

Financial Market Reactions to the Brazilian Central Bank's Decisions

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Resumo

Este artigo analisa a experiência brasileira depois da adoção do regime de metas de inflação no que concerne aos efeitos causados pelas novas práticas de transparência e de comunicação na política monetária. Baseia-se nas metodologias propostas por Cook e Hahn (1989) e Kuttner (2001) e utiliza-se de dados diários de transações do mercado futuro de depósitos interfinanceiros da BMF&BOVESPA para analisar a ocorrência de mudanças na formação de expectativas do mercado financeiro, considerando as ações de política monetária de julho de 1999 a janeiro de 2009. Além da análise para o período total, dois outros períodos são considerados: o “período de maturação” – a primeira fase dos efeitos causados pelo aumento da transparência do banco central; e o “período de sabedoria” – a segunda fase que considera as percepções do mercado financeiro em ambiente de maior transparência. Os resultados indicam que as reações do mercado financeiro em face das mudanças na taxa-meta de juros não são negligenciáveis. Em particular, a redução dos desvios-padrões das estimações no período de sabedoria sugere que o comportamento do Banco Central do Brasil ao longo do tempo aumentou a capacidade dos agentes de mercado de prever as decisões do Comitê de Política Monetária.

Palavras-chave: transparência, política monetária, regime de metas de inflação, mercado futuro de depósitos interfinanceiros

Abstract

This article makes an analysis of the Brazilian experience after the adoption of inflation targeting concerning the effects caused by the new practices of transparency and communication in the monetary policy. Based on methodologies proposed by Cook and Hahn (1989) and Kuttner (2001) and making use of daily data from transactions in the interbank deposit futures market of the Securities, Commodities and Futures Exchange (BMF&BOVESPA), the occurrence of changes in the financial market's expectation in regard to monetary policy actions from July 1999 to January 2009 is analyzed. Besides the analysis for the whole period, two other periods are considered: the “maturation period” - the first phase of the effects caused by an increase in central bank transparency; and the “wisdom period” - the second phase in the financial market's perception regarding an environment with more transparency. The findings indicate that the reaction of the financial market to changes in the interest rate target is not negligible. In particular, the fall in the standard errors for estimations in the wisdom period suggests that the Central Bank of Brazil's behavior over time has increased the capacity of market agents to forecast the Monetary Policy Committee's decisions.

Key words: transparency, monetary policy, inflation targeting, interest deposit futures market
Área 3 - JEL classification: E52, E43.

1. Introduction

The growing attention of central bankers to guide public's expectation can improve the transmission mechanism and the effectiveness of the monetary policy. An important tool in this framework is the central bank transparency. In particular, transparency is important under an environment with inflation targeting because it contributes to an increase in the convergence between public's expectation and the inflation target. Among several points which represent an advantage due to an increase in transparency, three deserve attention: (i) avoids the possibility of inflation bias and time inconsistency in the management of the monetary policy; (ii) represents a technology that contributes to develop credibility; and (iii) increases the central bank accountability.¹

Nowadays practices which decrease asymmetrical information between the central bank and the private agents can represent a preoccupation by policymakers in reducing idiosyncratic errors by the public. The dissemination of monetary regimes which work with more transparency and that pay attention to the public's expectation may indicate a new manner of taking into consideration a greater vulnerability of the economies in a globalized world.²

In fact, a combination of an efficient communication and higher transparency can facilitate the task of guiding the public's expectation which in turn can promote an environment where the private agents make decisions in a more efficient way.³ Under this view, actions and communications of the central bank which affect the term structure of interest rates (principally long-term interest rates), increase the efficiency of the economy and improve the efficiency regarding the public's decisions on consumption and investment and thus amplify the effects of monetary transmission mechanisms (Brunner, 1981; Blinder, 1998; and Woodford, 2001).

In brief, an important question that needs an answer is how the central bank may define the correct degree of transparency, an efficient communication strategy, and how to evaluate the results caused by the new strategy adopted. It is important to highlight that the analysis concerning the effects of a higher central bank transparency in emerging economies which have adopted inflation targeting is particularly relevant because these economies are more vulnerable to shocks. As a consequence, anchoring public's expectation and developing credibility represent a basic condition for the success of the central bank in the management of the monetary policy.

According to Blinder et al (2008) the use of inflation targeting has been the preferred way for anchoring expectations and thus becomes an essential source of research for analyzing the consequences of an increase in the central bank communication on economy. Moreover an important aspect for determining an efficient strategy of communication is to understand how new information is perceived by a developed and sophisticated financial market. In particular, as stated by Owens and Webb (2001), the interest rate futures market permits perceiving the financial market expectation for the term structure of interest rate with a greater efficiency than the recent past.

This article makes an analysis of the Brazilian experience after the adoption of inflation targeting concerning the effects caused by the new practices of transparency and communication in the monetary policy. Brazil is a country that deserves attention

¹ Regarding advantages caused by an increase in central bank transparency, see Geraats (2002); Gaspar, Smets, and Vestin (2006); and de Mendonça and Simão Filho (2007).

² There exists an extensive literature concerning this subject. See Guthrie and Wright (2000); Orphanides and Williams (2002); Walsh (2003); Demiralp and Jorda (2004); Kohn and Sack (2004); Woodford (2005); de Haan, Eijffinger, and Rybinski (2007); and Ehrmann and Fratzscher (2007a).

