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The Economic Determinants of the Brazilian Nominal Term Structure of Interest Rates

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THE ECONOMIC DETERMINANTS OF THE BRAZILIAN NOMINAL TERM STRUCTURE OF INTEREST RATES

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ABSTRACT

The purpose of this study is to identify the effects of monetary policy and macroeconomic shocks on the dynamics of the Brazilian term structure of interest rates. We estimate a near-VAR model under the identification scheme proposed by Christiano *et al.* (1996, 1999). The results resemble those of the US economy: monetary policy shocks flatten the term structure of interest rates. We find that monetary policy shocks in Brazil explain a significantly larger share of the dynamics of the term structure than in the USA. Finally, we analyze the importance of standard macroeconomic variables (e.g., GDP, inflation, and measure of country risk) to the dynamics of the term structure in Brazil.

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1. INTRODUCTION

Dates of meetings of the Brazilian Monetary Policy Committee (COPOM) and the announcements of targets for the overnight interest rate Selic[1] are special days in the calendar of Brazilian financial market players. Decisions about a new target for the Selic rate frequently cause strong reactions regarding financial assets, especially the term structure of interest rates. Fleming and Remolona (1997) found that days of announcements of decisions about monetary policy and relevant macroeconomic aggregates coincide with increased volatility of all markets' interest rates in the US financial market.

One important reason to study the factors that impact the dynamics of the term structure lies in its significance as a mechanism of monetary policy transmission. The capacity of a central bank to conduct a successful monetary policy is intrinsically linked to its power to influence--through the overnight interest rate as well as through indications of future movements of this same rate--the market's term structure of interest rates, which in turn influence real economic activity. The Central Bank of Brazil's Inflation Report (Dec. 2002) acknowledges that the market's interest rates influence the aggregate demand channel, which is one of the most important channels of monetary transmission.

[1] The Selic Rate is the overnight interest rate used by the Brazilian Central Bank for the conduct of its monetary policy. See the Appendix for a graphic of this rate during the period of analysis.

Simultaneously, one of the most important fields of research in finance is to determine what factors are responsible for movements of the term structure of interest rates. Nevertheless, the literature that relates those movements to observable macroeconomic variables is still incipient. The majority of the literature assumes that movements of the term structure of interest rates are related to non-observable factors.[2] Of all the possible determinants of the term structure, monetary policy seems to be the natural starting point to bridge the gap between finance and macroeconomics.

The main objective of this paper is to analyze how observable macroeconomic variables, especially monetary policy, affect the market's interest rates, as well as factors that compose the Brazilian term structure of interest rates. For that purpose, we use an approximation of the monetary policy reaction function within a near-vector autoregressive model, in a spirit close to that of Evans and Marshall (1998, 2001).

Brazilian interest rates have ranked among the world's highest since the Real Plan successfully brought inflation to single digits in June 1994. Between January 1995 and January 1999, during the crawling peg exchange rate regime, interest rates reacted heavily to external shocks (e.g., during the Mexican tequila crisis and the Asian and Russian crises), resulting in highly volatile overnight interest rates, as well as longer maturity rates, as the one-year fixed rate swap. Figure 1 in the Appendix [.1]presents the behavior of those two rates during the period of analysis. Since the abandonment of the crawling peg exchange rate in January 1999 and the subsequent adoption of an inflation targeting regime, interest rates have been lower and less volatile. Even so, Brazilian

[2] For example, see Litterman and Scheinkman (1991); Knez, Litterman, and Scheinkman (1994); Dai and Singleton (2000).

interest rates are still one of the highest among developing countries.[3] The study of the market's responses to a variety of macroeconomic shocks constitutes an important step towards a better understanding of the dynamics of interest rates in Brazil.

The organization of the paper is as follows. The next section briefly describes the literature that relates macroeconomic variables to the dynamics of the term structure. The third section describes the empirical methodology and discusses the identification of the model. Section 4 presents the results, and Section 5 concludes.

2. A BRIEF REVIEW OF THE LITERATURE

The literature that relates the dynamics of market rates to macroeconomic factors is relatively recent. Evans and Marshall (1998) studied the extent to which movements of the term structure can be explained by exogenous impulses of monetary policy and other macroeconomic variables (e.g., product and inflation). They used a VAR model under different identification schemes, such as those popularized by Christiano *et al*. (1996, 1999) and Galí (1992). Notwithstanding the different identification schemes, this study revealed that impulsive reactions to monetary policy have a significant impact on short-term rates. However, monetary policy shocks do not cause a parallel shift of the term structure; instead, they are followed by a flattening of the term structure. Based on that observation, the researchers extracted a quadratic approximation from the term structure to obtain measures of level, declivity, and curvature of the term structure. Including those measures on the estimated models, they

[3] See Muinhos and Nakane (2006) for a comparison between Brazilian equilibrium real interest rate and international ones.

verified that monetary policy shocks are responsible, to a great extent, for the variance of the declivity factor of the term structure in the US.

