weighing on the COPOM's decisions were excluded from our sample.
3: By including all the types of communication used by BCB to increase transparency and manage expectations we not only are able to construct a more comprehensive communication index but also benefit from having a larger size sample to use in our econometric exercises than those previously done in other studies on central bank communication in Brazil.

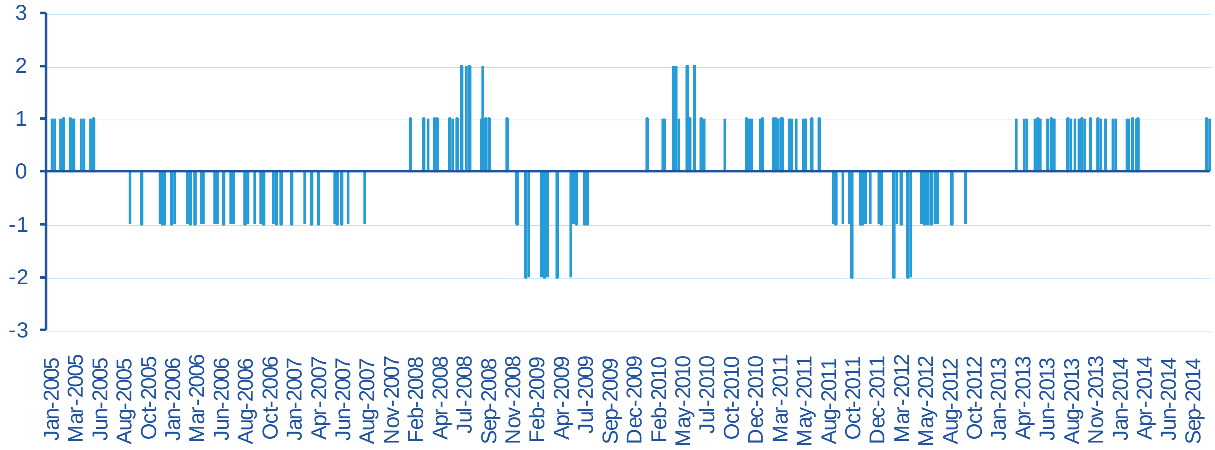
Table 1
Examples of BCB communication and attached code

Code	Meaning	Example of communication	Excerpts
2	Very hawkish	Speech (July 10, 2008)	“it is up to the monetary authorities adopt contractive measures”, “BCB will not wait to combat inflationary pressures”, “do not except complacency”
1	Hawkish	Inflation report (June 27, 2013)	“inflation shows an upward trend”, “the balance of risk is unfavorable”, “monetary policy is vigilant”
0	Neutral	Minutes (Oct 28, 2010)	“inflation consistent with the goals”, “deceleration of the activity”, “robust domestic demand”
-1	Dovish	Minutes (Dic 7, 2006)	“benign trend”, “parsimonious flexibilization”, “lower interest rates in real terms”
-2	Very dovish	Communique (Apr 18, 2012)	“risk to the inflation trajectory remain limited”, “given the fragility of the goal economy, the contribution of the external sector has been disinflationary”

Source: BCB and BBVA Research

In Figure 1 we display times series with the scores of all the communication included in our sample.

Figure 1
BCB communication index (Ranging from -2 to +2 and including 83 communiques, 83 minutes, 39 inflation reports and 24 speeches, from January 3rd 2005 to November 6th 2014)