³ See Svensson (2006); Woodford (2005); and Morris and Shin (2002).

because it is the largest economy in Latin America and has had success in the management of macroeconomic policies. The success of the stabilization program started in July 1994 (Real Plan) and complemented in July 1999 by the adoption of inflation targeting permitted the Brazilian economy to reach the investment grade rating in 2008. Another point that cannot be neglected is that Brazil has a sophisticated financial market. Therefore, Brazil is an adequate laboratory experiment for emerging economies.

Based on methodologies proposed by Cook and Hahn (1989) and Kuttner (2001) and making use of daily data from transactions in the interbank deposit futures market of the Securities, Commodities and Futures Exchange (BMF&BOVESPA), the occurrence of changes in the financial market's expectation in regard to monetary policy actions from July 1999 to January 2009 is analyzed. In short, the main objective of this study is to analyze changes in the Brazilian financial market behavior concerning the monetary policy strategy adopted by the Central Bank of Brazil (CBB) in the inflation targeting period. Beyond the analysis for the whole period, two other periods are considered: the "maturation period" - the first phase of the effects caused by an increase in central bank transparency; and the "wisdom period" - the second phase in the financial market's perception regarding an environment with more transparency.

This article is organized as follows. The next section makes a brief presentation of the connection between transparency and expectation hypothesis of the term structure of interest rate (EHT). Moreover, the methodologies proposed by Cook and Hahn (1989) and Kuttner (2001) are presented. Section 3 highlights the main changes in the Brazilian monetary policy due to the adoption of inflation targeting. Section 4 presents the data and methodology applied in this study. Section 5 makes an empirical analysis for the Brazilian financial market. The last section concludes the article.

2. A note about transparency and EHT

The research on new practices in the management of the monetary policy, which combines degree of transparency with a communication process, did still not present a definitive strategy. In a general way, the effects caused by central bank communication are little comprehended and there is no consensus in regard to the best practices for the central bank to improve the efficiency of the monetary policy.

The literature concerning central bank communication points out that three points need to be considered for evaluating the impact on the public's comprehension: (i) selection of macroeconomic variables which work as an anchor for public's expectation; (ii) content, procedure, and moment of issuing the information by the monetary authority; and (iii) framework, organization, and how the monetary policy committees work. In addition, according to Blinder et al (2008) the studies which look for an answer regarding an adequate central bank transparency and its effects on financial market include three perspectives. The first studies the presence of changes in the volatility of prices when the central bank communication occurs.⁴ The second analyzes the efficiency of each manner of communication by the central bank.⁵ The third line of research evaluates changes in the degree of public's comprehension regarding the monetary policy adopted due to modifications in the degree of transparency and in the strategy of communication.⁶

⁴ See Kohn and Sack (2004), Connolly and Kohler (2004), and Reeves and Sawick (2007).

⁵ See Ehrmann and Fratzscher (2007a, 2007b), and de Haan, Eijffinger, and Rybinski (2007).

⁶ See Cook and Hahn (1989), Kuttner (2001), Poole and Rasche (2003), and Lange, Sack, and Whitesell (2003).

The analysis concerning the expectations hypothesis of the term structure of interest rate (EHT) is a way of evaluating the presence of changes in the public's behavior under an environment with more transparency in the monetary policy. The observation, for a period of time, of the changes in the pattern of behavior of term structure of interest rate can detect modification in the public's behavior. Reactions that anticipate actions and communications of the monetary policy can reveal change in the public's behavior (caused by a better comprehension of monetary policy) and adjustments in the degree of transparency as well as in the strategy of communication.

Some authors analyzed the effect of changes in the interest rate target defined by the Monetary Policy Committee (MPC) on asset prices and derivatives negotiated in the financial market for several maturities. Among authors which concluded that there exists little evidence for EHT are: Mankiw and Miron (1986), Shiller, Campbell, and Schoenholtz (1983), Campbell and Shiller (1991), Fama (1984), Mishkin (1988), Hardouvelis (1988) and Longstaff (2000). On the other hand, a list of some authors who detected that central bank disclosures make significant effects on the short-term interest rate and on asset prices are: Cook and Hahn (1989), Roley and Sellon (1995), Thornton (1998), Bomfim and Reinhart (2000), Poole and Rasche (2000), Bomfim (2003), Rigobon and Sack (2004), and Kuttner (2001). The main difference in the results is attributed to the divergence in the empirical analysis and data used.

In particular, the studies of Cook and Hahn (1990) and Rudebusch (1995) deserve attention because they create a logical sense in the literature. These authors analyze the non-anticipated reaction of the financial market to the central bank disclosures. The conclusion is that the short-term interest rate has information on changes that will occur in the interest rates in the short-term. Notwithstanding, this observation loses significance while the time horizon is extended (Lange, Sack, and Whitesell, 2003).

An aspect that deserves special attention and that can explain the divergence in the analysis concerning EHT is the hypothesis that the interest rate forecast capability in the financial markets is an indicator of transparency, clarity, communication, and of the effectiveness of the monetary policy (Bernoth and von Hagen, 2004). Therefore, a higher degree of central bank transparency can improve the efficiency of EHT because it promotes a convergence between market interest rate expectations and the objectives of the monetary policy. According to Kuttner (2001) a higher transparency in the conduction of the monetary policy can amplify the financial market's capability of anticipating the actions of the monetary policy. As a consequence, an analysis of EHT which allow a better comprehension of the changes in the behavior of the financial market demands a division between non-anticipated and anticipated reactions to the monetary policy.

