

## The Impact of unexpected changes in the benchmark rate on the Brazilian stock market

**Fernando Nascimento de Oliveira<sup>†</sup>**  
IBMEC-RJ

**Alexandre Romaguera Rodrigues da Costa<sup>Ω</sup>**  
JAR Consultoria

### ABSTRACT

To analyze empirically the impact of unexpected changes in the basic interest rate (SELIC rate) on the Brazilian stock market between January 2003 and May 2012, we constructed a surprise measure based on the market consensus. Our sample of events is composed of 88 meetings of the Brazilian Central Bank's Monetary Policy Committee (COPOM). There were unexpected changes in the interest rate at 32 of these meetings. The results show that for each 1% unexpected increase in the SELIC rate, the stock market index (IBOVESPA) decreased 3.28%.

**Keywords:** SELIC rate; stock market; capital market; Bovespa; surprises; event study.

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\*Corresponding Authors:

<sup>†</sup>. PhD in Economics from PUC-RJ

**Institution:** Assistant Professor of Economics at IBMEC/RJ

**Address:** Rua Tiradentes 114 903 Ingá Niterói.

**E-mail:** [fernando.nascimento@bcb.gov.br](mailto:fernando.nascimento@bcb.gov.br)

**Telephone:** (21) 2189-5011 Fax: (21) 2189-5092

<sup>Ω</sup> Master's in Economics from IBMEC-RJ

**Institution:** JAR Consultoria

**Address:** Av. Almirante Barroso, 63, sl 1811, Rio de Janeiro – RJ – Brasil.

**E-mail:** [alexandre.romaguera@icloud.com](mailto:alexandre.romaguera@icloud.com)

**Telephone:** (21) 3923-5667

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## 1 INTRODUCTION

One of the main instruments used by central banks throughout the world to control inflation is adjustment of the basic interest rate. In Brazil, the benchmark rate is called the SELIC rate. The Brazilian Central Bank created the Monetary Policy Committee (COPOM) in 1996 to increase the level of transparency of its decisions regarding the SELIC rate.<sup>i</sup>

The decisions of the COPOM are reached at meetings held on dates announced in advance. At these meetings, the authorities discuss the current economic situation and the future perspectives of the macroeconomic aggregates, especially the inflation index used as the target. The decisions are announced at the end of each meeting, accompanied by a brief commentary. The more detailed reasons for maintaining or changing the target for the SELIC rate are stated in minutes published in week after the meeting.

Our objective here is to analyze how unanticipated changes in the basic SELIC rate affect the Brazilian stock market, measured by the returns of an aggregate index, the IBOVESPA.<sup>iiii</sup>

To estimate these responses, it is essential to correctly define the unanticipated monetary policy changes or shocks. There are various ways to do this. Here we create a surprise metric based on the consensus just before every COPOM meeting, as published from January 2003 to May 2012 in the newspaper *Valor Econômico*. A similar approach has been used, for example, by Poole, Rasche & Thornton (2002), who employed the consensus published in the *Wall Street Journal*.

The main result of our study is that an unexpected positive variation of 1% in the SELIC rate caused a negative variation of 3.28% in the IBOVESPA. This result is greater than that obtained by Gonçalves Junior (2007) in a similar study of the Brazilian stock market (a decline of 1.30% in the stock index for each 1% variation of the SELIC rate).<sup>iv</sup>

To check the robustness of our results, we performed some other empirical analyses. First we verified the response of a broader market index, the IBRA, on the dates of our events.<sup>v</sup> In this case, we found that an unexpected positive variation of 1% in the SELIC rate caused a negative variation of 1.28% in the IBRA.

We also studied the responses of the returns of 38 stocks in relation to variations in the SELIC rate on the COPOM meeting dates that are part of our sample. The majority of individual stocks behaved the same as the aggregate market indexes. Of the 38 assets

analyzed, 22 presented significant negative correlations with the unanticipated monetary policy shocks.

Stock prices respond to revisions of the expectations about future monetary policy. This policy, in turn, is affected by news about changes in macroeconomic conditions. Our focus on unexpected monetary policy actions avoids difficult questions of endogeneity and simultaneity, and thus more clearly reflects the stock market's reaction to monetary policy decisions.

In some points this article is aligned with that of Bernanke & Kuttner (2004). They used future short-term interest rates to construct a measure of surprise from the announcement of the Federal Reserve's Open Market Committee (FOMC) on the basic interest rate in the United States.<sup>vi</sup> They found that an unexpected increase of 1% in the fed funds rate was related to a decline of 1% in the aggregate U.S. stock market index. Besides this, they adapted the works of Campbell (1991) and Campbell & Ammer (1993) to study through what channels unexpected monetary policy shocks affect stock returns.

The basic objectives of monetary policy are expressed in terms of macroeconomic variables, such as production and inflation. However, the effect of monetary policy on these variables is indirect. The more direct effects of monetary policy actions are felt in the financial markets. By affecting stock prices, monetary policy influences the behavior of economic agents. Therefore, this article, by seeking to better understand the relations between unexpected monetary policy decisions and stock prices, also sheds light on the transmission mechanisms of monetary policy in Brazil. This can be useful both to the Brazilian Central Bank, which can increase the efficacy of its monetary policies, as well as to private agents in their economic choices.

The rest of the article is organized as follows. The second section contains a brief literature review; the third presents our empirical methodology; the fourth describes the data; the fifth presents the results; and the sixth section presents our concluding remarks.

## **2 LITERATURE REVIEW**

Although many articles have been published on the impacts of monetary policy on various aspects of the economy and market, operating through various channels, few have tried to explain the reactions of the stock market to monetary policy. As observed by Bernanke & Kuttner (2004), understanding this mechanism is very important for economic policymakers, because although the basic objective of monetary policy is to maintain the

health of macroeconomic variables (productivity, employment and inflation), monetary policy choices first propagate to the stock market.

In this context, Roley & Sellon (1995) concluded that the impacts of monetary policy on long-term interest rates were stronger than previously assumed. The previous studies had focused on a single event (the day the new interest rate is announced), while the long-term impacts are anticipated by the market and affect the rates if perceived as persistent changes.

The method developed by Campbell (1991) and Campbell & Ammer (1993), who used vector autoregression (VAR) to calculate revisions in the expectations about bond and stock returns as well as inflation and short-term interest rates, has subsequently been applied in various studies on the theme. This method allows decomposing the various effects acting on the price of a determined asset.

Kuttner (2001) sought to estimate the effects of changes in the Fed's policy on the yields of bills, notes and bonds by formulating a tool to measure the surprise in interest rate changes by the Federal Reserve, using the future fed funds rate. Bernanke & Kuttner (2004) used the tools developed by Kuttner (2001), Campbell (1991) and Campbell & Ammer (1993) to shed light on why unanticipated changes in monetary policy affect the stock market. Their article is an event study applying VAR to decompose the principal components of this impact among effects on the real interest rates, dividends and excess equity returns. Surprisingly, the authors found that the reaction of equity prices to monetary policy is for the most part not directly attributable to the monetary policy effects on the real interest rate.

Poole, Rasche & Thornton (2002) investigated to what extent market participants anticipate the monetary policy decisions of the Fed. They noted that event studies generate results that, although significant, possibly underestimate the intensity of these responses. They advocated greater transparency as a way to provide faster propagation of the new guidelines adopted in conducting monetary policy. The article covered the FOMC meetings starting in 1987, arguing that before then, the market focused more on the effect of policy actions on the rate of money growth rather than changes in the interest rate.

Thorbecke & Alami (1994) found a significant response of stock returns in the second half of the 1970s (represented by the Dow Jones and S&P indexes) to changes in the target rate established by the FOMC. Both articles found that stock prices respond to unexpected changes in the basic interest rate.

Finally, in a more recent study, Gürkaynak, Sack & Swanson (2005) used intraday data to measure to what extent surprises are due to FOMC actions in relation to FOMC statements. They discovered significance for both events with the use of a methodology with narrower time windows and isolation of the two factors. Curiously, the authors found greater relevance for the information disclosed by the Fed than the announcement of the interest rate target itself.