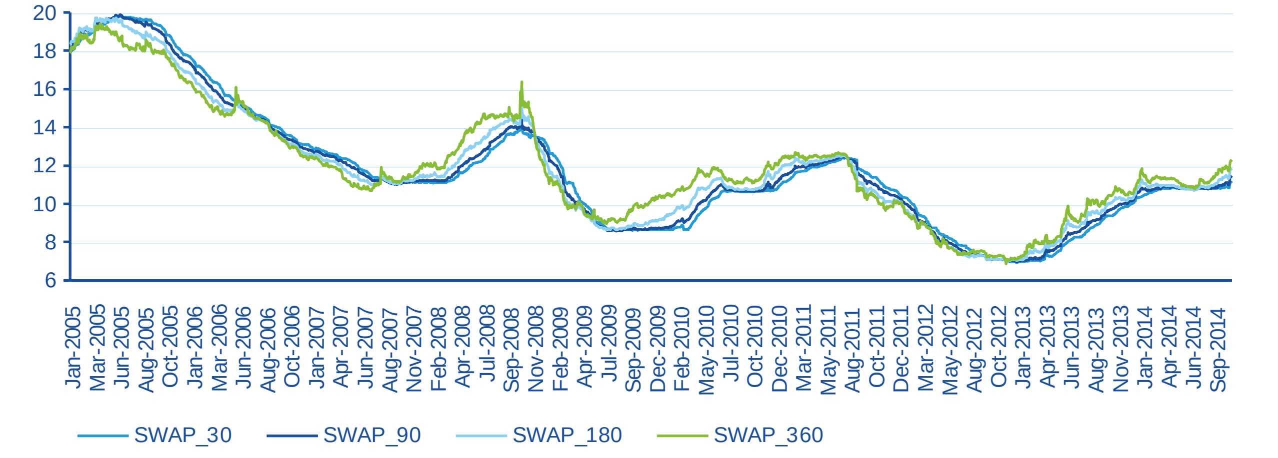


Source: BBVA Research

Financial markets: futures interest rates

As most of the literature on the impact of central bank communication, we focus on the effect on interest rate markets. More precisely, we use “swap pre x DI” fixed-rate swaps rates. These swaps are traded in BM&FBOVESPA Exchange and the time series are available at the BCB webpage. Due to the liquidity of these markets, “swaps DI x pre” are commonly used not only by the literature on central bank communication, but also by studies on the term structure of interest rates and the impact of monetary policy, among others (see Lima and Issler, 2003; Tabak and Tabata, 2004; Minella and Souza-Sobrinho, 2013; among many others). Moreover, these swaps are the ones traditionally used by the BCB as in input for futures interest rates 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).

Figure 2
Swap pre x DI" fixed-rate swaps rates, 30, 90, 180 and 360 days (%).(Traded at the BMF&BOVESPA, data available at bcb.gov.br)

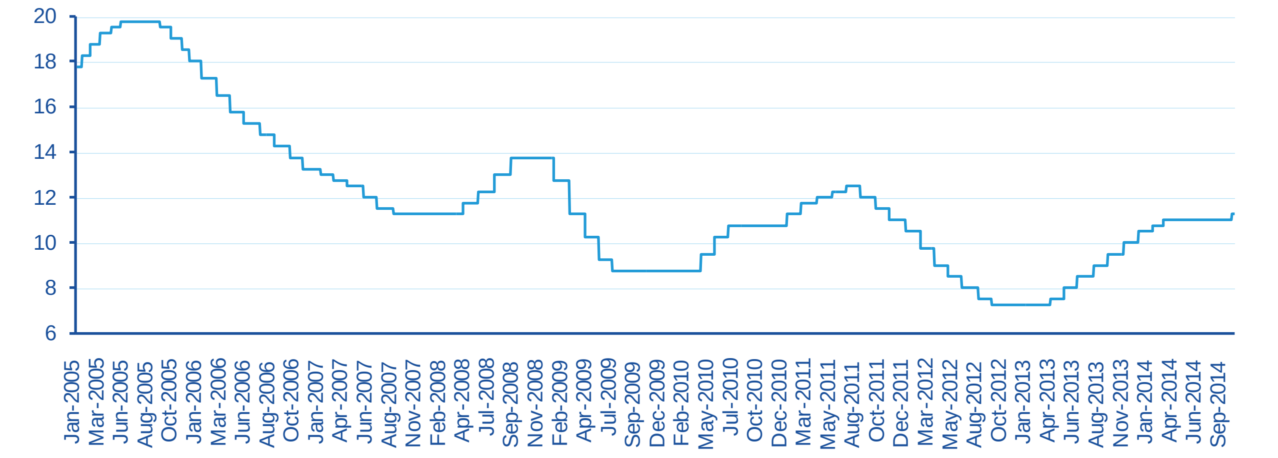


Source: BBVA Research

SELIC rates and other macroeconomic variables

The swaps pre x DI, our financial market of interest, will be the dependent variable in our econometric exercises. In addition to our BCB communication index, which is our main explanatory variable, we will include as controls in our quantitative analysis the SELIC interest rate set by the COPOM during its monetary policy meetings (see Figure 3), the dates of GDP and CPI inflation announcements in both Brazil and the US, global risk aversion proxied by the VIX and the US dollar interest rate swap (see the sub-section on methodology below for more details).

Figure 3
SELIC interest rate set by the COPOM (%)



Source: BBVA Research

2.2 Methodology

To evaluate the impact of BCB communication on Brazil's futures interest rate markets, we adopt an encompassing approach in the spirit of Ehrmann et al. (2007), using joint estimates of the mean and the volatility of futures interest rates. Regarding the first, we analyze empirically whether swap markets understand BCB's words. Following Ehrmann et al. (2007), we examine whether speeches and written statements move mean interest rates in the intended direction, i.e. as indicated by our BCB communication index. With respect to the volatility, we follow Kohn and Sack (2004), Connolly and Kohler (2004) and Reeves and Sawicki (2007). In principle, 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. However, a reduction in volatility could also be a response to central-bank communication in as far as the situation prior to such news was very uncertain and it helps calm down the market (Geraats (2002)).

The model is, thus, composed of two different parts. On the one hand, equation (1) analyses how central bank communication affects the mean interest rates. On the other hand, equations (2) and (3) specify the volatility of the change in the swap rate and how central bank communication may affect it. To that end, it uses a conditional volatility model, namely a component-GARCH model (to be explained below).