Ehrman and Fratzscher (2007b) highlight that the measurement of the effectiveness of communication as a tool of monetary policy must consider three aspects: (i) change in the ability of financial market to forecast future decisions of the monetary policy; (ii) skill of monetary policymakers to influence financial markets in changing asset prices; and (iii) central bank's capability to anchor and to guide market expectation for medium and long terms. Hence, the public's comprehension of the strategy adopted by a central bank may consider the disclosure of data which contains a central bank's forecast for the performance of the economy (Bernanke, 2008).

More accurate information with extended maturities may affect the long-term expectation of the term structure of the interest rate which can make it more sensitive to changes in the interest rate promoted by the central bank. Kuttner (2001) advances the analysis of the EHT making use of data from the American future interest rate market and dividing the reaction of the financial market into anticipated and non-anticipated to changes in the federal funds rate.

2.1. Reaction of the financial market

The methodologies proposed by Cook and Hahn (1989) and Kuttner (2001) permit the analysis of the reaction of the financial market to the actions and communications of the monetary policy. The main characteristic of the analysis developed by Cook and Hahn (1989) is the observation of the response of the interest rate practiced in the financial market on the day of MPC's meeting to the interest rate target defined by the central bank.

It is important to note that under an environment with high transparency, the observation of a change in the market interest rate can imply a misunderstanding of the behavior in the financial market. There exists the risk of confusing the validation of EHT with the measurement of the non-anticipated reaction to the statement of a new interest rate target. The absence of variation of the market interest rate on the day of MPC's announcement of a new target could mean that the financial market was insensitive to the variation of the interest rate target and could thus invalidate the EHT. On the other hand, if the central bank is successful in guiding expectations, the absence of variation in the market interest rate would denote that the financial market already anticipated the movement in the interest rate.

The observation above can explain why Kuttner (2001) detected a worsening of the financial market reaction to the FOMC's interest rate setting after the period analyzed by Cook and Hahn (1989).⁷ Kuttner (2001) admits that this result can be a consequence of a higher Fed transparency. Therefore, the methodology of Cook and Hahn (1989) needs to be complemented by the possibility of the financial market anticipating the reaction. In fact, the methodology proposed by Cook and Hahn (1989) takes into account only changes in the backward-looking reaction which in turn can be attenuated by an increase in the anticipation of monetary policy actions due to an increase in central bank transparency.

Kuttner (2001) introduces the expectations present in the interest rate futures market in the literature. This perspective considers the futures interest rate before $f_{s,t}^0$ and after $f_{s,t+1}^0$ MPC sets the interest rate. The difference between these rates Δr_t^u reveals how the financial market reacted in a non-anticipated (unexpected) way to the change in the interest rate target. Hence,

$$(1) \quad \Delta r_t^u = \frac{m}{m-t} (f_{s,t+1}^0 - f_{s,t}^0),$$

where, $f_{s,t}^0$ is the expectation of the average funds rate in month s on date t , and m is the number of days in the month.

The difference between the changes in the interest rate target defined by the MPC (Δr_m) and the non-anticipated reaction (Δr_t^u) is the anticipated reaction (expected) of the financial market (Δr_t^e). Therefore, when Δr_t^u is close to zero, and thus there exists a convergence between Δr_t^e and Δr_m , the interpretation is that the financial market has a better comprehension of the monetary policy. Hence,

$$(2) \quad \Delta r_t^e = \Delta r_m - \Delta r_t^u.$$

The empirical analysis of the EHT based on MPC's decisions, applying the methodology proposed by Kuttner (2001), can be made through OLS estimation where

⁷ The period analyzed by Cook and Hahn (1989) spans from 1974 to 1979, while Kuttner (2001) makes the analysis from 1989 to 2000.

the dependent variable is the change in the future market interest rate for different maturities (ΔR_t^h), before and after the MPC sets the interest rate target. The independent variables are Δr_t^e and Δr_t^u . Then, the equation to be estimated is given by

$$(3) \quad \Delta R_t^h = \alpha + \beta_1 \Delta r_t^u + \beta_2 \Delta r_t^e + \varepsilon_t.$$

Poole, Rasche, and Thornton (2002) proposed the use of future interest rates with greater maturity than used by Kuttner (2001) to segregate non-anticipated reaction of the anticipated. The main argument is that the nearest expiration date of the interbank deposit futures market can be influenced by the noise caused by the more intense correction of interest rate forecast errors.

3. Changes in the Brazilian monetary policy

The supposition of change in the Brazilian financial market after the adoption of inflation targeting is based on the hypothesis that a higher central bank transparency improves the public's comprehension regarding the management of the monetary policy. Due to the central bank's objective of guiding the public's expectation, it is expected that the expectation of a change in the central bank's interest rate setting behavior corresponds to the effective change in the interest rate target. This result would suggest that the communication strategy and the degree of transparency adjust the public's expectation in a better manner.

According to Owens and Webb (2001) the contracts of future interest rates are non-biased forecaster of future interest rates and have been considered a useful instrument for identifying anticipated changes in the monetary policy. It is important to note that there exists a difference between the future market interest rate and the target interest rate in Brazil. The interest rate which represents the tool of monetary policy is the Over/SELIC (overnight rate) while the interest rate which is used in the future markets is the DI-CETIP rate. The Over/SELIC rate is a result of transactions of one workday in the interbank market for federal public bonds. The interest rate which works as a reference for transactions in the Brazilian interbank market is the DI-CETIP rate. The contract negotiated in the Brazilian futures market concerning interest rate considers the average interest rate which represents the expectation of DI-CETIP rate accumulated until the expiration date of the contract. Hence there exists information concerning the behavior of future interest rates.