For the Brazilian market, initial mention should go to the paper by Tabak & Tabata (2004). The authors found evidence that the yield curve in Brazil responds to monetary policy actions. In a subsequent study, they decomposed the basic interest rate into anticipated and unanticipated components (TABATA; TABAK, 2004), using various tests in an event study covering the period from 2000 to 2003. This time they confirmed the degree of anticipation previously noted, but also found significant responses of the yield curve to the unanticipated component.

Barbosa (2008) investigated the impact of the same decisions on the yield curve and concluded this impact exists for the period from January 2004 to September 2008. As will be seen, the period for analysis, in terms of Brazilian reality, can substantially modify the conclusions of a study.

Oliveira & Ramos (2011) identified unexpected interest rate shocks by means of future interbank deposit (*Depósito Interfinanceiro* - DI) contracts. Based on this identification, they studied the relationship between these shocks and the interest rate term structure. The authors found empirical evidence suggesting that the market anticipates, at least partially, the interest rate decisions of the Brazilian Central Bank, and also showed that unanticipated monetary policy shocks are in general able to affect the yield curve.

Finally, Gonçalves Junior (2007) studied the impact of unexpected monetary policy decisions on the IBOVESPA during the period from June 1996 to March 2006. He carried out an event study with a sample similar to that used by Bernanke & Kuttner (2004), which we also use here, and found that for each 1% unanticipated increase in the SELIC rate, the IBOVESPA declined 1.3%. This is a similar impact to that found by Bernanke & Kuttner (2004). Intuitively, the impact in Brazil should be greater, because it is an emerging market with much higher capital costs than those in mature markets like the United States.

### 3 EMPIRICAL METHODOLOGY

#### 3.1 DEFINITION OF INTEREST RATE SURPRISE

Bernanke & Kuttner (2004) used future short-term interest rates to construct their measure of surprise in relation to the announcement by the FOMC regarding the fed funds rate. This same method was applied by Gonçalves Junior (2007), using the average 1-day DI rate in Brazil.

More recently, the Brazilian press has started carrying consensus projections regarding the SELIC rate leading up to each COPOM meeting, including noting when there is a lack of consensus. Consideration of such consensus projections has been used previously, for example, by Poole, Rasche & Thornton (2002), who employed the consensus published by the *Wall Street Journal*.

We use the consensus projections from January 2003 to May 2012, published on the dates before each COPOM meeting by the newspaper *Valor Econômico*. These are shown in Table 1.<sup>vii</sup> This table also shows the actual SELIC target defined, the total change in the rate and the respective surprise and expected components, calculated by equations (1) and (2) below:

$$\Delta a^i = MS^d - EM^{d-1} \quad (1)$$

Where:  $\Delta a^i$  is the unexpected component of the change;  $MS^d$  is the SELIC target announced by the COPOM and  $EM^{d-1}$  is the expected SELIC target according to *Valor Econômico* on the day before the COPOM meeting.

By definition,  $\Delta a^i > 0$  is a positive surprise and  $\Delta a^i < 0$  is a negative surprise.

$$\Delta a^e = EM^{d-1} - MS^{d-1} \quad (2)$$

Where:  $\Delta a^e$  is the expected component of the change;  $EM^{d-1}$  is the expected SELIC target according to *Valor Econômico* on the day before the COPOM meeting; and  $MS^{d-1}$  is the current SELIC rate on the day before the announcement by the COPOM.

By definition, the total variation is the sum of the expected and unexpected portions.

### 3.2 ESTIMATION OF THE STOCK MARKET RESPONSE

Following Bernanke & Kuttner (2004), we adopt the event study method. In other words, we study how the stock market index behaves before and after the announcement of the basic interest rate by the COPOM. First we test whether the total change in the SELIC rate has an impact on the aggregate indexes of the São Paulo Stock Exchange, the IBOVESPA. For this purpose, we estimate equation (3) below by ordinary least squares (OLS).<sup>viii</sup>

The null hypothesis is that  $\beta$  is equal to zero, i.e., that the total variations in the SELIC rate do not have an impact on the IBOVESPA.

$$H_t = \alpha + \beta \Delta a_t + \varepsilon_t \quad (3)$$

Where:

$H_t$  Daily return of the stocks composing the IBOVESPA;

$\Delta a_t$  Total variation of the SELIC rate in an event; and

$\varepsilon_t$  Error term, representing other factors not associated with monetary policy, where

$$E[\varepsilon_t] = 0, \text{Var}(\varepsilon_t) = \sigma^2.$$

Next we separate the total variation into the surprise and expected components. We estimate equation (4) below by OLS. In this model, the null hypotheses we test are that  $\beta^e$  and  $\beta^i$  are equal to zero, respectively.

$$H_t = \alpha + \beta^e \Delta a_t^e + \beta^i \Delta a_t^i + \varepsilon_t \quad (4)$$

Where:

$H_t$  Daily return of the stocks composing the IBOVESPA;

$\Delta a_t^e$  Expected variation of the SELIC rate in an event;

$\Delta a_t^i$  Unexpected variation of the SELIC rate in an event; and

$\varepsilon_t$  Error term, representing other factors not associated with monetary policy, where

$$E[\varepsilon_t] = 0, \text{Var}(\varepsilon_t) = \sigma^2$$

One of the limitations of this paper, as in that by Bernanke & Kuttner (2004), is the attempt to explain the variation of the aggregate stock market index only by means of total, expected and unexpected changes in the basic interest rate, the SELIC.

There is an extensive literature that models the aggregate return of stock market indexes differently than we do here. To cite some articles, we can mention: Boyd, Jagannathan; Hu, (2001), who used the unanticipated surprise about the American unemployment rate to explain the stock market index; Campbell (1991) and Campbell & Ammer (1993), who showed that unexpected returns of the aggregate stock market index in the U.S. are correlated with the expectation of future dividends and expectation of future returns of the index; Thornebecke (1997), who analyzed the reaction of the aggregate index in the American market to innovations in the basic interest rate, unexpected changes in free reserves and narrative indicators of monetary policy surprises by examining event windows; and Rigobon & Sack (2004), who tried to resolve problems of endogeneity of the responses of asset prices, proposed a new estimator based on the heteroskedasticity in the high-frequency stock price data.

### 3.3 ORTHOGONALITY

As described by Bernanke & Kuttner (2004), the orthogonality between the errors and the regressors of equations (3) and (4) would be violated if the central bank defined the interest rate in response to changes in the stock market. Or, as they also observed, orthogonality might not hold if both responded together to the same data (e.g., weaker job market figures). However, while these are normal aspects of the American market, they are not of great importance in the recent history of the Brazilian market.<sup>ix</sup>

In our sample of COPOM decisions, we noted that the Central Bank nearly always responded to the outlook for internal inflationary pressures. Even against the backdrop of the most serious recent economic crisis (the subprime crisis<sup>x</sup>, which started in 2006, the Central Bank continued cutting the interest rate starting in September 2005. Therefore, and

additionally considering that the fact that, as pointed out by Poole, Rasche & Thornton (2002), event studies tend to underestimate the results, we decided to maintain the approach of estimating equations (3) and (4) by OLS, as described previously.<sup>xi</sup>

### 3.4 ASYMMETRY

Another relevant question is asymmetry. This would occur in the case of a much stronger and more relevant response to one type of monetary policy surprise than to another type. Therefore, an asymmetric response occurs when the direction of the information (positive or negative) influences the impact of the response.

An example would be if the market responds more strongly to surprise declines in the interest rate than to unanticipated increases (a generally more optimistic than pessimistic market). To test this hypothesis, we inserted a dummy (binary) variable equal to 1 for a positive surprise and another dummy variable equal to 1 for a negative surprise.

A positive surprise for the stock market occurs when the rate defined by the Central Bank is lower than expected by the market. For example, a cut in the SELIC rate greater than expected or an increase lower than expected is defined as a positive surprise. Applying the same logic, a negative surprise occurs when the increase in the rate is greater than anticipated or the cut is less than expected.