We make the futures interest rate (SWP in our notation below) depend on the central bank communication variable (COM), as well as on other relevant controls. In the volatility part of the analysis, the absolute value of the communication variable (ACOM) replaces the BCB communication variable. Such a communication variable enters the equation at time t. The control variables include, most importantly, the stance of monetary policy, i.e. the observed daily change (ΔPR) in the SELIC rate. In addition we allow for calendar effects such as end-of-week (or public holiday eve) (F), and beginning of week (or day after public holiday) (M). Finally, we control for key data releases, namely Brazilian GDP and CPI announcements with a dummy (MACRO) which takes a value of one on days of GDP growth or inflation releases, and zero otherwise, and similarly for the dummy representing US macro news on GDP or inflation (USNEWS). In addition we control for the well-known global risk aversion, proxied by the VIX in first difference (since the level of this variable is non-stationary), as well as the (one-year) US dollar interest rate swap rate to control for changes in the US monetary policy stance.

It is important issue to determine whether communication impacts long-run or short-run volatility. We employ the component-Garch (C-GARCH) model of Engle and Lee (1999) and Ding and Granger (1996) in order to be able to do precisely this. The encompassing model is a C-GARCH model for the swap interest rate of maturity j as follows, with mean equation (1) and volatility equations (2) and (3):

$$\Delta SWP_{jt} = a_1 + \sum_{k=1to10} a_{2k}\, \Delta SWP_{jt-j} + a_3\, COM_t + a_4\, (\Delta PR)_t + a_5\, \Delta VIX_t + a_6\, F_t + a_7\, M_t$$

$$+ a_8\, \Delta USSWAP + (h_t)^{1/2} \nu_t \qquad (1)$$

$$(q_t) = \omega + \rho\, (q_{t-1} - \omega) + \phi\, [\, (\varepsilon_{t-1})^2 - h_{t-1}] + \lambda\, ACOM_t \qquad (2)$$

$$(h_t - q_t) = \alpha\, [\, (\varepsilon_{t-1})^2 - q_{t-1}] + \beta\, [h_{t-1} - q_{t-1}] + \mu\, ACOM_t \qquad (3)$$

The time-varying variance of the change in the swap rate is noted as h_t, and ε_t is a unit-variance, serially uncorrelated, zero mean, i.i.d. error term. In adddition, q represents the long run component of volatility, which converges to the long-run time-invariant volatility level ω according to the magnitude of ρ. Equation (3) specifies the short-run dynamics, in which volatility moves around this long-run time-varying mean. 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 from such long-run variance and the previous deviation of the conditional variance from the long-run variance q. It is noteworthy that the short run component can be either positive or negative, since volatility fluctuates around the long run component.

We should also 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 (Zakoian (1994) and Glosten, Jaganathan and Runkle (1993)). Combined with the C-GARCH model, this replaces equation (3) by equation (4), such as:

$$(h_t - q_t)= \alpha\ [\ (\varepsilon_{t-1})^2 - q_{t-1}] + \gamma\ [\ (\varepsilon_{t-1})^2 - q_{t-1}]d_{t-1} + \beta\ [h_{t-1} - q_{t-1}] + \mu\ ACOM_t \quad (4)$$

where d_{t-1} equals unity if $\varepsilon_t < 0$, and zero otherwise. 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, and when γ is different from zero the impact of news is asymmetric.

Due to the ever-present non-normality in the residuals, we use the Generalized-Error Distribution suggested by Nelson (1991), which embodies several other distributions depending on the value of the tail-thickness parameter.

We estimate restricted versions of this model in two separated steps. On the one hand, we examine whether markets understand the BCB by excluding the absolute value of the communication variable from the conditional variance ($\mu = \lambda=0$ in equations (2) and (3) or (4)). On the other hand, we test whether the volatility of interest rates reacts to the BCB 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 rather the long run (λ different from zero) or the short run (μ different from zero) component of volatility.

3 Effects of BCB communication on interest rate swap markets

In this section we show the results of our model estimations that measure the effect of changes in the SELIC rate and, more importantly given this paper's objectives, the impact of communication on the volatility and the mean of swap rate changes.

We focus our analysis on two periods, the first from January 2nd 2005 until September 12th 2008, the "pre-crisis period", and from January 2nd 2009 until November 6th 2014, the "post-crisis period". We treated the period between September 13th 2008 and December 31st, 2008, characterized by the outbreak of the global financial crisis, as an outlier and withdrew it from our analysis given the abnormal turbulence in financial markets observed in these few months.

The division of the sample in two sub-periods, the "pre-crisis period" and the "post-crisis period", is in line with the general perception and the evidence already presented by the literature that the global financial crisis structurally changed, among many other things, the management and the impact of monetary policy (our findings, to be shown below, reinforce this claim).