Due to the fact that the both above-mentioned interest rates are practiced in the interbank market in transactions with banking reserves with maturity of one day, the difference between them is in regard to the credit risk, which in turn is lower in operations with public bonds. In a general way, the credit risk of the transactions among banks with maturity of one day is negligible. As a consequence, in practice, Over/SELIC and DI-CETIP are very closed due to the arbitrage operation in the interbank market.

After the adoption of flexible exchange rate regime in January 1999 and the adoption of inflation targeting in June 1999, Brazil has experienced new practices to conduct its monetary policy.⁸ Under inflation targeting, the central bank's implicit function of guiding public's expectation implies an increase in the accountability concerning information. The objective of increasing the transparency of the CBB is observed in the inauguration speech of the current governor of CBB:

“The production of reports and the release of studies and research is also

⁸ For an analysis of inflation targeting and its performance in Brazil, see de Mendonça (2007).

fundamental aiming at increasing the transparency of the Bank's activities to the public. (...) Thus, the Central Bank will emphasize not only the improvement of statistics and models, but also its transparency and communication.” (Meirelles, 2003, p. 6)

Indeed, although the changes in Presidency of the Republic and in the chairman of CBB during the inflation targeting have occurred, the priority in the stabilization of prices and the increase in the transparency in the conduction of the monetary policy remain. Therefore, there is no doubt that with the adoption of inflation targeting, several measures for increasing the CBB transparency have been adopted. The definition of inflation targets 2 years in advance, the disclosure of inflation reports and the minutes of MPC's meetings, the publication of open letters when the inflation target is not achieved, are examples of practices adopted which increased the transparency of the monetary policy.

The CBB's communication has a regular pattern. The MPC's meetings have been held every 45 days since 2006 (from 1999 to 2005 the meetings were monthly). Two consecutive days are used for the meetings and at the end of the second day the decisions are disclosed. After 5 workdays from the end of the meeting, the MPC's minutes are disclosed explaining the central bank's reasons for its decisions.

It is important to note that the MPC's decisions are quite always unanimous, and the number of votes of the committee is informed in the minute published after each meeting. Based on the classification adopted by Ehrmann and Fratzcher (2007a), the MPC's decisions are collegial as there is no individual exposition concerning decisions.

Therefore, the recent characteristics of the Brazilian monetary policy suggest that there have occurred improvements in transparency and communication. Hence, it is important to analyze if this new behavior of the Brazilian monetary authority implied a change in the reaction of the financial market to MPC's interest rate settings after the adoption of inflation targeting (July 1999). It is expected that the adoption of this monetary strategy increases the public's perception on monetary policy and induces the public's expectation to the targets defined by the central bank. As a consequence, it is supposed that the anticipated reaction to the monetary policy is not negligible in the period.

It is important to highlight that the few communications to the public in the time between the week after MPC's meeting and the next meeting contribute to an analysis of the financial market reaction. The main reason is that the public's expectation regarding changes in the interest rate target is focused on the date close to MPC's meetings. Hence the observation of the variation in the market interest rate, before and after MPC's meetings, can allow the measurement of the degree of anticipated reaction by the financial market.

4. Data and methodology

This study makes an evaluation of the changes in the Brazilian financial market, after the adoption of inflation targeting, inspired in the methodologies suggested by Cook and Hahn (1989) and Kuttner (2001).⁹ The changes in the backward-looking and forward-looking reactions in the Brazilian financial market is based on the observation of the variation in the interest rate practiced in the National Treasury Bills (LTNs) market and in the interbank deposit futures market for the period from July 1999 to

⁹ Another type of analysis which considers the effect of an increase in the central bank transparency on volatility of macroeconomic variables for the Brazilian case is presented by de Mendonça and Simão Filho (2008).

January 2009.

This analysis considers the whole period, and two other periods. The first period from July 1999 to December 2003 and the second from January 2004 to January 2009. The first period is defined as a “maturation period”, that is, the period for adaptation of the financial market to the increase in the transparency of the monetary policy. This period is marked by some instabilities (energy crisis (2001), presidential election (2002), etc.) and by the effort for developing credibility. The second period is defined as a “wisdom period”, which represents a period with domestic macroeconomic stability and the perception of the financial market regarding central bank transparency is greater than the previous period.

The variations in the yields of LTNs (data from BMF&BOVESPA) and of futures market (data from ANBIMA) are achieved taking into account the variation in the interest rates before and after MPC’s announcement of the interest rate target. It is important to note that the number of negotiations in the future market is greater than the negotiations in the LTNs market. Table 1 compares the frequency of negotiations in LTNs market to futures market for July 1999 to January 2009, which corresponds to 103 MPC’s meetings. Each observation regarding the variation of the interest rate considers the existence of negotiations before and after the communication of the interest rate target for each maturity under analysis (from 1 month to 7 months).

Table 1
Frequency of negotiations in LTNs market and futures market (Jul/99- Jan/09)

Maturity	LTNs		Futures	
At most 1 month	LTN0	45	FIR0	103
At most 2 months	LTN1	38	FIR1	101
At most 3 months	LTN2	46	FIR2	97
At most 4 months	LTN3	42	FIR3	85
At most 5 months	LTN4	34	FIR4	35
At most 6 months	LTN5	42	FIR5	45
At most 7 months	LTN6	36	FIR6	37

Based on information gathered from CBB,¹⁰ the changes in the interest rate targets with its respective date and time of disclosure for the public, the non-anticipated and anticipated interest rates (see equations 1 and 2) based on each of the next two expirations dates of the one-day interbank deposit futures market (first and second expiration dates after each MPC’s meeting), are considered.¹¹ Furthermore, taking into account the method proposed by Kuttner (2001), the sensitiveness of the interest rates to anticipations and non-anticipations regarding the interest rate targets based on the first (hereafter “Kuttner1”) and second (hereafter “Kuttner2”) expiration dates of the futures market, permits the identification of the best methodology for evaluating the behavior of the Brazilian financial market.