Wu (2001, 2003) used a VAR model similar to that of Evans and Marshall (1998) under the identification scheme of Sims and Zha (1995) to extract the exogenous components of monetary policy and link them to the term structure. He also estimated a Taylor rule by the generalized method of moments (GMM) and used its residuals as a second measure of non-systematic monetary policy. After relating those measures to the term structure, Wu corroborated the results of Evans and Marshall (1998), and concluded that monetary policy is the major force behind movements of the declivity factor of the term structure.

Ang and Piazzesi (2003) introduced two observable macroeconomic factors in an affine model of the term structure. The first factor is the first principal component extracted from a large set of economic activity measures, and the second one is similarly extracted from a set of price indexes. These researchers found that those macroeconomic factors are responsible for almost 85% of the long-term variance of short-term yields, but have a much less significant effect on long-term interest rates. Consequently, they shift the declivity of the term structure, but not its level.

Evans and Marshall (2001) sought to identify the effects of macroeconomic shocks on the term structure. For that purpose, they estimated a vector-autogression with short- and long-run restrictions (Galí, 1992). These researchers also made use of theoretic model measures of shocks, such as the ones proposed by Basu, Fernald, and Shapiro (2001 a, b) for technology shocks and Blanchard and Perotti (2000) for fiscal shocks, and a measure of marginal rate of substitution shocks, similar to that proposed by Hall (1997).

Diebold *et al.* (2005) estimated a model in state-space form for the term structure of interest rate, where the dynamics of the term structure is formulated in terms of non-observable factors (i.e., level, declivity, and curvature), as well as observable macroeconomic factors (i.e., economic activity, stance of monetary policy, and inflation.). Unlike the others, this model allows a bi-causal relationship between the term structure and macroeconomic variables. Hence, the authors were able to test whether the relation flows from the term structure to macroeconomic factors, or vice versa. Interestingly, their research revealed evidence of a strong effect of macroeconomic variables on the dynamics of the term structure but a weak effect of the term structure on macroeconomic variables.

A number of other studies have focused on the relation of monetary policy and long-term interest rates within a regression-based approach, initiated by Cook and Hahn (1989) and further developed by Kuttner (2001). The findings of these studies were similar: unanticipated monetary policy movements have minimal effects on long-term interest rates. Larraín (2005) applied the methodology proposed by Kuttner to Chile´s long-term inflation-linked bond rates (2001) and found that long-term rates had little effect on expected and unexpected monetary policy actions, although he did find a deeper effect for unpredicted monetary policy movements.

Seeking to quantify the effects of systematic monetary policy, Leeper, Sims, and Zha (1996) and Bernanke, Gertler, and Watson (1997) also included long-term interest rates in their models. Although they used different methodologies, these researchers' results were qualitatively similar to those of other works and to the present study.

3. IDENTIFICATION

First, we assume that the monetary policy instrument is the overnight interest rate, Selic (S_t), determined by the COPOM. We assume that S_t is determined by a rule of the following form:

$$S_t = \psi(\Omega_t) + \sigma\varepsilon_t \,, \tag{1}$$

where Ω_t denotes the set of information available to the monetary authority in period t, ψ is a linear function that describes the reaction of the monetary policy to the estate of the economy, ε_t is an exogenous shock to the monetary policy with unit variance, and σ is a scalar parameter. The monetary policy reaction function incorporates the preferences of the monetary authority regarding stabilization policies and inflation aversion. The residual, ε_t, reflects random nonsystematic factors that affect policy decisions (e.g., the personalities and view of central bank governors, and political factors), as well as technical factors (e.g., measurement errors in macroeconomic time series) (see Bernanke and Mihov, 1996). By decomposing the overnight Selic rate between components explained by economic factors and another random one, we may use the latter to identify the effects of monetary policy on macroeconomic variables and on the term structure of interest rates.

We consider the effects of monetary policy shocks on nominal interest rates of different maturities. Let Z_t be a vector of macroeconomic variables at period t and R_t^j be a nominal interest rate of maturity j. The monetary policy rule (1) can be estimated as one of the following near–VAR:

$$\begin{bmatrix} a & b \\ c & 1 \end{bmatrix} \begin{bmatrix} Z_t \\ R_t^j \end{bmatrix} = \begin{bmatrix} A(L) & B(L) \\ C(L) & D(L) \end{bmatrix} \begin{bmatrix} Z_{t-1} \\ R_{t-1}^j \end{bmatrix} + \sigma \begin{bmatrix} \varepsilon_t^Z \\ \varepsilon_t^j \end{bmatrix} \qquad (2)$$

In this equation, a is a square matrix with 1 on the diagonal; b is a scalar; c is a line vector; $A(L)$ is a polynomial matrix on the lag operator L; $C(L)$ is a line polynomial vector; and $D(L)$ and $C(L)$ are polynomial scalars. The error terms are *i.i.d.* processes of shocks mutually non-autocorrelated; the variance is an identity matrix; and σ is a diagonal matrix.