In both cases, the result should be statistically insignificant for the tests, since the stock market should react with the same intensity in both senses. Later we estimate the model described in equation (5) below by OLS. The null hypothesis is that  $\beta^{assim} = 0$ .

$$H_t = a + \beta^e \Delta a_t^i + \beta^{assim} dummy^{assim} + \varepsilon_t \quad (5)$$

## 4 DATA

Our sample period runs from January 2003 to May 2012. During this period there were 88 COPOM meetings, all of them regularly scheduled (no extraordinary meetings). Table 1 below presents the consensus, expected and unexpected components and total change in the SELIC rate at each meeting. The consensus was obtained from *Valor Econômico* on the day before the meeting. A surprise is as defined in equation (1), while the expected change is as defined in equation (2). The total change is the sum of the anticipated and unanticipated changes.<sup>xii</sup>

As can be observed in Appendix A, the number of positive shocks or surprises outnumber the negative ones. There are 19 positive shocks, with an average of 0.18 percentage point and a standard deviation of 0.11, against 13 negative shocks, with mean of -0.56 and standard deviation of 0.252.

**TABLE 1 - CONSENSUS AND EXPECTED AND UNEXPECTED CHANGES IN THE SELIC RATE – ANNUAL AVERAGES**

Ano	Meta Selic definida pelo		Consenso	Componente Esperada	Componente Surpresa	Mudança total
	BACEN					
2003	23,08		23,17	-0,63	-0,08	-0,71
2004	16,44		16,39	0,05	0,05	0,10
2005	19,15		19,10	-0,02	0,04	0,02
2006	15,09		15,05	-0,64	0,05	-0,59
2007	11,94		11,91	-0,28	0,03	-0,25
2008	12,59		12,58	0,30	0,02	0,31
2009	9,81		9,84	-0,59	-0,03	-0,63
2010	10,03		10,06	0,28	-0,03	0,25
2011	11,78		11,86	0,11	-0,08	0,03
2012	9,44		9,44	-0,63	0,00	-0,63

The table presents the consensus, expected component, unexpected (surprise) component and total change at each COPOM meeting during the sample period from January 2003 to May 2012. The consensus was obtained from *Valor Econômico* newspaper on the day before the COPOM meeting. The surprise is defined in equation (1) of the text, while the expected change is defined in equation (2). The total is the sum of the expected and unexpected change.

Besides the IBOVESPA, we also analyzed the robustness of the responses by examining another aggregate index, the IBRA. Panels A and B of Table 2 below present the descriptive statistics and correlation matrix between these two stock market indexes and the total, expected and unexpected changes in the SELIC rate.

As can be seen, the mean variation in the IBOVESPA is 0.33 (standard deviation of 1.99) and the mean variation of the IBRA is 0.43 (standard deviation of 1.56).<sup>xiii</sup> In relation to the monetary policy surprises, the mean is 0.00 (standard deviation of 0.18), the highest positive value is 0.50% (meeting of April 19 2006) and the greatest change in absolute value is the unexpected cut of 1.00% (at the meeting of August 20, 2003). The correlations of both aggregate indexes to SELIC rate surprises are negative, as expected.

Graphs 1 and 2 below show the dispersion of the unanticipated component of the variation of the SELIC rate against the variation of the IBOVESPA and IBRA respectively. As can be seen, the two graphs are very similar. Besides this, there is little dispersion for the two indexes.

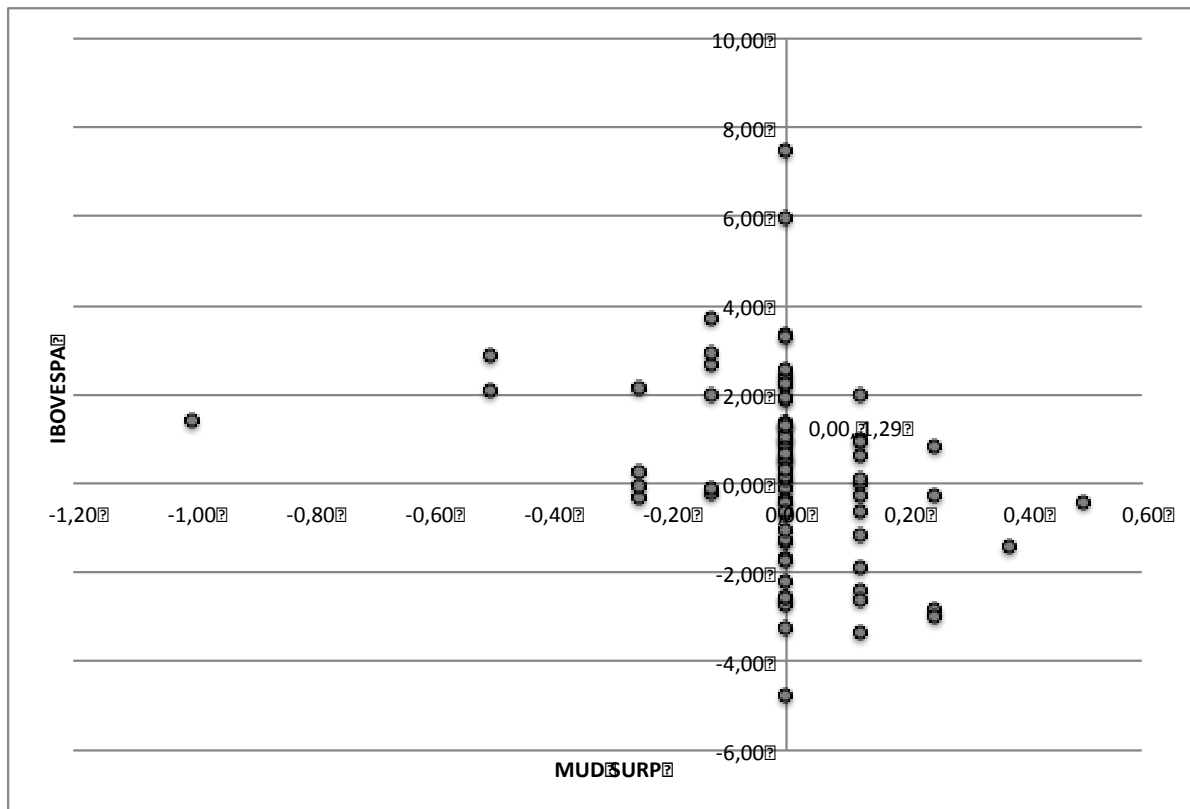
The sample goes from January 2003 to May 2012. The consensus was obtained from *Valor Econômico* on the day before the COPOM meeting. The positive surprise is as defined in equation (1) while the negative surprise is as defined in equation (2). The total change is the sum of the expected and unexpected changes. Panel A presents the descriptive statistics and Panel B the correlation matrix.