It is important to highlight that due to the backward-looking characteristic of the analysis proposed by Cook and Hahn (1989) – hereafter “Cook- Hahn” - the response of the interest rate is directly comparable to the unanticipated response in the Kuttner1 and Kuttner2 models. In brief, making use of estimations by OLS method for the three

¹⁰ Available from authors on request.

¹¹ The use of the second expiration date is based on suggestion made by Poole, Rasche, and Thornton (2002).

models (Cook-Hahn, Kuttner1, and Kuttner2), the first step considers the whole period and the second step makes an analysis for the maturation period and for the wisdom period.

5. Empirical evidence

In a general way, independent of the methodology applied, the interest rates in LTNs market with maturity up to 3 months (LTN0 to LTN2) indicate that the coefficients for the response of LTNs rates to changes in the interest rate target are relatively stable and are statistically significant (see table 2). Contrary to this, it is observed that for the interest rates with greater maturity, with the exception of LTN5, the magnitude of the coefficient for the response fall considerably and the statistical significance is eliminated. In brief, while the horizon is increasing the response of interest rates in LTNs market is decreasing. This result is in accordance with that found by Cook and Hahn which denotes that the EHT is valid for short-term interest rates.

Focusing on the models Kuttner1 and Kuttner2 it is possible to identify the behavior of the financial market regarding the announcements of the interest rate target. In other words, if the financial market anticipated or not the MPC's decision on the interest rate target. The results from both models do not present a considerable difference. With exception for the case of LTN0 in Kuttner1, there exists an indication that the unanticipated response is greater than the anticipated response.

With the objective of checking the validity of the result above, a Wald test was performed (see table A.1 – appendix). The findings indicate that the difference between the coefficients of unanticipated and anticipated responses of LTNs to changes in the interest rate target is not significant. As a consequence, it is not possible to assure for this market, taking into account the whole period, a positive effect caused by an increase in transparency and communication.

In the futures market the prices are defined based on the expectation of the futures interest rates and they are used for reducing the exposition of market agents to variation in the interest rate. Therefore, the behavior in this market is different from LTNs which has the objective of financing the federal budget deficits and thus the variation in the interest rate target implies an influence on supply and demand for these bonds. Hence, the analysis concerning anticipation and non-anticipation response of the futures interest rate to changes in the interest rate target also gives information regarding the analysis of the behavior of the Brazilian financial market.

The results present in table 2 suggest that the use of the futures interest rate is better than in LTNs market in the models. In a general way, the statistics are better for the models with futures interest rate (greater R^2 , lower SE, etc.). A possible justification for this result is that other variables can explain the volatility in LTNs market. Such as identified by Owens and Webb (2001), the imbalance between supply and demand caused by public sector borrowing requirements in the National Treasury Bills market can promote this distortion.

The analysis of the Cook-Hahn model for futures interest rates implies different results in regard to those observed for the LTNs market. Contrary to the previous case, the coefficients regarding the response of interest rate to changes in the interest rate target have statistical significance for all maturities (except for FIR6). Therefore, this observation suggests that the changes in the interest rate target matters for the behavior in the futures market.

An important difference concerning the results of Kuttner1 and Kuttner2 models for futures market in relation to LTNs market is that, according to the outcomes of Wald test (see table A.1 – appendix), the hypothesis that there exists difference between the

coefficients of unanticipated and anticipated responses of futures interest rates to changes in the interest rate target is not rejected. Hence, it is possible to conjecture an effect caused by an increase in transparency and communication on the behavior of this market.

The findings in both models (Kuttner1 and Kuttner2) denote that unanticipated responses are dominant over anticipated responses. Moreover, it is observed that the coefficients on responses in Kuttner1 are greater than in Kuttner2 for short horizons (up to 3 months). Notwithstanding, the statistical significances for anticipated and unanticipated responses are very close for both models and the difference in the magnitude of the coefficients is small. As a consequence, the anticipation of MPC's decisions by the Brazilian financial market cannot be neglect.

Table 2*The response of interest rates of LTNs and futures market to changes in the interest rate target (July 1999 to January 2009)*