In addition, we take a deeper look at the results for the post-crisis period by further dividing it into two sub-periods. The first, from January 2nd 2009 to December 31st 2010, the two years following the global crisis in which the BCB was under the presidency of Henrique Meirelles. The second period, from January 2nd 2011 until November 6th 2014, corresponds to the years when the BCB was ruled by the president Alexandre Tombini[4].

3.1 Do changes in the SELIC rate impact futures interest rates?

From the estimation of equation (1), leaving parameter a3 free, we are able to get an estimate for the parameter a4, which measures the impact of changes in the traditional monetary policy instrument, i.e. the SELIC policy rate, on swap rates.

The Table 2 shows that in the two main periods of interest, namely the pre- and the post-crisis ones, this effect is positive and significant for all the maturities considered. This means that increases (decreases) in the SELIC rate drive swap rates up (down), as expected. However, there is a sharp contrast in terms of the magnitude of this effect between the pre- and post-Lehman periods. Indeed, while this magnitude was large before the crisis, that effect fell sharply after the Lehman bankruptcy by a factor of two to nine.

Table 2
Effect of changes in SELIC rate on daily changes in swap rates

Swap rate changes (maturity)	Pre-crisis: 02 Jan 2005-12 Sept 2008	Post-crisis: 02 Jan 2009-06 Nov 2014
30 days	0.078***	0.022***
90 days	0.117***	0.0124***
180 days	0.143***	0.033***
360 days	0.147***	0.056***

Interest rate swap rate: Daily close minus previous day close. Component-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table 2.1. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

4: The Henrique Meirelles' term as president of the BCB began in January 1st 2003 and ended in January 1st when he was replaced by Alexandre Tombini.

As exhibited in Table 3, the estimated impact of deeds on futures interest rates is also positive for all the maturities, in each one of the sub-period analyzed after the global financial crisis in 2008. However, in some cases, especially during Tombini's tenure, this impact is not significant at the standard levels for some maturities.

Table 3
Effect of changes in SELIC rate on daily changes in swap rates

Swap rate changes (maturity)	Post-crisis, Meirelle's tenure: 02 Jan 2009-31 Dec 2010	Post-crisis, Tombini's tenure: 02 Jan 2011-06 Nov 2014
30 days	0.005	0.015**
90 days	0.021**	0.011
180 days	0.076***	0.012
360 days	0.053*	0.052***

Interest rate swap rate: Daily close minus previous day close. Component-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table 2.1. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

3.2 Does BCB communication impact the mean of futures interest rates?

From the estimation of equation (1) we also obtain an evaluation of the impact of the variable constructed to summarize the directional intent and intensity of communication (COM) on swap rates.

Table 4
Effect of BCB communication on daily changes in swap rates

Swap rate changes (maturity)	Pre-crisis: 02 Jan 2005-12 Sept 2008	Post-crisis: 02 Jan 2009-06 Nov 2014
30 days	-0.0003	0.0018
90 days	0.0024	0.0056***
180 days	0.0037	0.0084***
360 days	0.0011	0.0086**

Daily close minus previous day close. The COM dummy for communication and the SPEECH dummy for speeches only has a FIVE-pronged classification as very dovish (-2), dovish (-1), neutral (0), hawkish (+1), and very hawkish (+2). These dummies are included alternatively in the equation. Component-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table A.2.1. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

Interestingly, we find that the swap rates generally react to oral and written communication by the BCB in the intended direction, i.e. they increase (decrease) following hawkish (dovish) pieces of communication. Nonetheless, this impact is only significant in the post-crisis subsample.

These results reinforce the diagnostics of changes in the impact of monetary policy after the 2008 crisis. Not only the effect of deeds became smaller, but also the effect of words became stronger.

Table 5
Effect of BCB communication on daily changes in swap rates

Swap rate changes (maturity)	Post-crisis, Meirelle's tenure: 02 Jan 2009-31 Dec 2010	Post-crisis, Tombini's tenure: 02 Jan 2011-06 Nov 2014
30 days	-0.001	0.0008
90 days	0.0096***	0.0035**
180 days	0.0051	0.0088***
360 days	0.0019	0.0069

Daily close minus previous day close. The COM dummy for communication and the SPEECH dummy for speeches only has a FIVE-pronged classification as very dovish (-2), dovish (-1), neutral (0), hawkish (+1), and very hawkish (+2). These dummies are included alternatively in the equation. Component-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table A.2.1. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

Table 5 shows that, with the exception of the 90 days maturity, the swap-rates reaction to BCB communication after the global financial crisis was concentrated in the last few years, i.e. from 2011 onwards, during Tombini's tenure.

3.3 Does BCB communication impact the volatility of futures interest rates?

Leaving λ or μ free in equations (2) and (3) or (4), we test the hypothesis that the volatility of swap rates moves in a statistically significant way right after the release of BCB communication.