**TABLE 2 - DESCRIPTIVE STATISTICS: IBOVESPA, IBRA AND MONETARY POLICY SHOCKS**  
**Panel A Descriptive statistics**

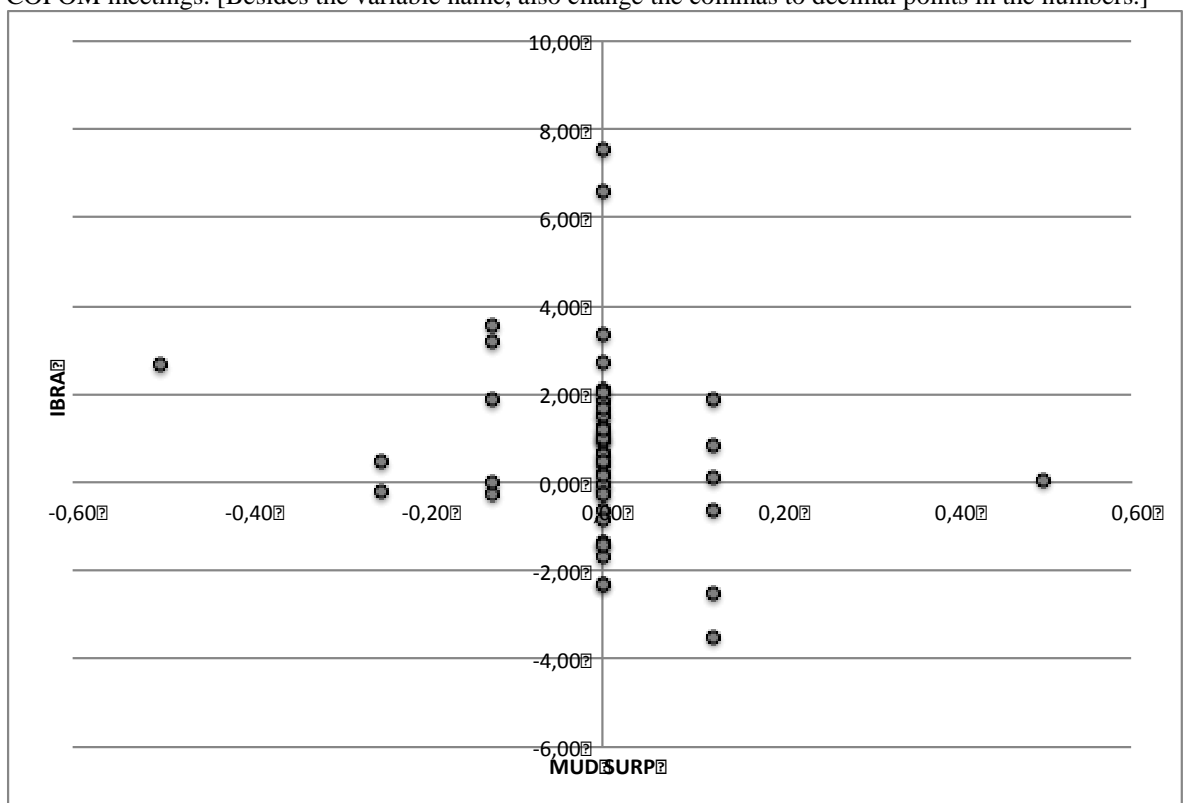
	<b>Média</b>	<b>Mediana</b>	<b>Máximo</b>	<b>Mínimo</b>	<b>Desvio Padrão</b>
IBOVESPA	0,33	0,42	7,47	-4,77	1,99
IBRA	0,43	0,00	7,53	-3,50	1,56
SELIC	14,91	13,75	26,50	8,50	4,77
Consenso	14,91	13,75	26,75	8,50	4,77
Mudança	-0,19	0,00	1,00	-2,50	0,62
Esperada	-0,18	0,00	1,25	-2,00	0,59
Surpresa	0,00	0,00	0,50	-1,00	0,18
Observações	88	88	88	88	88

**Panel B Correlation matrix**

	<b>IBOVESPA</b>	<b>IBRA</b>	<b>MUDANÇATOTAL</b>	<b>MUDANÇESP</b>	<b>MUDANÇSURP</b>
IBOVESPA	1,0000				
IBRA	0,8000 (0,0000)	1,0000			
MudançaTotal	0,0226 (0,8345)	0,0780 (0,4701)	1,0000		
MudançaEsperada	0,1091 (0,3115)	0,1161 (0,2815)	0,9584 (0,0000)	1,0000	
MudançaNãoEsperada	-0,2879 (0,0065)	-0,1188 (0,2701)	-0,2870 (0,0067)	0,0016 (0,9879)	1,0000
OBS	88	88	88	88	88



Graph 1 - Dispersion of the unexpected component (SURP) against the variation of the IBOVESPA for 68 COPOM meetings. [Besides the variable name, also change the commas to decimal points in the numbers.]



Graph 2 - Dispersion of the unexpected component (SURP) against the variation of the IBRA for 50 COPOM meetings.

We also analyzed the impact of unexpected changes in the SELIC rate on various stocks individually. For this purpose we used 38 of the 65 stocks making up the IBOVESPA. These

stocks have data starting from January 1, 2003. Since there were a large number of IPOs in the ensuing period, we excluded some firms from the sample, since they only were included in the IBOVESPA during our sample period and hence do not have complete data for the entire period.

Table 3 presents the descriptive statistics of the returns of these individual assets in the sample and the correlations with the unexpected and expected changes in the SELIC rate on the COPOM meeting dates.

The table presents the descriptive statistics of the daily returns of individual stocks for the days of the events analyzed. The return refers to the variation of the day after the COPOM announcement in relation to the preceding day. The sample period is January 2003 to December 2009.

TABLE 3 - DESCRIPTIVE STATISTICS OF INDIVIDUAL STOCK RETURNS

	Média	Mediana	Desvio Padrão
AMBV4	0,16	0,02	1,86
BBAS3	0,37	0,29	2,63
BBDC4	0,63	0,29	2,71
BRAP4	0,49	0,39	2,74
BRKM5	0,22	0,31	2,83
OIBR4	0,01	-0,04	2,62
CCRO3	0,56	0,20	3,04
CMIG4	-0,09	0,09	2,36
CPLE6	0,11	0,31	2,58
CRUZ3	0,26	0,06	2,52
CSNA3	0,64	0,58	2,73
ELET3	0,21	0,04	3,22
ELET6	0,14	-0,20	2,71
EMBR3	-0,11	0,09	2,41
GGBR4	0,43	0,49	2,76
GOAU4	0,39	0,19	2,74
ITSA4	0,72	0,42	2,48
ITUB4	0,65	0,38	2,60
KLBN4	0,73	0,40	3,18
LAME4	0,41	0,22	2,43
LIGT3	0,06	0,00	3,41
NETC4	0,01	0,00	3,34
PCAR4	0,17	0,00	2,27
PETR3	0,44	0,20	2,42
PETR4	0,37	0,44	2,44
SBSP3	0,03	0,07	2,39
TIMP3	-0,02	-0,07	3,08
TCSL4	0,06	0,00	2,60
VIVT4	-0,10	-0,08	2,05
TMAR5	0,11	-0,14	2,58
TNLP3	0,37	0,16	2,69
TNLP4	-0,02	0,00	2,20
TRPL4	0,20	0,23	2,38
UGPA3+4	0,59	0,53	1,88
USIM5	0,38	0,40	2,88
VALE3	0,47	0,22	2,49
VALE5	0,34	0,22	2,22
VIVO4	0,21	0,00	3,09

	Parou de negociar em 05/04/2012
	Parou de negociar em 02/08/2011
	Parou de negociar em 07/06/2011
	Mudança de ativo subjacente

It can be seen that some stocks behaved very differently than the aggregate indexes. Some, such as Vale3 and Vale5, show a positive correlation with unexpected monetary policy shocks.

## 4 RESULTS

### 4.1 RESPONSES OF THE STOCK MARKET

We estimated equations (3) and (4) above by ordinary least squares (OLS), corrected for serial correlation and heteroskedasticity of the errors using the Newey & West test (1987), obtaining the results presented in Table 4 below.

The sample period goes from January 2003 to May 2012, during which there were 88 COPOM meetings. The consensus was obtained from *Valor Econômico* on the day before the meeting. The surprise is defined as in equation (1) while the expected change is defined as in equation (2). The total change is the sum of the expected and unexpected changes. The first column presents the results of the estimation of equation (3) while the second column presents the estimations of equation (4). The values are corrected for heteroskedasticity by the Newey & West test (1987).

**TABLE 4 - IBOVESPA AND CHANGES IN THE SELIC RATE**

	<b>IBOVESPA</b>	<b>IBOVESPA</b>
Intercepto	0,0720 (0,8345)	0,3929 (0,0695)
Mudança Total	0,0720 (0,8345)	
Mudança Esperada		0,3685 (0,2912)
Mudança não Esperada		-3,2415 (0,0065)
R <sup>2</sup>	0,0005	0,0946
White	0,8342	0,9816
DW	2,3567	2,4198
Observações	88	88

As can be seen from the results in Table 4, the estimated coefficients of equation (3) are not statistically significant. But when the surprise element of equation (4) is included, the coefficient of this variable becomes significant. Moreover, the sign is also as expected by the economic theory. A positive surprise in the basic interest rate decision by the COPOM implies a negative variation of the IBOVESPA. For each 1% unexpected increase in the SELIC rate, the IBOVESPA falls 3.28%.