Throughout this paper, we assume that $b = 0$ and $B(L) = 0$, such that contemporaneous and past values of the term structure are not allowed to impact the macroeconomic block Z_t of the model. In this way, we assure that the identified monetary policy shocks are invariant to the maturity j of the different rates included in the model, as in Marshall and Evans (1998, 2001) and Wu (2001, 2003).

The data vector, as well as its ordering, is given by $Z_t = (IP_t, P_t, CBOND_t, S_t, M_1)$, where *IP* denotes industrial production, *P* denotes the price level measure by the *IPCA*[4] index, *CBOND* denotes the spread of the *CBOND*[5] to the US bond of the same maturity as a measure of country risk, *S* denotes the overnight Selic rate, and *M1* denotes the monetary aggregate M1.

[4] The consumer price index IPCA released by the Brazilian Institute of Geography and Statistics is the official price index pursued by the Central Bank of Brazil in its inflation-targeting framework.
[5] The CBOND was the most-traded Brazilian external debt bond during the period of analysis.

Minella (2003) argues in favor of the inclusion of a measure of country risk when estimating the channels of monetary policy in Brazil, given the fact that monetary policy has had to react strongly to external shocks in the recent past. Also, the country risk is a forward-looking variable that seems to play the same role as commodity price indexes do on the transmission mechanism of monetary policy in developed countries. The omission of this variable often leads to the so-called price puzzle (i.e., a positive reaction of inflation after a monetary policy shock).

Therefore, the reaction function identified is given by:

$$S_t = A_4(L)Z_{t-1} - a_{41}PI_t - a_{42}INF_t - a_{43}CBond_t + \sigma_{44}\varepsilon_t^Z, \qquad (3)$$

where $A_4(L)$ is the fourth line of the polynomial $A(L)$ and a_{ji} denotes o $(i,j)^{th}$ element of the a matrix. The monetary policy shock ε_t is the fourth element of ε_t^Z. We assume that it is orthogonal to all variables on the right-hand side of the equation.

In order to investigate more deeply the effect of macroeconomic variables--especially that of monetary policy--on the dynamics of the term structure, we obtain approximations of the level, declivity, and curvature factors, following the methodology of Ang and Piazzesi (2001). As a measure of the level of the term structure, the authors use the arithmetic mean of the one-, twelve-, and sixty-month rates. Adapting the structure to our dataset, we use the mean of the one-, six-, and twelve-month rates. Our measure of declivity is given by the spread of the twelve-month rate to the one-month rate. Lastly, the curvature measure is given by the sum of the one-month and twelve-month rates, less the six-month rate.

In the following section, we make use of those factors to infer how monetary policy and other macroeconomic variables influence the dynamics of the Brazilian term structure of interest rates.

4 RESULTS

The VARs are estimated with monthly data for the period of January 1995 to December 2003. Six lags are used in each equation, in order to obtain white noise residuals and to allow a lag structure rich enough to take into account all the dynamics between the variables.

4.1 Response of Macro Variables to a Monetary Policy Shock

Figure 2 plots the effects of a one-standard-deviation monetary policy shock on macro variables.

[INSERT FIGURE 2 ABOUT HERE]

The effects of a monetary policy-tightening are the expected ones: a monetary policy shock has a significant negative effect on industrial production. It reaches its maximum effect five to six months after the shock. Eleven months later, point estimates are once more equal to zero. Following a monetary policy shock, the price level slowly declines after the two first months. After nine months, this fall reaches its maximum. After this period, the monetary policy shock is no longer statistically significant. As one would also expect, a positive monetary policy shock raises the overnight interest rate, Selic. It is noteworthy that this effect is significant even five months after the shock, revealing a high degree of persistence of the Brazilian overnight interest rate. Lastly, a monetary policy-tightening decreases the stock of money in the economy.

Also noteworthy is the fact that a tightening of monetary policy causes the so-called liquidity effect, since money and interest rates respond in opposite ways after the shock (Christiano *et al.*, 1999).

4.2 The Impact of Monetary Policy Shocks on the Term Structure

This section traces the response of the term structure of interest rate to the monetary policy shocks identified above. For that purpose, we use one-month, three-month, six-month, and twelve-month nominal fixed swap rates.

[INSERT FIGURE 3 ABOUT HERE]

A decrease in the impact of monetary policy shocks is apparent with rates of longer maturities (Fig. 3). But the larger difference between the estimates lies in their statistical significance. Monetary policy shocks have a statistically significant impact on the one-month interest rate for more than five months. In contrast, the significance of the impact on the twelve-month interest rate barely lasts two months.

In summary, no parallel shift in the term structure follows a monetary policy shock. On the contrary, shocks have a stronger, more significant impact on short-term interest rates, making the term structure flatter. Marshall and Edelberg (1996), Evans and Marshall (1998, 2001), and Wu (2001, 2003) found qualitatively similar results for the term structure of interest rates in the USA.

In order to measure the importance of the overnight interest rate in the dynamics of the Brazilian term structure, we present in Table 1 the results of the forecast error variance decomposition.