As far as the expected sign is concerned, existing literature has long preferred to rationalize increases in volatility in response to communication as a confirmation that markets listen to central-bank communication. The underlying justification was that messages from central bankers convey new information and that the latter tends to move markets. Another view, expressed more recently, would rather interpret a fall in volatility as an indication that central bank communication is able to calm markets. The explanation of the latter phenomenon, suggested by Geraats (2002), relies on the presence of a degree of uncertainty before the central bank speaks and also the clarity of its speech. In her view, central banks may as well confuse markets (increasing volatility) as clarify the situation (reducing it). The novelty of our analysis consists in ascertaining whether such an impact on volatility is transitory or persistent.

Results in Table 6 confirm, for practically all maturities, the hypothesis that the volatility in swap markets increases significantly following the release of BCB communication, indicating that the BCB words do convey information that markets perceive as relevant. This is in line with Remolona and Fleming (1999) and Ehrmann and Fratzscher (2007).

Table 6
Effect of BCB communication on volatility of changes in swap rates

Swap rate (maturity)	Post-crisis, Meirelle's tenure: 02 Jan 2005-12 Sep 2008	Post-crisis, Tombini's tenure: 02 Jan 2009-06 Nov 2014
30 days	P 0.0008***	T -0.00006
90 days	P 0.0018***	T 0.0005**
180 days	T 0.0029**	T 0.0025***
360 days	T -0.0008*	T 0.0043***

This corresponds to the coefficient of ACOM in equation (2) for the permanent component of volatility and either equation (3) or (4) for the temporary component, all estimated jointly with equation (1). We report the coefficients of control variables in Appendix 2, Table A.2.2 .1). The table presents the coefficient of the absolute value of the dummy for coded speeches and statements. The ACOM dummy takes a value of one when a speech or a written statement occur and zero when there is no speech or statement. Component-GARCH estimation with Generalized Error Distribution. *** significant at the 1% (**5; * 10%) on the basis of the z-statistics. In each cell in this table, T stands for temporary effects and P for permanent ones.

By comparing the pre- to the post-crisis periods in Table 6 we see that, with the exception of the 360-days 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 results previously presented, to the effect that the impact of communication on the level of swap rates is higher in the most recent years, these results suggest that since 2009 the monetary authority has been able to better manage its communication as a policy instrument.

In addition, the component-Garch model enables us to observe that while before the crisis the impact of communication on the variance of swap rates was permanent in some cases (the 30- and the 90-days maturities) and temporary in other ones (180- and 360-days maturities), after the crisis the impact was temporary in all maturities. This reinforces the claim that communication became less noisy after the 2008 crisis.

Table 7
Effect of BCB communication on volatility of changes in swap rates

Swap rate (maturity)	Post-crisis, Meirelle's tenure: 02 Jan 2009-31 Dec 2010	Post-crisis, Tombini's tenure: 02 Jan 2011-06 Nov 2014
30 days	T 5.72 E-05	T-0.00015***
90 days	T 8.25 E-0.5	T0.0009**
180 days	T -0.00037	T0.0037***
360 days	T 0.002	T0.0058***

This corresponds to the coefficient of ACOM in equation (2) for the permanent component of volatility and either equation (3) or (4) for the temporary component, all estimated jointly with equation (1). We report the coefficients of control variables in Appendix 2, Table A.2.2. The table presents the coefficient of the absolute value of the dummy for coded speeches and statements. The ACOM dummy takes a value of one when a speech or a written statement occur and zero when there is no speech or statement. Component-GARCH estimation with Generalized Error Distribution. *** significant at the 1% (**5; * 10%) on the basis of the z-statistics. In each cell in this table, T stands for temporary effects and P for permanent ones.

Finally, in Table 7 we compare the impact on volatility for the years after the crisis in which the BCB was under President Meirelles with those in which it was under President Tombini. For all maturities in each subsample the impact is temporary. The results are only significant in the latter period.

3.4 Robustness analysis

One could argue that we should focus more on the impact of a surprise change in the SELIC rate rather than in the actual change in interest rates by the central bank.

Kuttner (2001) indeed shows that futures interest rates respond more sharply to the surprise component of the Fed target than to changes in the target itself. Indeed, in line with the expectations hypothesis of the term structure, interest rates respond very little to the changes in the anticipated component of changes in the Fed funds target. Since the response of Fed funds future rates to unexpected policy actions is quite similar over the one to five month horizon, Kuttner (2001) concludes that the short end of the yield curve does contain much information about future movements in short rates. By contrast, Guirguis and Giannikos (2005) document that it is rather the expected component of changes in Fed funds rates which generate sharper and more significant movements in long rates.

Accordingly, we re-estimate our mean model substituting the observed change in the SELIC rate for the unexpected change of the policy rate in equation (1). We use the information available at the webpage of the BCB on the expected SELIC changes.

As shown in Table 8, by considering surprise changes in the SELIC rates we also obtain as the main finding that the impact of deeds declined after the Lehman Brothers crisis. In quantitative terms the effect of surprise changes falls much less dramatically after 2008 than the effect of observed changes in the SELIC rate.