## 4.2 ASYMMETRY

As mentioned earlier, asymmetry means that the response of the stock market to a monetary policy surprise in one direction is much stronger than that to a surprise in the opposite direction.

To test for this asymmetry, we included two dummy variables, one for positive surprises and the other for negative ones. If asymmetry exists, theoretically one of these dummies should be statistically significant, indicating that the market does not react with equal intensity to the two types of surprises.

Table 5 shows the results of estimating equation (5) by OLS and correcting for serial autocorrelation and heteroskedasticity by the Newey & West test (1987). As can be seen, the coefficients of the dummy variables for asymmetry in both directions are not statistically significant.

We should note that during the event window analyzed, there were far more negative than positive surprises, but still the negative dummy was not statistically significant. It can be argued that the market is apparently more optimistic than pessimistic in relation to the positions of the COPOM, but this does not impact the way the market reacts to the changes.

This sample here goes from January 2003 to December 2009, during which there were 69 COPOM meetings. As in other cases, the consensus comes from *Valor Econômico* on the day before the meeting. The surprise is defined as in equation (1) while the expected change is defined as in equation (2) and the total change is the sum of the expected and unexpected changes. The first column presents the results of estimating equation (5) with the negative dummy variable as the regressor and the second column presents the same estimations with the positive dummy as the regressor. All the estimations were by OLS with correction for serial autocorrelation and heteroskedasticity with the Newey & West test (1987). The p-values are in parentheses.

**TABLE 5 - IBOVESPA AND CHANGES IN THE SELIC RATE WITH ASYMMETRY**

	<b>IBOVESPA</b>	<b>IBOVESPA</b>
Intercepto	0,5805 (0,0030)	0,1811 (0,2485)
Mudança Esperada	0,3317 (0,3399)	0,3451 (0,3302)
Mudança não Esperada	-2,0596 (0,1459)	-2,7302 (0,0090)
Dummy Negativa	-0,8875 (0,1429)	
Dummy Positiva		0,3702 (0,6500)
R <sup>2</sup>	0,1178	0,0972
White	0,4404	0,7094
DW	2,4256	2,3899
Breusch-Godfrey (2 lags)	0,1151	0,1072
Observações	88	88

As expected, we can conclude from our event sample that the market responds independently of the direction of the surprise. Once again, the greater presence of negative than positive impacts should be noted along with the size of the sample itself. Therefore, although the response is reasonably similar in both directions, the consensus in the sample period was generally more optimistic.

#### 4.3 ANALYSIS OF ROBUSTNESS

To analyze the robustness of our previous results, here we carry out two steps. In the first we replace the IBOVESPA with another market index, the IBRA, to check whether the sign and magnitude of the effects are the same as for the IBOVESPA. In the second step, we individually analyze the reaction of 32 stocks belonging to the IBOVESPA to unanticipated monetary policy shocks.

##### 4.3.1 The other stock market index: IBRA

The IBRA is a broader index than the IBOVESPA. It started on December 29, 2005 (first quotation in 2006). Its portfolio includes all stocks that meet the following criteria, based on the preceding 12 months: inclusion in a group of stocks whose combined trading indexes represent 99% of the accumulated value of the individual indexes, and trading session participation greater than or equal to 95% in the period. The index contains all the stocks of the IBOVESPA and 74 others.

We performed three analyses with the IBRA. In the first we carried out a regression with equation (3), replacing the IBOVESPA with the IBRA. Once again we corrected for serial autocorrelation and heteroskedasticity with the Newey & West test (1987). The results are reported in Panel A of Table 6. As can be seen, the response of the IBRA is a decline of 1.20% for an unexpected rise of 1% in the SELIC rate.

For a second analysis of the IBRA, we created a system of two linear equations where the regressors were the same as in equation (3), and the dependent variables were respectively the IBOVESPA and IBRA. To estimate the system, we used seemingly unrelated regression (SUR). Additionally, we tested whether the marginal effect of unexpected shocks on the IBOVESPA is greater than the effect on the IBRA. Panel B of Table 6 presents the results. As can be seen, the coefficient of unexpected shocks of the equation for the IBOVESPA is negative (-2.40%) and significant (p-value of 0.00) while the same variable in the equation for the IBRA is not statistically significant (p-value of 0.34), although the sign is again negative (-1.20) as expected. Regarding the test to verify the relation between the coefficients of the unexpected shocks in the two equations, the coefficient of the IBOVESPA is statistically higher in absolute value, with p-value of 0.0015.

The third analysis entailed testing if the asymmetry of the response to the positive or negative shocks is relevant to this aggregate index. As before, we inserted the two dummy variables for positive and negative surprises. If asymmetry exists, one of them should be statistically significant.

As shown in Panel C of Table 6, like in the case of the IBOVESPA, the stock market responds independently of the direction of the surprises. Once again, it is worth noting the greater presence of negative impacts than positive one and the size of the sample. Although the response is reasonably similar in both directions, the consensus in the sample period was generally more optimistic.

The sample period goes from January 2003 to May 2012, during which there were 88 COPOM meetings. The consensus was obtained from *Valor Econômico* on the day before the meeting. The surprise is defined as in equation (1) while the expected change is defined as in equation (2). The total change is the sum of the expected and unexpected changes. Panel A presents the estimation of equation (3) by OLS, replacing the IBOVESPA with the IBRA. Panel B presents the results of estimating a system of equations with the IBOVESPA and IBRA as the dependent variables (equation (4)) using SUR. Panel C shows the estimation of

equation (5) replacing the IBOVESPA with the IBRA. In all cases we tested for the presence of serial correlation and heteroskedasticity with the Newey & West test (1987).

**TABLE 6 - IBRA AND CHANGES IN THE SELIC RATE**

**Panel A Univariate model**

	<b>IBRA</b>	<b>IBRA</b>
Intercepto	0,2077 (0,2793)	0,4800 (0,0000)
Mudança Total	0,1956 (0,3662)	
Mudança Esperada		0,3000 (0,1900)
Mudança não Esperada		-1,0500 (0,1000)
R <sup>2</sup>	0,0050	0,0277
White	0,6532	0,9501
DW	1,6457	2,3300
Breusch-Godfrey (2 lags)	0,0001	0,0008
Observações	88	88

**Panel B System of equations**

	<b>Equação IBOVESPA</b>	<b>Equação IBRA</b>
Intercepto	0,3800 (0,0670)	0,4716 (0,0049)
Mudança Esperada	0,4716 (0,0049)	0,3696 (0,0849)
Mudança não Esperada	-3,2441 (0,0050)	-1,0512 (0,2580)
p-valor da diferença mudança não esperada	-2,1800 (0,0015)	
Observações	88	88

**Panel C IBRA and changes in the SELIC rate with asymmetry**

	<b>IBRA</b>	<b>IBRA</b>
Intercepto	0,5930 (0,3165)	0,4563 (0,0472)
Mudança Esperada	0,2756 (0,2235)	0,2976 (0,2202)
Mudança não Esperada	-0,2100 (0,9756)	-0,7804 (0,3927)
Dummy Negativa	-0,7700 (0,0699)	
Dummy Positiva		0,1974 (0,7517)
R <sup>2</sup>	0,0600	0,0280
White	0,4567	0,6453
DW	2,3451	2,3733
Breusch-Godfrey (2 lags)	0,1855	0,1234
Observações	88	88

#### 4.5 INDIVIDUAL STOCKS

To measure the impact on individual stocks, we used the same equations as explained in item 3.2, except we measured the returns of each stock on the event date<sup>xiv</sup>. For this case, we tested 38 of the 65 stocks making up the IBOVESPA that have data since January 1, 2003. Since the period saw a large number of IPOs, many stocks only were included in the IBOVESPA later in the period.