[INSERT TABLE 1 ABOUT HERE]

As Table 1 indicates, monetary policy shocks are responsible for almost three-quarters of the conditional variance of the one-month interest rate one month after its initial impact. If we interpret the two-years-ahead conditional variance as a proxy for the unconditional variance, we see that monetary policy shocks are responsible for nearly half of the long-term variance of the one-month rate. Those numbers are considerably larger than those for the US economy. Evans and Marshall (1998) found that monetary shocks are responsible for only 7% of the unconditional variance of one-month rates in the USA.

The relative importance of monetary policy shocks declines as we consider longer-term rates, as indicated by the impulse response functions. But those shocks are still responsible for a noteworthy share of the unconditional variance even for the twelve-month interest rate. For that maturity, we find an initial percentage of 35%, which falls to 12% after two years. In general, monetary policy shocks seem to be relatively more important in the dynamics of the term structure in Brazil than in the U.S.

The impulse response functions and the variance decompositions suggest, as noted by Evans and Marshall (1998) and Wu (2001), that the monetary policy shocks resemble the slope factor identified by Litterman and Scheinkman (1991). Since monetary policy shocks do not cause a parallel shift in the term structure, they should be responsible for a change in its declivity.

For a clearer understanding of the effects of monetary policy shocks on the dynamics of the Brazilian term structure of interest rates, we estimate impulse response functions as well as variance decompositions of the three factors, as presented by Ang and Piazzesi (2001).

[INSERT FIGURE 4 ABOUT HERE]

As Fig. 4 reveals, the response of the level factor to an exogenous impulse in monetary policy is similar to that of the one-month interest rate. That is, a monetary policy shock has a positive effect on the level of the term structure that lasts approximately six months.

The impulse response functions indicate that a monetary policy shock does not have a symmetric impact on the term structure, since the shock to long-term interest rates is less significant than the shock to short-term interest rates. Thus, it is expected that monetary policy shocks flatten the term structure. Figure 5 plots the response of the declivity factor to an impulse in monetary policy. As anticipated, a shock to monetary policy reduces the declivity of the term structure. This effect seems to last four to six months--approximately the same extent of the monetary policy effect on short-term maturity rates, such as the one-month rate.

[INSERT FIGURE 5 ABOUT HERE]

Finally, we present the impulse response functions of the curvature to the monetary policy shocks identified (Fig. 5[.2]). A small increase in the curvature of the term structure follows a monetary policy shock, as Evans and Marshall (1998) and Wu (2003) found.

[INSERT FIGURE 6 ABOUT HERE]

We examine more precisely the relative importance of monetary impulses to the dynamics of the three factors, through the analysis of the variance decomposition of the term structure. Table 2 reveals the share of the conditional variance of the term structure that can be attributed to monetary policy shocks.

[INSERT TABLE 2 AROUND HERE]

Monetary policy shocks are the most important shocks behind the unconditional variance of the declivity factor, being responsible for more than half of its variance. Monetary policy shocks also explain a significant share of the level and curvature variance, in particular.

4.3 The Importance of other Macroeconomic Variables

This section analyzes the contribution of other macroeconomic variables to the dynamics of the term structure.

4.3.1 The Impact of Country Risk

We use the model described in Section 2 to study the effects of other macroeconomic shocks that may influence the dynamics of the term structure. Figure 7 indicates the impact of a country risk shock, measured by the spread of the C-Bond.

[INSERT FIGURE 7 ABOUT HERE]

The relative importance of country risk shocks increases monotonically along with term structure maturity. Again, the main difference between the responses of the term structure seems to be in their statistical significance. While the response of the one-month interest rate is significant for only four months, that of the twelve-month interest rate is significant for eight months.

Table 3 illustrates the percentage of the forecast error variance decomposition due to the country risk shock. The relative importance of country risk shock to the dynamics of interest rates grows monotonically as the maturity of the interest rate increases. While country risk shocks explain approximately 10% of the unconditional variance of one-month rates, this percentage reaches 40% with the twelve-month rate. Hence, country risk shocks seem to be the most important determinant of twelve-month rates in Brazil.

[INSERT TABLE 3 AROUND HERE]

For a more detailed understanding of the importance of such shocks to the dynamics of interest rates in Brazil, we verify their effects on each of the factors that compose the term structure.

Country risk shocks seem to be an important feature for the determination of the level of interest rates in Brazil (Table 4). [.3]The two other factors, declivity and curvature, do not seem to be significantly explained by shocks to the country risk. Interestingly, country risk shocks have exactly the opposite effect as monetary policy shocks on the term structure: they make the term structure more inclined. An initial explanation of this fact may be found in the response of inflation to each of the two shocks. Whereas monetary policy shocks are associated with a fall of future inflation, country risk shocks are expected to have a positive shock on inflation through devaluation of the exchange rate.

4.4.2 The Impact of Product and Inflation

Evans and Marshall (1998, 2001) and Wu (2001, 2004) found that a noteworthy share of long-term interest rates can be explained by product shocks. Approximately 20% of the unconditional variance of the twelve-month interest rate can be attributed to product shocks. As Table 5 reveals, this share is similar to that of the Brazilian case. It is interesting to note that the proportion of variance due to the product shock is similar across the term structure.