Maturity	Cook-Hahn					Kuttner1						Kuttner2					
	Intercept	Response	R ²	SE	DW	Intercept	Anticip. response	Unantic. response	R ²	SE	DW	Intercept	Anticip. response	Unantic. response	R ²	SE	DW
LTN0	6.21 (0.82)	41.87 (4.61)***	0.33	50.37	1.79	5.46 (0.70)	42.12 (4.58)***	39.33 (3.68)***	0.33	50.84	1.79	5.63 (0.74)	39.67 (4.25)***	41.02 (4.50)***	0.35	50.32	1.82
LTN1	6.78 (0.63)	53.06 (4.09)***	0.32	65.84	1.68	8.11 (0.73)	52.72 (4.01)***	56.57 (3.79)***	0.32	66.55	1.70	5.67 (0.53)	49.56 (3.65)***	51.06 (3.87)***	0.33	66.01	1.67
LTN2	11.53 (1.37)	41.24 (3.39)***	0.21	56.98	1.59	12.42 (1.45)	41.73 (3.40)***	45.99 (3.20)***	0.21	57.37	1.62	10.52 (1.22)	38.23 (2.91)***	39.20 (3.10)***	0.21	57.36	1.60
LTN3	7.98 (0.89)	10.79 (0.87)	0.02	57.92	1.64	10.55 (1.19)	5.70 (0.45)	17.35 (1.35)	0.08	56.85	1.63	6.03 (0.68)	4.98 (0.39)	7.27 (0.58)	0.07	57.06	1.62
LTN4	6.01 (0.54)	25.19 (1.53)	0.07	65.06	1.58	8.59 (0.78)	17.99 (1.08)	30.84 (1.87)*	0.14	63.60	1.65	4.12 (0.36)	18.79 (1.07)	20.55 (1.21)	0.10	64.99	1.58
LTN5	17.03 (1.92)*	41.69 (3.36)***	0.22	57.31	1.99	17.44 (1.91)*	41.90 (3.33)***	43.68 (3.92)***	0.22	58.00	2.01	16.67 (1.83)*	40.62 (3.03)***	40.97 (3.16)***	0.22	58.00	2.01
LTN6	13.86 (1.42)	13.20 (0.79)	0.02	58.24	2.12	16.24 (1.65)	6.04 (0.35)	16.50 (0.98)	0.07	57.65	2.07	13.03 (1.30)	9.67 (0.52)	10.45 (0.58)	0.02	58.93	2.09
FIR0	3.47 (1.31)	34.71 (9.55)***	0.48	26.75	1.90	4.93 (1.89)*	31.35 (8.49)***	35.67 (10.11)***	0.51	25.96	2.00	3.42 (1.36)	30.49 (8.42)***	32.15 (9.20)***	0.53	25.42	2.00
FIR1	4.42 (1.15)	26.71 (4.94)***	0.20	38.42	1.78	5.97 (1.56)	23.17 (4.20)***	28.16 (5.29)***	0.23	37.73	1.79	4.26 (1.16)	21.15 (3.88)***	23.31 (4.43)***	0.27	36.86	1.81
FIR2	5.95 (1.36)	26.29 (4.50)***	0.18	42.78	1.75	7.46 (1.70)*	22.94 (3.80)***	27.50 (4.75)***	0.20	42.33	1.77	5.71 (1.35)	20.88 (3.53)***	23.10 (4.05)***	0.24	41.32	1.79
FIR3	5.09 (0.98)	18.49 (2.49)**	0.07	46.64	2.37	6.08 (1.21)	7.55 (0.93)	16.66 (2.35)**	0.15	44.89	2.29	3.69 (0.74)	9.60 (1.27)	12.43 (1.71)*	0.17	44.37	2.29
FIR4	-5.32 (-0.85)	15.82 (1.83)*	0.09	36.52	1.62	-2.85 (-0.49)	0.37 (0.04)	8.37 (1.03)	0.27	33.33	1.41	-5.20 (-0.81)	13.05 (1.31)	13.47 (1.41)	0.10	37.01	1.61
FIR5	6.71 (1.30)	44.59 (5.72)***	0.43	34.41	2.30	9.83 (1.91)*	43.50 (5.86)***	50.06 (6.13)***	0.48	33.48	2.29	7.70 (1.70)*	36.82 (5.35)***	40.11 (5.97)***	0.58	30.08	2.27
FIR6	7.83 (0.76)	7.42 (0.56)	0.01	62.21	2.39	10.99 (1.11)	-11.75 (-0.76)	8.70 (0.70)	0.13	59.16	2.59	6.25 (0.62)	-2.47 (-0.17)	0.20 (0.01)	0.08	60.91	2.81

Note: The change in the interest rate target is expressed in percent, and the interest rate changes are expressed in basis points. Anticipated and unanticipated changes in the interest rate target are computed from the future interest rates, as described in the text. Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.1. t-statistics in parentheses.

5.1. Empirical evidence from maturation and wisdom periods

This section analyzes the results for the response of futures interest rates to changes in the interest rate target for two distinct periods: (i) maturation period - from July 1999 to December 2003; and (ii) wisdom period – from January 2004 to January 2009. The analysis for these periods considers only the responses of interest rates in the futures market due to two main reasons: (i) the number of observations regarding the variation of the interest rates in LTNs market becomes very reduced for both periods; and (ii) the models which used the futures market for the whole period presented a greater capacity of explanation regarding the responses of interest rates.

Table 3 shows the number of observations between maturation and wisdom periods regarding the number of interest rate changes in basis points for futures interest rates before and after every of MPC's 103 meetings. The objective of splitting the whole period is an attempt to perceive if the CBB's behavior based on more transparency allows the financial market to have a better perception of its actions. Due to the fact that this process takes time, it is probable that the results regarding the wisdom period present a better quality in comparison to that from maturation period.

Table 3

Frequency of negotiations in futures market – Maturation and Wisdom periods

Maturity		Whole period	Maturation period	Wisdom period
At most 1 month	FIR0	103	54	49
At most 2 months	FIR1	101	53	48
At most 3 months	FIR2	97	52	45
At most 4 months	FIR3	85	47	38
At most 5 months	FIR4	35	24	11
At most 6 months	FIR5	45	25	20
At most 7 months	FIR6	37	20	17

Note: Whole period is from July 1999 to January 2009. Maturation period is from July 1999 to December 2003. Wisdom period is from January 2004 to January 2009.

The results of the estimations are presented in table 4. Focusing on the Cook-Hahn model, the estimations denote that the responses of futures interest rates to changes in the interest rate target are strongest for the maturation period when short horizons are considered. Taking into consideration horizons greater than 3 months, the response is greater for the wisdom period (exception is FIR5). Moreover, it is important to highlight that the wisdom period presents higher R^2 and lower standard errors.