Table 8

Effect of surprise change in SELIC on daily changes in swap rates

Swap rate (maturity)	Post-crisis: 02 Jan 2005-12 Sept 2008	Post-crisis: 02 Jan 2009-06 Nov 2014
30 days	0.520***	0.304***
90 days	0.601***	0.353***
180 days	0.683***	0.328***
360 days	0.520***	0.237***

The Surprise variable is observed minus expected SELIC rate. Component--GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table A.2.3. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

Controlling for surprise SELIC changes, the impact of communication on the level of swap rates (Table 9) is very similar to that displayed previously in Table 4. This implies that, in line with Kuttner's (2004) results for the US, in the case of Brazil it is the unexpected part of changes in the policy rates which is driving the effects on swap rates, while the predicted part has hardly any impact.

Table 9

Effect of BCB communication on daily changes in swap rates, with surprise SELIC changes

Swap rate changes (maturity)	Pre-crisis: 02 Jan 2005-12 Sept 2008	Post-crisis: 02 Jan 2009-06 Nov 2014
30 days	0.001	0.0012
90 days	0.001	0.0053***
180 days	0.0058	0.0085***
360 days	0.0054	0.0084**

Daily close minus previous day close. The COM dummy for communication and the SPEECH dummy for speeches only has a FIVE-pronged classification as very dovish (-2), dovish (-1), neutral (0), hawkish (+1), and very hawkish (+2). These dummies are included alternatively in the equation. Component-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 2 Table A.2.3. *** significant at the 1% (** 5%; * 10%) on the basis of the z-statistics.

4 Conclusions

This paper provides evidence of the ability of the Central Bank of Brazil (BCB) to affect interest rate markets by using either deeds, i.e. changes in the SELIC interest rate, or words, i.e. written and oral statements. In particular, it shows that from January 2005 to November 2014 futures interest rates in general 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, it also reveals that the volatility of swap rates increased right after monetary policy communication.

By looking at two different periods, the pre-crisis (2005-2008) and the post- crisis (2009-2014), this study shows that after the global financial crisis the impact of changes in the SELIC rate declined while the impact of words on swap rates increased. In addition, the effects of communication on volatility declined after 2008 and became temporary rather than permanent as in the pre-crisis period, reinforcing the evidence of a better management of communication as a policy instrument in the most recent years.

Therefore, in the post-crisis period a new balance emerged in terms of monetary policy management: words became more relevant while the importance of deeds declined. The former is a positive evolution, which is in line with the trend observed in developed economies, and could be the result of the longer experience of the BCB in managing an inflation target system. However, the lower impact of the changes in the SELIC rate on swap markets is a negative development, consistent with the generalized perception that the BCB has become more tolerant with respect to inflation and therefore lost some credibility.

Appendix 1 Descriptive statistics and unit-root tests

Table A1.1
Descriptive statistics on swap rate change

Swap rate change (maturity)	02 Jan 2005- 12 Sept 2008	3 Jan 2009- 6 Nov 2014
30 days		
Mean	-0.0046	-0.0015
Std. dev	0.029	0.031
Skewness	0.0037	-2.51
Kurtosis	11.95	32.65
90 days		
Mean	-0.00468	-0.0011
Std. dev	0.037	0.039
Skewness	0.965	-1.74
Kurtosis	18.69	31.91
180 days		
Mean	-0.00438	-0.00058
Std. dev	0.054	0.053
Skewness	1.45	-0.96
Kurtosis	19.22	21.34
360 days		
Mean	-0.0036	0.0001
Std. dev	0.084	0.071
Skewness	1.319	-0.308
Kurtosis	21.83	9.61

Table A1.2
Unit root tests

Elliott-Tottenberg-Stock DF-GLS Test stat	02 Jan 2005- 12 Sept 2008	3 Jan 2009- 6 Nov 2014
Swap rate (maturity)		
30	0.90	-0.075
90	0.909	0.097
180	1.03	0.021
360	0.362	-0.223
Swap rate change (maturity)		
30	-3.32	-9.39
90	-7.02	-11.76
180	-11.69	-12.62
360	-10.02	-15.71

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 2 Detailed estimation results

A. Effect of communication on mean

Table A2.1
Swap rate change with observed change in SELIC (and com in mean equation)

Panel A	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14
Mean	**30D**	**30D**	**90D**	**90D**
Cst	-0.0013**	0.00033	-0.0016***	0.00053
S AR	0.82***	0.72**	0.56***	0.63***
(1 to n)	-10	-9	-10	-10
DSelic	0.078***	0.022***	0.117***	0.124**
Com	-0.0003	0.0018	0.0024	0.0056***
Friday	-	-	-	-
Monday	-0.0021***	-	-0.0021**	-
DVIX	0.0019***	-	0.0029***	-0.00043**
DUSswap	-	0.038***	-0.046***	0.0408**
Variance				
χ	0.0005***	0.0017	0.0005***	0.0041
ρ	0.992***	0.990***	0.994***	0.993***
ϕ	-0.0158*	0.11	-0.003**	0.169*
α	0.170***	0.219**	0.096***	0.142**
γ	-	0.137***	-0.118***	-
β	0.325***	0.493***	0.697***	0.733***
GED	1.08***	0.91***	1.10***	0.864***
Adj R2	0.293	0.230	0.227	0.131
AR(10)	7.65 [0.66]	7.07 [0.71]	7.31 [0.69]	8.24 [0.60]
ARCH	0.116 [0.89]	0.09 [0.75]	1.14 [0.28]	0.26 [0.61]