[INSERT TABLE 5 AROUND HERE]

Another similarity between the results of this paper and the studies of the US economy lies in the low predictive power of (past) inflation for the movements of the term structure. Evans and Marshall (1998, 2001) and Wu (2001, 2003) determined that approximately 3% to 5% of the variance of the term structure may be explained by inflation shocks; for our case, the estimated proportion is not statistically significant.

Considering these results, it would be interesting to determine the share of the unconditional variance of the twelve-month interest rate of Brazil that may be explained by macroeconomic shocks. Table 6 compares the results for the Brazilian and US economies, as found by Evans and Marshall (2001) and Ang and Piazzesi (2003).

[INSERT TABLE 6 ABOUT HERE]

The contribution of macroeconomic shocks for the variance of the twelve-month interest rate is similar for both economies. The importance of macroeconomic shocks increases with rates of longer maturities. Table 7 reveals the variance attributed to macroeconomic variables for the Brazilian term structure.

[INSERT TABLE 7 ABOUT HERE]

While macroeconomic shocks are responsible for about 55% of the variance of the one-month rate, this share increases to almost 85% for the twelve-month rate. Hence, we may conclude that as the term structure of interest rates in Brazil increases its maturity, the importance of macroeconomic factors to its dynamics will increase.

5. CONCLUSION

The aim of this paper is to discuss the economic determinants of the Brazilian term structure of interest rates. For that purpose, we have estimated a near–VAR model in which the macroeconomic block has an effect on the term structure, but the latter is not allowed to impact the former. Thus, we assure that the monetary policy and macroeconomic shocks are invariant to the maturity and factors of the term structure. We have found that monetary policy shocks are responsible for an important share of the Brazilian term structure dynamics. Those shares are, in general, significantly larger than those of the US economy. In accordance with the international literature, we have confirmed that monetary policy shocks are especially important for the dynamics of the declivity factor of the term structure. Consequently, monetary policy shocks flatten the term structure.

Additionally, the importance of other standard macroeconomic variables (e.g., country risk and industrial production) was investigated. Among the standard macroeconomic variables responsible for the dynamics of the Brazilian term structure, industrial production shocks seem to be the most important. This paper analyzes the dynamics of interest rate markets, focusing on shocks that typically affect emerging market economies (e.g., country risk shocks).

Future extensions of the current paper may opt for different identification structures, such as that proposed by Galí (1992). By using a vector autoregression approach, we have aimed to identify the stylized facts of the dynamic relation between macroeconomic variables and the term structure of interest rates, with a special emphasis on monetary policy. It is not our objective to derive a pricing model of the term structure. Based on the stylized facts discussed in this paper, future research may focus on a term structure model with observable macroeconomic factors, in order to investigate the dynamics of the Brazilian term structure.