A possible interpretation for the result above is that the disclosure of the interest rate target in the period when the public has more capacity to perceive the central bank actions (that is, the wisdom period), it is important to guide futures interest rates with longer maturities. On the other hand, while the information is not well comprehended by the market (that is, the maturation period), the disclosures of the interest rate target cause an impact basically on futures interest rates of short maturity.

Such as observed from the results in the Cook-Hahn model, the results observed in Kuttner1 model indicate that the difference between maturation and wisdom periods cannot be neglected. The wisdom period shows higher R^2 and lower standard errors for

all horizons, which in turn, indicates more confidence in the estimations. The standard errors in wisdom period are close to that found by Cook and Hahn (1989) and Kuttner (2001) for the American financial market. As a consequence, the lower standard errors can reveal a better comprehension of the financial market in regard to the central bank actions.

The apparent surprising result is that the difference between the coefficients on anticipated and unanticipated responses is greater in the wisdom period than maturation period. However, it is important to note that the confidence of the outcomes observed in the maturation period is questionable due to the high standard errors of regressions. In addition, one very important observation is regarding the results from Wald tests. While for the maturation period, the tests indicate that there is no difference between the coefficients of non-anticipation and anticipation responses of futures interest rates to changes in the interest rate target for several horizons, in the wisdom period the difference between them is assured for all horizons. Hence, although the unanticipated response is greater than the anticipated response in this model, it is possible to assure that the use of the EHT is more adequate for the wisdom period. Last but not least, in a general way, the outcomes in the Kuttner2 model do not present significant differences in comparison to those observed in Kuttner1 model.

Table 4*The response of futures interest rates to changes in the interest rate target (Maturation and Wisdom periods)*

Maturity	Cook-Hahn					Kuttner1						Kuttner2						
	Intercept	Response	R ²	SE	DW	Intercept	Anticip. response	Unantic. response	R ²	SE	DW	Intercept	Anticip. response	Unantic. response	R ²	SE	DW	
Maturation period	FIR0	4.42 (0.92)	37.73 (7.20)***	0.51	35.37	1.88	7.53 (1.54)	34.37 (6.47)***	38.74 (7.58)***	0.53	34.48	1.99	4.84 (1.04)	33.54 (6.38)***	35.11 (6.91)***	0.55	33.94	1.96
	FIR1	5.5 (0.76)	29.17 (3.59)***	0.20	52.42	1.77	8.78 (1.19)	25.66 (3.11)***	30.66 (3.83)***	0.24	51.80	1.78	5.81 (0.83)	23.60 (2.87)***	25.66 (3.22)***	0.26	50.85	1.79
	FIR2	7.15 (0.89)	27.68 (3.23)***	0.17	57.83	1.74	10.22 (1.23)	24.48 (2.76)***	28.86 (3.38)***	0.20	57.61	1.76	7.44 (0.95)	22.38 (2.56)**	24.47 (2.90)***	0.23	56.44	1.77
	FIR3	6.06 (0.65)	18.53 (1.72)*	0.06	62.02	2.39	8.93 (0.98)	7.29 (0.61)	16.32 (1.57)	0.14	60.19	2.32	4.56 (0.51)	9.22 (0.83)	11.95 (1.12)	0.15	59.66	2.30
	FIR4	-11.77 (-1.39)	14.43 (1.42)	0.08	40.81	1.63	-7.96 (-0.99)	-0.64 (-0.06)	6.71 (0.69)	0.25	37.82	1.38	-11.51 (-1.31)	11.80 (0.99)	12.12 (1.06)	0.08	41.82	1.63
	FIR5	4.77 (0.54)	50.82 (4.45)***	0.46	44.29	2.30	11.08 (1.21)	50.04 (4.60)***	57.48 (4.70)***	0.51	43.42	2.24	8.72 (1.10)	42.13 (4.17)***	45.49 (4.60)***	0.60	39.25	2.16
	FIR6	14.43 (0.76)	6.06 (0.31)	0.01	85.29	2.42	21.15 (1.13)	-14.39 (-0.63)	8.87 (0.48)	0.14	81.53	2.71	10.53 (0.54)	-3.54 (-0.16)	-1.00 (-0.05)	0.07	85.02	2.82
Wisdom period	FIR0	1.41 (0.99)	18.72 (5.62)***	0.40	9.80	1.73	0.84 (0.71)	11.30 (3.53)***	20.15 (7.21)***	0.59	8.17	2.15	0.80 (0.66)	13.76 (4.47)***	16.19 (5.56)***	0.57	8.39	2.09
	FIR1	2.35 (1.66)	14.53 (4.41)***	0.30	9.68	1.81	1.64 (1.55)	5.77 (2.05)**	16.19 (6.60)***	0.62	7.17	2.39	1.56 (1.51)	8.17 (3.17)***	11.28 (4.63)***	0.64	7.01	2.39
	FIR2	4.07 (2.29)**	18.38 (4.46)***	0.32	11.74	1.72	2.87 (2.18)**	8.12 (2.36)**	21.87 (7.13)***	0.64	8.59	2.35	2.86 (2.11)**	11.38 (3.43)***	14.97 (4.75)***	0.62	8.82	2.35
	FIR3	3.94 (1.62)	18.72 (3.25)***	0.23	14.35	1.96	2.12 (1.11)	5.67 (1.11)	21.78 (4.90)***	0.56	10.99	2.00	2.70 (1.41)	11.92 (2.55)**	15.89 (3.53)***	0.55	11.15	2.20
	FIR4	8.70 (1.30)	22.00 (1.24)	0.15	21.90	2.13	3.94 (0.78)	-5.88 (-0.38)	36.39 (2.68)**	0.61	15.69	2.33	5.30 (0.85)	14.52 (0.89)	21.08 (1.33)	0.40	19.41	1.37
	FIR5	6.66 (2.16)**	24.18 (3.76)***	0.44	13.34	1.32	6.24 (2.27)**	18.26 (2.94)***	26.80 (4.62)***	0.58	11.84	1.59	4.30 (1.74)*	16.53 (3.07)***	19.74 (3.87)***	0.69	10.29	1.99
	FIR6	0.45 (0.14)	13.56 (2.00)*	0.21	12.89	1.69	0.15 (0.06)	-2.23 (-0.28)	10.70 (1.86)*	0.49	10.75	2.60	2.47 (0.76)	3.75 (0.42)	7.31 (0.96)	0.33	12.28	1.79