Interest rate swap rate: Daily close minus previous day close. The observed policy rate (SELIC) is included in the mean equation. C-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4).. Parameters μ and λ are constrained to zero *** Z-statistic significant at 1% level (** 5%; * 10%).

Table A2.1 (cont)

Swap rate change with observed change in SELIC (and com in mean equation)

Panel B	**02 Jan 2005-12-sep-08**	**3 Jan 2009-06-nov-14**	**02 Jan 2005-12-sep-08**	**3 Jan 2009-06-nov-14**
Mean	180D	180D	360D	360D
Cst	-0.0021***	9.32 E-05	-0.0042**	3.30 E-05
S AR	0.43***	0.42**	0.150***	0.24***
(1 to n)	-10	-10	-7	-9
(DR)	0.143***	0.033***	0.147***	0.056***
Friday	-		-0.0095**	-
Monday	-0.0068***	0.0021***	-	-
Com	0.0037	0.0084***	0.0011	0.0086**
DVIX	0.0059***	-0.0014***	0.0118***	-0.0027***
DUSswap	-	0.0081***	-	0.206***
Dum052406	0.515***			
Variance				
χ	0.002***	0.0083	0.0057***	0.006
ρ	0.899***	0.996***	0.881***	0.99***
ϕ	0.124***	0.113***	0.194***	0.06**
α	0.045	0.009**	0.077*	0.084*****
γ	-	-	0.132**	-
β	-0.718**	0.765***	-0.574***	0.790***
GED	1.03***	0.987***	1.23***	1.13***
Adj R2	0.209	0.072	0.051	0.038
AR(10)	6.38 [0.78]	12.0 [0.28]	4.96 [0.89]	9.17 [0.51]
ARCH	0.17 [0.67]	0.27 [0.60]	0.003 [0.95]	0.29 [0.58]

Interest rate swap rate: Daily close minus previous day close. The observed policy rate (SELIC) is included in the mean equation. C-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). Parameters μ and λ are constrained to zero.*** Z-statistic significant at 1% level (** 5%; * 10%)

B. Effect of communication on volatility

Table A2.2
Swap rate change with observed change in SELIC (and com in variance equation)

Panel A	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14
Mean	30D	30D	90D	90D
Cst	-0.001	0.0001	-0.002***	0.0072***
S AR	0.78***	0.79**	0.60***	0.64***
(1 to n)	-10	-6	-10	-10
DSelic	0.07***	0.005	0.0126***	0.0114***
Friday	-	-	-0.0024**	-0.0024**
Monday	-0.0021***	-	-	-
DVIX	0.0019***	-	0.0026***	-0.0006***
DUSswap	-	0.044***	-0.036**	0.044**
Variance				
χ	0.0004***	0.0017	0.0006***	0.004
ρ	0.786***	0.951***	0.535***	0.991***
ϕ	0.340	0.441***	0.782***	0.176**
α	-0.224	-0.151**	-0.581*	0.159***
γ		0.189**	-0.210***	
β	0.891	0.383***	1.12****	0.674***
λ	0.0008***	-	0.0018***	-
μ	-	-0.0001**	-	0.00046**
GED	1.10***	0.921***	1.14***	0.873***
Adj R2	0.287	0.209	0.232	0.127
AR(10)	7.67 [0.66]	11.7 [0.22]	9.36 [0.49]	9.90 [0.44]
ARCH	0.08 [0.77]	0.10 [0.74]	0.70 [0.40]	0.35 [0.55]

Interest rate swap rate: Daily close minus previous day close. The observed policy rate (SELIC) is included in the mean equation. Component-GARCH estimation with Generalized Error Distribution. This corresponds to equation (1), where a3 is constrained to zero, together with equations (2) and either equation (3) or (4).*** Z-statistic significant at 1% level (** 5%; * 10%).