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APPENDIX[.4] 1 – FIGURES

FIGURE 1: The Selic Rate and th e Tw elve-Month Fixed Interest Rate

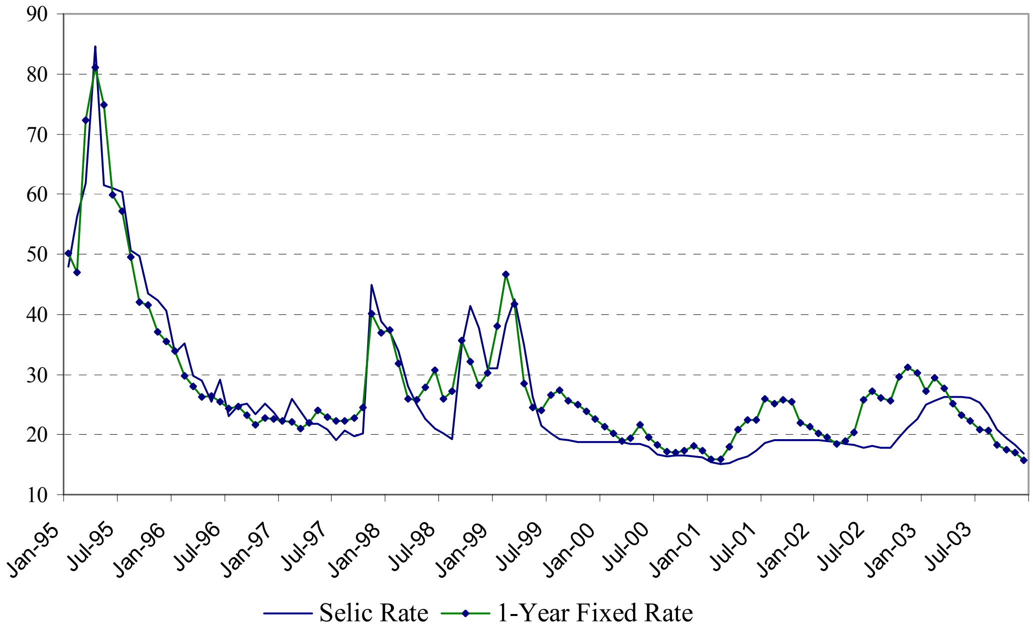


FIGURE 2: Response of Macro Variables to a Monetary Policy Shock

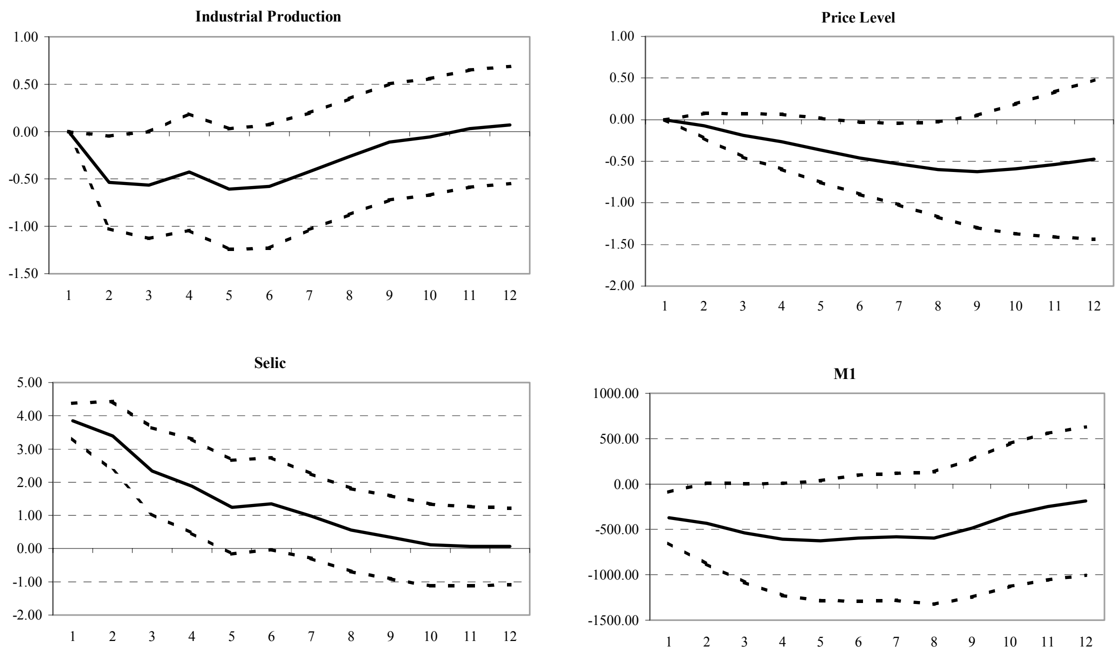


FIGURE 3: Response of the Term Structure to Monetary Policy Shocks