Some assets should respond more strongly than others, due to the greater influence of questions such as the dividend policy and future prospects of each firm than to the type of firm (e.g., banks) or the liquidity of the stock. An important fact to note is the behavior during the subprime crisis. The Brazilian stock market in the 2007-2008 period fell 15%, and some stocks responded more strongly to this impact. Companies with major presence in the export market or sale of commodities suffered more (e.g., the airplane maker Embraer fell 57%, the mining company Vale fell 19% and steelmaker Usiminas declined 19%). These stocks were not as strongly affected by positive surprises in the internal market as were retail chains, for example.

Despite these variations, the majority of the individual stocks showed the same behavior as the aggregate indexes. Of the 38 stocks analyzed, 22 presented positive and significant (at 5%) coefficients for the SELIC surprise regressor. The results for the individual stocks are presented in Table 7 below. Panel A of Table 7 shows the estimated coefficients and their statistical significance for each asset, while Panel B contains a brief summary of the estimations.

This sample here goes from January 2003 to December 2009, during which there were 69 COPOM meetings. The consensus comes from *Valor Econômico* on the day before the meeting. The surprise is defined as in equation (1) while the expected change is defined as in equation (2) and the total change is the sum of the expected and unexpected changes. For all the assets we estimated an equation similar to equation (1), replacing the IBOVESPA returns with the returns of the individual stocks. Panel A presents the estimated coefficients of the responses of the stocks to variations in the SELIC rate. Panel B presents a brief summary of all the estimations. In all of them, we controlled for serial autocorrelation and heteroskedasticity with the Newey & West test (1987).

**TABLE 7 - INDIVIDUAL STOCKS AND CHANGES IN THE SELIC RATE****Panel A Estimation of individual stocks**

	Intercepto	Mudança Esperada	Mudança não Esperada	R <sup>2</sup>
AMBV4	-0,0911 (0,2149)	-0,7292 (0,2766)	-2,3792 (0,8000)	0,101076
BBAS3	0,3942 (0,4060)	0,4084 (0,4300)	-0,5370 (1,3231)	0,009124
BBDC4	0,4584 (0,3180)	-0,3248 (0,3604)	-1,8423 (1,2846)	0,020341
BRAP4	0,6324 (0,4114)	0,2745 (0,4079)	-2,8171 (1,1323)	0,031655
BRKM5	0,2336 (0,3936)	-0,2570 (0,5291)	-6,0588 (1,2964)	0,140068
BRTO04	0,1865 (0,4088)	0,1087 (0,5637)	-3,9913 (0,7681)	0,067217
CCRO3	0,6739 (0,4409)	0,1144 (0,3995)	-0,9582 (0,9288)	0,003162
CMIG4	0,0374 (0,2723)	0,4562 (0,2883)	-5,1938 (1,2328)	0,15541
CPLE6	0,2598 (0,3192)	0,8290 (0,5346)	-0,5586 (2,4227)	0,031347
CRUZ3	0,4687 (0,4161)	0,3324 (0,3549)	-2,8639 (1,8516)	0,044186
CSNA3	0,7794 (0,3751)	0,4751 (0,4539)	-5,0550 (0,9297)	0,109676
ELET3	0,5029 (0,3599)	0,4603 (0,5571)	-3,7555 (1,8823)	0,043707
ELET6	0,3308 (0,2905)	0,4296 (0,4119)	-3,8800 (1,5233)	0,068296
EMBR3	-0,5162 (0,2941)	-0,5418 (0,5346)	-1,1878 (1,2525)	0,024396
GGBR4	0,4940 (0,3143)	0,3898 (0,3391)	-4,0142 (1,4086)	0,072363
GOAU4	0,4138 (0,3389)	0,3022 (0,3940)	-3,1283 (1,4293)	0,046081
ITSA4	0,6486 (0,3003)	0,1301 (0,3531)	-0,9666 (0,8640)	0,005779
ITUB4	0,5015 (0,3012)	-0,0227 (0,3373)	-2,2414 (1,0470)	0,025245
KLBN4	0,9191 (0,4070)	0,9792 (0,3887)	-3,7166 (1,1975)	0,067887
LAME4	0,0634 (0,3448)	-0,4225 (0,3571)	-1,6501 (1,2520)	0,02992
LIGT3	0,3336	1,0266	-3,0110	0,045852

**Panel B Brief summary of the estimations**

	Qtdade
<b>Ativos analisados</b>	<b>38</b>
Significância > 10%	11
Significância 10%	4
Significância 5%	23

**4.4 DISCUSSION OF THE RESULTS**

The reaction of economic agents to the basic interest rate derives from the broad impact of monetary policy decisions on the real economy. There is consensus in the literature that changes in the basic interest rate produce effects on important economic variables, such as the yield curve, level of credit, exchange rate and price of financial assets, such as stocks, bonds and derivatives.

According to the economic theory, changes in monetary policy are transmitted to the stock market by means of changes in the values of households' or individuals' portfolios, the wealth effect, and by changes in the cost of capital.

Taken as a whole, the results presented above confirm the existence of a reaction of the Brazilian stock market to unexpected changes in the SELIC rate. This is evidence that monetary policy in Brazil has real effects that can be quantitatively relevant.

Although we found a reasonably strong effect of monetary policy on the stock market, we should emphasize that the monetary policy surprises are responsible for only a small part of the overall variability of stock prices.

Our results are consistent with those of other studies that have analyzed the relationship between monetary policy and the stock market. In this respect, besides Bernanke & Kuttner (2004), we can mention Thorbecke (1997), who documented a response of stock prices to unanticipated monetary policy shocks using a vector autoregressive (VAR) model.

In the case of the Brazilian literature, our results can be compared to those of Gonçalves Junior (2007). He observed a smaller impact of unexpected interest rate changes. He found that each unexpected increase of 1% in the overnight interest rate (one-day DI) caused the IBOVESPA to fall by 1.3%. This impact is similar to that measured by Bernanke & Kuttner (2004). However, we believe his number could have underestimated the real impact, because the Brazilian stock market is an emerging one, with greater information asymmetry and with higher rates of return than those observed in industrialized countries. The smaller impact in that study can also be explained by the earlier time frame, from June 1996 to March 2006.

## 5 CONCLUSION

Based on the articles of Bernanke & Kuttner (2004) and Gonçalves Junior (2007), we constructed a measure of the surprise over interest rate decisions by the Brazilian Monetary Policy Committee (COPOM) and used it to estimate the impact of those decisions on the stock market. This measure of surprise was based on the market consensus as published on the day before each COPOM meeting by the newspaper *Valor Econômico*.

Our main result is that each positive surprise of 1% in the SELIC rate on the COPOM meeting dates had a negative impact of around 3% on the stock market during our sample period. We did not find any relevant asymmetry for the response of the IBOVESPA to positive or negative unanticipated shocks in the SELIC rate. The impacts on the stock market were roughly the same to surprises in both directions.

To check the robustness, we also analyzed the reaction of another, broader, stock market index, the IBRA, as well as of individual stocks to unexpected monetary policy shocks. In the case of the IBRA, we found a statistically significant decline of 1.20% for an unexpected increase of 1% in the SELIC rate. For the individual assets, the results were in line with the general model applied to the indexes. Furthermore, we did not find significant evidence of a greater response in a determined economic segment in comparison to others, although the subprime crisis did have a stronger impact on certain assets.

This article presents a methodology based on event studies. In this methodology, we explained the variation of the stock market index solely due to expected and unexpected changes in the SELIC rate. As discussed previously, there are various other ways to model the returns of aggregate market indexes and those of individual stocks. We believe this is a limitation of this study. Future works could use other specifications for stock market index returns to shed more light on the dynamic relationship of the stock market and monetary policy in Brazil.