Table A2.2 (cont)

Swap rate change with observed change in SELIC (and com in variance equation)

Panel B	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14
Mean	**180D**	**180D**	**360D**	**360D**
Cst	-0.0025***	-0.0001	-0.0044**	0.0002
S AR	0.43***	0.47**	0.185***	0.23***
(1 to n)	-10	-10	-7	-8
(DR)	0.143***	0.071***	0.146***	0.058***
Friday	-		-0.0096**	-
Monday	-0.0067***	0.0023***	-	-
DVIX	0.0059***	-0.0013***	0.0120***	-0.0028***
DUSswap	-	0.113***	-	0.206***
Dum052406	0.516***			
Variance				
χ	0.0018***	0.003**	0.006***	0.006***
ρ	0.861***	0.979***	0.894***	0.968***
ϕ	0.193***	0.104***	0.193***	0.131**
α	-0.055	0.074*	0.070*	-0.006
γ			0.142***	
β	0.531***	0.46***	-0.599***	0.426***
λ	-	-	-	-
μ	0.0029**	0.029***	-0.0008*	0.0055***
GED	1.09***	1.02***	1.24***	1.20***
Adj R2	0.212	0.089	0.051	0.039
AR(10)	5.81 [0.83]	9.16 [0.51]	4.99 [0.89]	13.4 [0.19]
ARCH	0.05 [0.82]	0.30 [0.58]	0.001 [0.97]	0.17 [0.68]

Interest rate swap rate: Daily close minus previous day close. The observed policy rate (SELIC) is included in the mean equation. C-GARCH estimation with Generalized Error Distribution. This corresponds to equation (1) where is constrained to zero, together with equation (2), and either equation (3) or (4).*** Z-statistic significant at 1% level (** 5%; * 10%).

Table A2.3

Swap rate change with unexpected change in SELIC

Panel A	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14
Mean	**30D**	**30D**	**90D**	**90D**
Cst	-0.0035***	0.0003	-0.002***	0.0006
S AR	0.60***	0.75**	0.59***	0.66***
(1 to n)	-5	-6	-10	-10
(**R-R**^{e})	0.531***	0.304***	0.587***	0.353***
Friday	0.0027**	-	-	
Monday	-	-	-0.0018**	
Com	0.0033*	0.0012	0.0027	0.0053***
DVIX	0.0016***	-0.0003*	0.0027***	-0.0005**
DUSswap	-	0.042**	-0.045***	0.040***
Variance				
χ	0.0005***	0.0007	0.0005***	0.0027
ρ	0.999***	0.977***	0.991***	0.991***
ϕ	-0.007*	0.081	-0.003*	0.143*
α	0.124***	0.264**	0.121***	0.138**
γ	-	-	-	-
β	0.609***	0.525***	0.542***	0.745***
GED	1.13***	1.05***	1.02***	0.889***
Adj R2	0.308	0.362	0.188	0.207
AR(10)	12.4 [0.25]	12.2 [0.27]	7.47 [0.68]	6.95 [0.73]
ARCH	0.12 [0.72]	0.0002 [0.98]	0.16 [0.68]	0.21 [0.64]

The Surprise variable is observed minus expected SELIC rate. C-GARCH estimation with Generalized Error Distribution. This corresponds to equation (1) together with equation (2). *** Z-statistic significant at 1% level (** 5%; * 10%). This corresponds to the estimation of equation (1) and (2) or (3) in the text with corresponding definitions of variables and parameters. Parameters μ and λ are constrained to zero.

Table A2.3 (cont.)

Swap rate change with unexpected change in SELIC

Panel B	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14	02 Jan 2005-12-sep-08	3 Jan 2009-06-nov-14
Mean	**180D**	**180D**	**360D**	**360D**
Cst	-0.0033***	4.51 E-05	-0.0054***	-0.0004
S AR	0.33***	0.40**	0.195***	0.27***
(1 to n)	-5	-9	-10	-9
(**R-R**^{e})	0.683***	0.328***	0.52***	0.237***
Friday	-	-	-0.010**	-
Monday	-0.007***	0.0021***	-	0.0030*
Com	0.0063*	0.0085***	0.0054	0.0084*
DVIX	0.0059***	-0.0017***	0.0124***	-0.0029***
DUSswap	-	0.094***	-	0.215***
Variance				
χ	0.0026***	0.009	0.005***	0.006*
ρ	0.848***	0.996***	0.994***	0.991***
ϕ	0.274***	0.106***	-0.007***	0.062**
α	0.013	0.087***	0.283***	0.079**
γ	-	-		-
β	-0.595	0.761***	0.289***	0.792***
GED	1.00***	0.987***	1.197***	1.144***
Adj R2	0.071	0.112	0.044	0.050
AR(10)	9.22 [0.51]	11.9 [0.28]	1.89 [0.99]	7.12 [0.71]
ARCH	0.25 [0.61]	0.25 [0.61]	0.0001 [0.97]	0.29 [0.59]

The Surprise variable is observed minus expected SELIC rate. C-GARCH estimation with Generalized Error Distribution. This corresponds to the estimation of equation (1) jointly with (2) and either (3) or (4). The coefficients of control variables are reported in Appendix 3 Table 3.3. Parameters μ and λ are constrained to zero. *** Z-statistic significant at 1% level (** 5%; * 10%). This corresponds to the estimation of equation (1) and (2) or (3) in the text with corresponding definitions of variables and parameters.

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Working Papers

2015

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