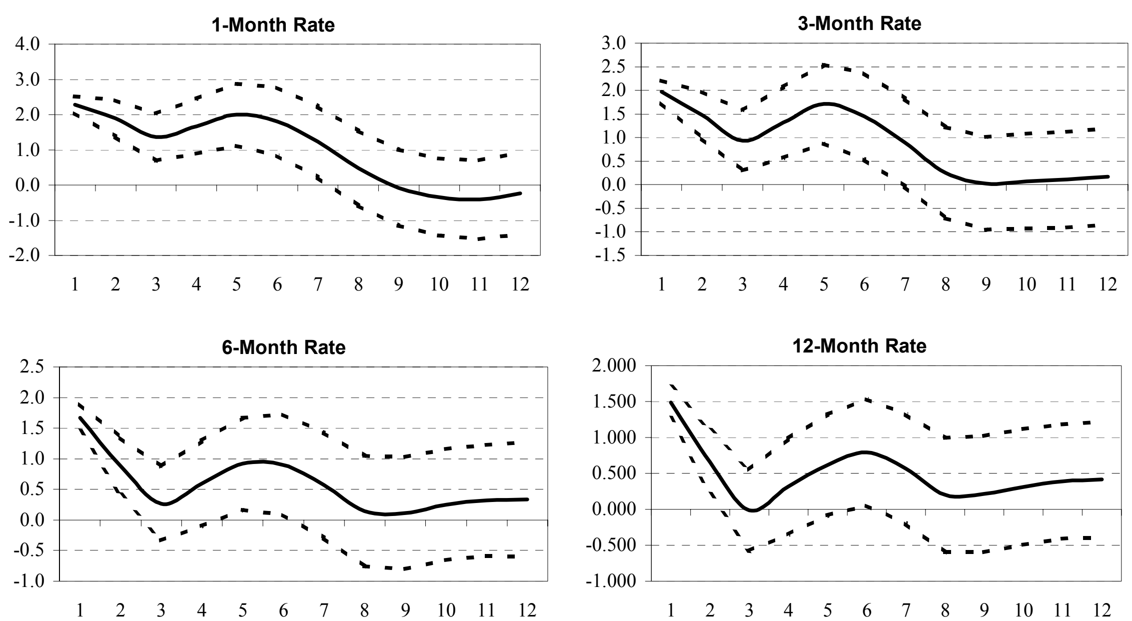


FIGURE 4: Response of Level Factor to a Monetary Policy Shock

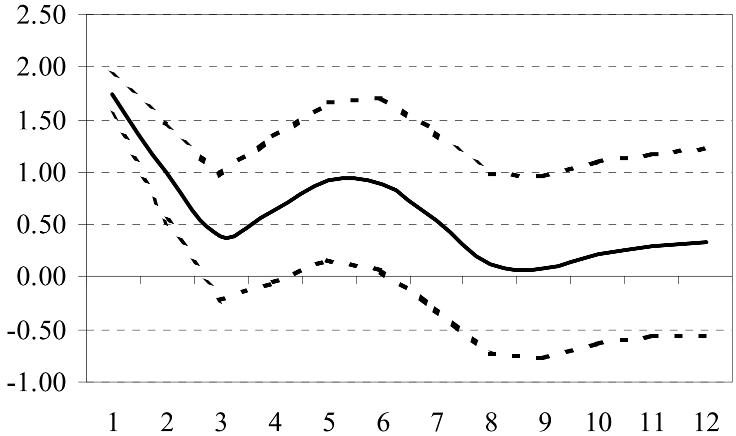


FIGURE 5: Response of Declivity Factor to a Monetary Policy Shock

FIGURE 6: Response of Curvature Factor to a Monetary Policy Shock

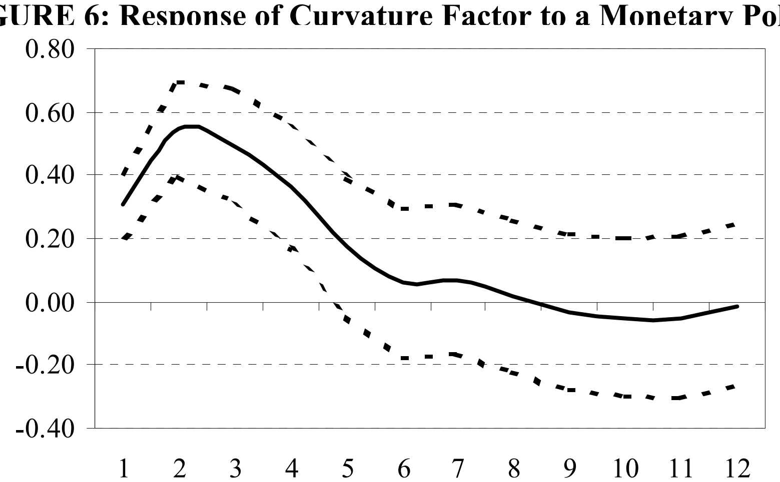
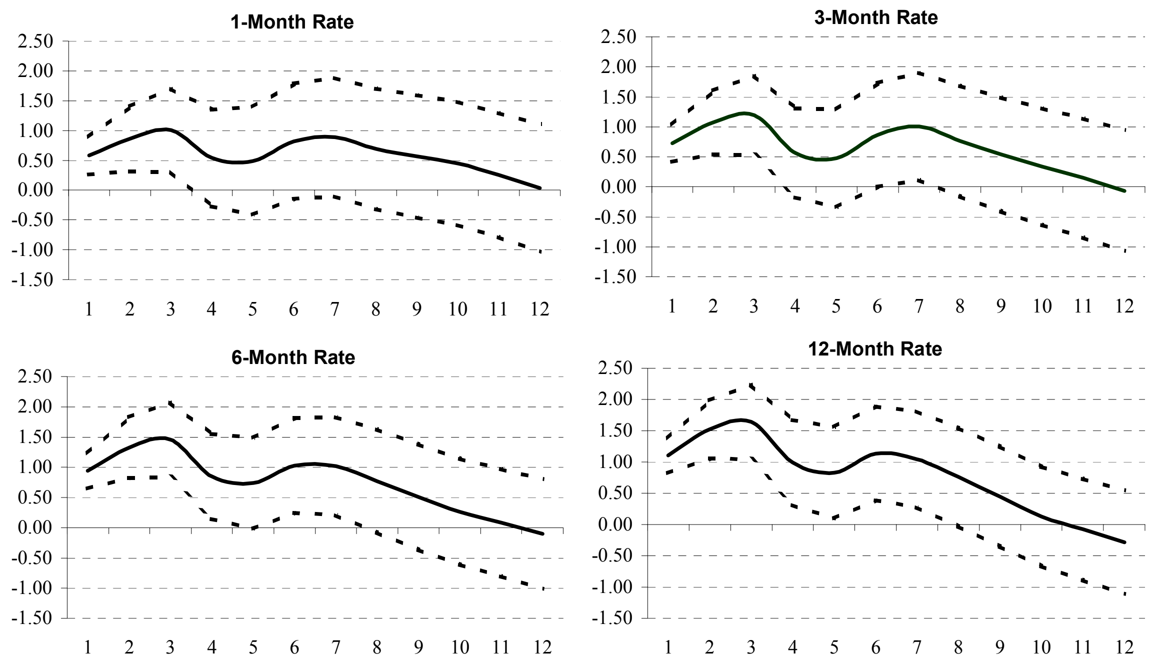