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## APPENDIX A: IBOVESPA, IBRA AND SURPRISE COMPONENTS

The table presents the consensus, expected component, unexpected (surprise) component and total change at each COPOM meeting during the sample period from January 2003 to May 2012. The consensus was obtained from *Valor Econômico* newspaper on the day before the COPOM meeting. The surprise is defined in equation (1) of the text, while the expected change is defined in equation (2). The total is the sum of the expected and unexpected change.

Date	SELIC Target Set by	Consensus	Expected	Surprise	Total Change
22-01-03	25.50	25.50	0.50	0.00	0.50
19-02-03	26.50	26.75	1.25	-0.25	1.00
19-03-03	26.50	26.50	0.00	0.00	0.00
23-04-03	26.50	26.50	0.00	0.00	0.00
21-05-03	26.50	26.50	0.00	0.00	0.00
18-06-03	26.00	25.75	-0.75	0.25	-0.50
23-07-03	24.50	24.25	-1.75	0.25	-1.50
20-08-03	22.00	23.00	-1.50	-1.00	-2.50
17-09-03	20.00	20.00	-2.00	0.00	-2.00
22-10-03	19.00	18.75	-1.25	0.25	-1.00
19-11-03	17.50	18.00	-1.00	-0.50	-1.50
17-12-03	16.50	16.50	-1.00	0.00	-1.00
21-01-04	16.50	16.13	-0.38	0.38	0.00
18-02-04	16.50	16.50	0.00	0.00	0.00
17-03-04	16.25	16.50	0.00	-0.25	-0.25
14-04-04	16.00	16.00	-0.25	0.00	-0.25
19-05-04	16.00	15.88	-0.13	0.13	0.00
16-06-04	16.00	16.00	0.00	0.00	0.00
21-07-04	16.00	16.00	0.00	0.00	0.00
18-08-04	16.00	16.00	0.00	0.00	0.00
15-09-04	16.25	16.25	0.25	0.00	0.25
20-10-04	16.75	16.50	0.25	0.25	0.50
17-11-04	17.25	17.25	0.50	0.00	0.50
15-12-04	17.75	17.63	0.38	0.13	0.50
19-01-05	18.25	18.25	0.50	0.00	0.50
16-02-05	18.75	18.88	0.63	-0.13	0.50
16-03-05	19.25	19.13	0.38	0.13	0.50
20-04-05	19.50	19.38	0.13	0.13	0.25
18-05-05	19.75	19.63	0.13	0.13	0.25
15-06-05	19.75	19.75	0.00	0.00	0.00
20-07-05	19.75	19.75	0.00	0.00	0.00
17-08-05	19.75	19.63	-0.13	0.13	0.00
14-09-05	19.50	19.50	-0.25	0.00	-0.25
19-10-05	19.00	19.00	-0.50	0.00	-0.50
23-11-05	18.50	18.38	-0.63	0.13	-0.50
14-12-05	18.00	18.00	-0.50	0.00	-0.50
18-01-06	17.25	17.38	-0.63	-0.13	-0.75
08-03-06	16.50	16.38	-0.88	0.13	-0.75
19-04-06	15.75	15.25	-1.25	0.50	-0.75
31-05-06	15.25	15.25	-0.50	0.00	-0.50
19-07-06	14.75	14.75	-0.50	0.00	-0.50
30-08-06	14.25	14.38	-0.38	-0.13	-0.50

18-10-06	13.75	13.75	-0.50	0.00	-0.50
29-11-06	13.25	13.25	-0.50	0.00	-0.50
24-01-07	13.00	12.88	-0.38	0.13	-0.25
07-03-07	12.75	12.75	-0.25	0.00	-0.25
18-04-07	12.50	12.50	-0.25	0.00	-0.25
06-06-07	12.00	12.00	-0.50	0.00	-0.50
18-07-07	11.50	11.50	-0.50	0.00	-0.50
05-09-07	11.25	11.25	-0.25	0.00	-0.25
17-10-07	11.25	11.13	-0.13	0.13	0.00
05-12-07	11.25	11.25	0.00	0.00	0.00
23-01-08	11.25	11.25	0.00	0.00	0.00
05-03-08	11.25	11.25	0.00	0.00	0.00
16-04-08	11.75	11.63	0.38	0.13	0.50
04-06-08	12.25	12.38	0.63	-0.13	0.50
23-07-08	13.00	12.88	0.63	0.13	0.75
10-09-08	13.75	13.75	0.75	0.00	0.75
29-10-08	13.75	13.75	0.00	0.00	0.00
10-12-08	13.75	13.75	0.00	0.00	0.00
21-01-09	12.75	12.75	-1.00	0.00	-1.00
11-03-09	11.25	11.25	-1.50	0.00	-1.50
29-04-09	10.25	10.25	-1.00	0.00	-1.00
10-06-09	9.25	9.50	-0.75	-0.25	-1.00
22-07-09	8.75	8.75	-0.50	0.00	-0.50
02-09-09	8.75	8.75	0.00	0.00	0.00
21-10-09	8.75	8.75	0.00	0.00	0.00
09-12-09	8.75	8.75	0.00	0.00	0.00
27-01-10	8.75	8.75	0.00	0.00	0.00
17-03-10	8.75	9.00	0.25	-0.25	0.00
28-04-10	9.50	9.38	0.63	0.13	0.75
09-06-10	10.25	10.25	0.75	0.00	0.75
21-07-10	10.75	10.88	0.63	-0.13	0.50
01-09-10	10.75	10.75	0.00	0.00	0.00
20-10-10	10.75	10.75	0.00	0.00	0.00
08-12-10	10.75	10.75	0.00	0.00	0.00
19-01-11	11.25	11.25	0.50	0.00	0.50
02-03-11	11.75	11.75	0.50	0.00	0.50
20-04-11	12.00	12.13	0.38	-0.13	0.25
08-06-11	12.25	12.25	0.25	0.00	0.25
20-07-11	12.50	12.50	0.25	0.00	0.25
31-08-11	12.00	12.50	0.00	-0.50	-0.50
19-10-11	11.50	11.50	-0.50	0.00	-0.50
30-11-11	11.00	11.00	-0.50	0.00	-0.50
18-01-12	10.50	10.50	-0.50	0.00	-0.50
07-03-12	9.75	9.75	-0.75	0.00	-0.75
18-04-12	9.00	9.00	-0.75	0.00	-0.75
30-05-12	8.50	8.50	-0.50	0.00	-0.50

**APPENDIX B: IBOVESPA, IBRA AND SURPRISE COMPONENTS**

The table shows the surprise component, direction of the surprise and variation of the IBOVESPA on the COPOM meeting dates in the sample period from January 2003 to December 2009. The consensus was obtained from *Valor Econômico* newspaper on the day before the COPOM meeting. The surprise component is defined in equation (1) of the text.

Date	Surprise	Direction of the	IBOVESPA	IBRA Variation
22-01-03	0.00	Neutral	0.18	0.00
19-02-03	-0.25	Positive	-0.34	0.00
19-03-03	0.00	Neutral	1.38	0.00
23-04-03	0.00	Neutral	-2.21	0.00
21-05-03	0.00	Neutral	0.51	0.00
18-06-03	0.25	Negative	-2.81	0.00
23-07-03	0.25	Negative	-0.27	0.00
20-08-03	-1.00	Positive	1.40	0.00
17-09-03	0.00	Neutral	2.41	0.00
22-10-03	0.25	Negative	-2.99	0.00
19-11-03	-0.50	Positive	2.08	0.00
17-12-03	0.00	Neutral	1.37	0.00
21-01-04	0.38	Negative	-1.43	0.00
18-02-04	0.00	Neutral	-4.77	0.00
17-03-04	-0.25	Positive	2.14	0.00
14-04-04	0.00	Neutral	-2.56	0.00
19-05-04	0.13	Negative	-2.40	0.00
16-06-04	0.00	Neutral	-0.61	0.00
21-07-04	0.00	Neutral	-0.37	0.00
18-08-04	0.00	Neutral	0.68	0.00
15-09-04	0.00	Neutral	2.38	0.00
20-10-04	0.25	Negative	0.81	0.00
17-11-04	0.00	Neutral	-0.11	0.00
15-12-04	0.13	Negative	1.00	0.00
19-01-05	0.00	Neutral	-2.73	0.00
16-02-05	-0.13	Positive	2.68	0.00
16-03-05	0.13	Negative	0.93	0.00
20-04-05	0.13	Negative	-1.18	0.00
18-05-05	0.13	Negative	-0.28	0.00
15-06-05	0.00	Neutral	1.06	0.00
20-07-05	0.00	Neutral	0.54	0.00
17-08-05	0.13	Negative	-1.89	0.00
14-09-05	0.00	Neutral	1.09	0.00
19-10-05	0.00	Neutral	-3.25	0.00
23-11-05	0.13	Negative	0.01	0.00
14-12-05	0.00	Neutral	-1.30	0.00
18-01-06	-0.13	Positive	2.94	3.20
08-03-06	0.13	Negative	-2.62	-2.51
19-04-06	0.50	Negative	-0.41	0.05
31-05-06	0.00	Neutral	3.33	2.75
19-07-06	0.00	Neutral	-2.55	-2.31
30-08-06	-0.13	Positive	-0.22	-0.25
18-10-06	0.00	Neutral	0.60	0.68
29-11-06	0.00	Neutral	-0.09	-0.05