Note: The change in the interest rate target is expressed in percent, and the interest rate changes are expressed in basis points. Anticipated and unanticipated changes in the interest rate target are computed from the future interest rates, as described in the text. Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.1. t-statistics in parentheses.

6. Concluding remarks

The empirical analysis of changes in the Brazilian financial market behavior after adoption of inflation targeting, reveals that the use of the interest rate of futures market is better than interest rates of LTNs market in the three models considered (Cook-Hahn, Kuttner1, and Kuttner2). Moreover, taking into account the results from Kuttner1 and Kuttner2 models, the difference between unanticipated and anticipated responses of futures interest rates to changes in the interest rate target is not negligible. Notwithstanding, it is not possible to state that there exists an increase in the anticipation of the financial market to the central bank actions. The macroeconomic stabilization and the presence of the inflation targeting are permitting a better comprehension of the market agents, but this perception is not clearly observed through anticipation of MPC's decisions.

The analysis concerning the response of futures interest rates to changes in the interest rate target for the maturation period and the wisdom period deserves attention. Based on the results from Cook-Hahn model, the maturation period is relevant only for short horizons while the wisdom period is also relevant for extended horizons. As a consequence, it is possible to conjecture that in the wisdom period the central bank is successful for influencing the expectations and thus increasing the capacity for setting the futures interest rates with longer maturities.

Kuttner1 and Kuttner2 models do not present significant differences between themselves for the analysis of maturation and wisdom periods. In a general way, the wisdom period presents higher R^2 and lower standard errors for all horizons and thus indicates more confidence in the estimations. Furthermore, in the wisdom period the difference between non-anticipation and anticipation responses of futures interest rates to changes in the interest rate target is assured for all horizons. Although it is observed in the estimations that the unanticipated response is greater than the anticipated response, it is possible to assure that the EHT is more adequate in this period.

Therefore, the results from the Brazilian financial market are in consonance with the idea that a higher degree of central bank transparency can improve the efficiency of EHT. The findings indicate that the reaction of the financial market to changes in the interest rate target is not negligible. In particular the fall in the standard errors for estimations in the wisdom period suggest that CBB's behavior over time has increased the capacity of market agents to forecast the MPC's decisions. In other words, in the Winkler's (2000) sense, CBB seems honest with the disclosure of information and in the settings of the interest rate target.

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Appendix

Table A.1

Wald tests of the $\beta_1 = \beta_2$ restriction (equation 3)

	Whole period		Maturation period		Wisdom period	
	<i>Kuttner1</i>	<i>Kuttner2</i>	<i>Kuttner1</i>	<i>Kuttner2</i>	<i>Kuttner1</i>	<i>Kuttner2</i>
LTN0	0.215 (0.645)	1.082 (0.304)	-	-	-	-
LTN1	0.240 (0.627)	0.823 (0.371)	-	-	-	-
LTN2	0.403 (0.529)	0.412 (0.525)	-	-	-	-
LTN3	2.516 (0.121)	2.212 (0.145)	-	-	-	-
LTN4	2.488 (0.125)	1.076 (0.308)	-	-	-	-
LTN5	0.060 (0.809)	0.051 (0.822)	-	-	-	-
LTN6	1.698 (0.202)	0.205 (0.654)	-	-	-	-
FIR0	7.014 (0.009)	11.584 (0.001)	3.625 (0.063)	5.374 (0.025)	21.648 (0.000)	18.163 (0.000)
FIR1	4.415 (0.038)	9.258 (0.003)	2.102 (0.153)	4.066 (0.049)	38.807 (0.000)	42.713 (0.000)
FIR2	2.896 (0.092)	7.709 (0.007)	1.298 (0.260)	3.418 (0.071)	38.288 (0.000)	34.219 (0.000)
FIR3	7.516 (0.008)	9.610 (0.003)	3.709 (0.061)	4.557 (0.038)	26.330 (0.000)	24.631 (0.000)
FIR4	7.692 (0.009)	0.204 (0.654)	4.781 (0.040)	0.086 (0.772)	9.534 (0.015)	3.455 (0.100)
FIR5	3.782 (0.059)	14.730 (0.000)	2.397 (0.136)	7.866 (0.010)	5.858 (0.027)	13.249 (0.002)
FIR6	4.620 (0.039)	2.440 (0.128)	2.643 (0.122)	1.063 (0.317)	7.582 (0.016)	2.534 (0.133)

Note: F-statistics are accompanied by P-values (between parentheses).