24-01-07	0.13	Negative	-0.61	-0.64
07-03-07	0.00	Neutral	1.87	1.84
18-04-07	0.00	Neutral	0.11	-0.05
06-06-07	0.00	Neutral	0.54	-0.05
18-07-07	0.00	Neutral	0.99	1.25
05-09-07	0.00	Neutral	0.30	0.60
17-10-07	0.13	Negative	0.11	0.12
05-12-07	0.00	Neutral	1.33	1.52
23-01-08	0.00	Neutral	5.95	6.60
05-03-08	0.00	Neutral	-2.56	-2.30
16-04-08	0.13	Negative	0.63	0.85
04-06-08	-0.13	Positive	3.69	3.58
23-07-08	0.13	Negative	-3.34	-3.50
10-09-08	0.00	Neutral	3.30	3.33
29-10-08	0.00	Neutral	7.47	7.53
10-12-08	0.00	Neutral	-1.24	-1.38
21-01-09	0.00	Neutral	-1.68	-1.37
11-03-09	0.00	Neutral	0.89	1.06
29-04-09	0.00	Neutral	0.13	0.20
10-06-09	-0.25	Positive	0.28	0.46
22-07-09	0.00	Neutral	2.22	2.11
02-09-09	0.00	Neutral	0.58	0.44
21-10-09	0.00	Neutral	0.99	1.12
09-12-09	0.00	Neutral	1.05	0.97
27-01-10	0.00	Neutral	0.80	0.96
17-03-10	-0.25	Positive	-0.04	-0.21
28-04-10	0.13	Negative	1.98	1.88
09-06-10	0.00	Neutral	2.55	2.10
21-07-10	-0.13	Positive	1.97	1.89
01-09-10	0.00	Neutral	-0.39	-0.61
20-10-10	0.00	Neutral	-1.07	-1.67
08-12-10	0.00	Neutral	-0.43	-0.25
19-01-11	0.00	Neutral	-0.71	-0.84
02-03-11	0.00	Neutral	1.28	1.00
20-04-11	-0.13	Positive	-0.13	-0.01
08-06-11	0.00	Neutral	0.69	0.48
20-07-11	0.00	Neutral	1.93	1.49
31-08-11	-0.50	Positive	2.87	2.65
19-10-11	0.00	Neutral	-1.74	-1.40
30-11-11	0.00	Neutral	2.23	2.02
18-01-12	0.00	Neutral	0.33	0.16
07-03-12	0.00	Neutral	1.35	1.18
18-04-12	0.00	Neutral	-0.62	-0.25
30-05-12	0.00	Neutral	1.29	1.67

## NOTES

<sup>i</sup> After the Real Plan in mid-1994 finally managed to stabilize the Brazilian economy after over a decade of persistently high inflation, including episodes of hyperinflation (as high as 80% per month), Brazil had a fixed

exchange rate with gradual adjustments (sliding peg) until January 1999, when the currency was floated after coming under intense pressure from the market. From this point on the COPOM started to gain relevance and surprises in its decisions began to impact the stock market, generating immediate reactions in the main index, the IBOVESPA. However, the economy's volatility was still very great, and the necessary changes in the SELIC rate were commensurately large. When the administration of President Lula (who took office in January 2003) maintained the principal macroeconomic policies of his predecessor, Fernando Henrique Cardoso (who as finance minister had orchestrated the Real Plan), the market became calmer and took on the outlines of normality with respect to the decisions of the COPOM<sup>i</sup>. The normality affected the way the revision of the SELIC target impacted the economic variables (interest rate, credit volume, inflation expectations and asset prices).

<sup>ii</sup> The IBOVESPA is the index most used by the market to measure the average trading price. The rules for selection of the hypothetical portfolio have not changed since 1968. It reflects the performance of the main stocks of the São Paulo Stock Exchange (those in the index account for over 80% of the number of trades and financial volume). The IBOVESPA is currently composed of 69 stocks.

<sup>iii</sup> It is unlikely that the stock market would respond to monetary policy actions that are already anticipated. See Bernanke & Kuttner (2004) for a discussion of this matter.

<sup>iv</sup> A possible explanation for the difference in the results is the differences in the importance of credit in Brazil in recent years in comparison with the period studied by Gonçalves Junior (2007).

<sup>v</sup> The IBRA is a broader index than the IBOVESPA. It started to be computed on December 29, 2005 (first quotation in 2006). Its portfolio includes all stocks that meet the following criteria, based on the preceding 12 months: inclusion in a group of stocks whose combined trading indexes represent 99% of the accumulated value of the individual indexes, and trading session participation greater than or equal to 95% in the period. The index contains all the stocks of the IBOVESPA and 74 others.

<sup>vi</sup> Gonçalves Junior (2007) used the same method, but with the average overnight interest rate (one-day DI rate).

<sup>vii</sup> The consensus projections are published in the morning of the day when the policy rate is announced by the COPOM and normally reflect the position of between three and five key market participants. When there was a division of opinion regarding the consensus, as reported in the newspaper, we used the average of the reported opinions (Source: *Valor Econômico*).

<sup>viii</sup> This same approach was used by Gonçalves Junior (2007). A new approach, with briefer windows (intraday) was used by Gürkaynak, Sack, Swanson (2005), but they also worked with the event study concept. As observed by Poole, Rasche & Thornton (2002), event studies tend to provide significant values, but can underestimate the impacts.

<sup>ix</sup> A way to correct the distortion of possible orthogonality is to use intraday data to isolate the impacts on the stock market just after the central bank's interest rate announcement. Following this method, Gürkaynak, Sack, Swanson (2005) reported that the results were very near those obtained with daily data, with the exception that the use of intraday data increased the  $R^2$  value.

<sup>x</sup> In August and September 2008, the subprime crisis reached its peak, with the nationalization of Fannie Mae and Freddie Mac and the failure of Lehman Brothers. The impending crisis had become public knowledge in February 2007, and in the middle of that year the French bank BNP Paribas froze withdrawals from some funds, citing problems in the American subprime market.

<sup>xi</sup> Bernanke & Kuttner (2004) treat orthogonality in the same way. They also discuss other ways to try to correct orthogonality in the American market – such as Rigobon & Sack (2004) — who used an estimator that, taking advantage of the heteroskedasticity introduced by exogenous monetary policy actions, supplied estimators consistent with the response of the stock market, reaching values very near those obtained with daily data.

<sup>xii</sup> Appendix B contains a table with the IBOVESPA, IBRA and surprise components for each COPOM meeting date.

<sup>xiii</sup> We performed the test of means between these two variations, which did not reject the null hypothesis of equality of the means (p-value of 0.71)

<sup>xiv</sup> There is an extensive literature that also models the returns of individual stocks differently than our model. See Cochrane (2005) for a detailed discussion of this issue.