FIGURE 7: The Response of the Term Structure to a Country Risk Shock



APPENDIX 2 - TABLES

Table 1: Proportion of Variance Explained by the Selic Rate

	1-Month	3-Month	6-Month	12-Month
1	67.67 (6.35)	55.97 (6.93)	45.74 (6.96)	38.29 (6.77)
2	58.60 (8.49)	44.73 (8.23)	30.99 (7.07)	23.81 (6.11)
3	52.54 (9.90)	36.93 (9.25)	21.67 (7.10)	15.93 (5.31)
4	52.46 (10.81)	37.81 (10.33)	20.08 (8.07)	14.04 (5.85)
5	54.28 (11.51)	41.45 (11.25)	21.51 (9.14)	14.43 (6.81)
6	53.67 (12.06)	41.74 (11.79)	22.17 (9.66)	15.26 (7.46)
7	51.93 (12.32)	40.36 (11.82)	21.59 (9.63)	15.17 (7.51)
8	50.77 (12.33)	39.33 (11.64)	20.92 (9.48)	14.74 (7.30)
9	50.28 (12.17)	38.92 (11.44)	20.70 (9.42)	14.69 (7.25)
10	49.66 (11.96)	38.50 (11.26)	20.72 (9.41)	14.88 (7.28)
11	48.59 (11.85)	38.06 (11.16)	20.85 (9.42)	15.21 (7.31)
12	47.50 (11.77)	37.83 (11.07)	21.07 (9.42)	15.62 (7.32)
24	45.34 (11.51)	37.65 (11.85)	21.07 (9.33)	15.75 (7.51)

- Standard Errors obtained by Monte Carlo Simulation (10.000 repetitions)

Table 2: Proportion of Variance of Factors Explained by Monetary Policy Shocks

	Level	Declivity	Curvature
1	51.82	36.92	14.01
	(6.92)	(7.27)	(5.97)
2	35.49	49.62	31.76
	(7.47)	(9.04)	(8.86)
3	24.92	55.93	41.77
	(7.66)	(10.29)	(9.89)
4	22.70	57.14	41.89
	(8.48)	(11.00)	(10.17)
5	23.50	58.61	39.96
	(9.45)	(11.18)	(10.18)
6	23.72	57.86	38.28
	(9.84)	(10.85)	(9.94)
7	22.80	57.09	37.27
	(9.62)	(10.55)	(9.74)
8	22.00	56.41	36.29
	(9.37)	(10.30)	(9.49)
9	21.73	56.23	35.63
	(9.24)	(10.25)	(9.35)
10	21.69	56.03	35.47
	(9.18)	(10.28)	(9.32)
11	21.78	55.82	35.48
	(9.14)	(10.30)	(9.29)
12	21.96	55.63	35.45
	(9.13)	(10.26)	(9.27)
24	21.82	52.81	35.35
	(9.03)	(10.50)	(9.60)

- Standard Errors obtained by Monte Carlo Simulation (10.000 repetitions)

Table 3: Proportion of Variance due to a Country Risk Shock

	1-Month	3-Month	6-Month	12-Month
1	4.37 (4.84)	7.56 (5.63)	14.43 (6.61)	21.06 (7.00)
2	7.16 (6.18)	12.32 (7.10)	22.90 (8.52)	31.83 (8.77)
3	10.28 (7.73)	16.42 (8.71)	28.30 (9.92)	37.56 (10.34)
4	9.27 (8.25)	14.83 (9.03)	27.49 (10.37)	36.97 (10.98)
5	8.15 (8.39)	12.97 (8.97)	26.72 (10.38)	36.54 (11.28)
6	8.53 (8.93)	13.34 (9.46)	27.73 (10.76)	37.46 (11.58)
7	9.52 (9.76)	14.98 (10.23)	29.27 (11.18)	38.35 (11.64)
8	10.29 (10.10)	16.10 (10.50)	30.34 (11.28)	38.95 (11.52)
9	10.91 (10.07)	16.71 (10.39)	30.85 (11.16)	39.12 (11.25)
10	11.16 (9.89)	16.82 (10.14)	30.79 (10.89)	38.77 (10.95)
11	10.98 (9.72)	16.67 (9.91)	30.50 (10.60)	38.31 (10.68)
12	10.71 (9.55)	16.55 (9.70)	30.30 (10.33)	38.12 (10.48)
24	9.42 (9.67)	16.30 (9.63)	21.07 (10.24)	39.24 (10.71)

- Standard Errors obtained by Monte Carlo Simulation (10.000 repetitions)

TABLE 4: Proportion of Factors Variance due to Country Risk Shocks

	Ang and Piazzesi (2003)		
	Level	**Declivity**	**Curvature**
1	13.73 (6.74)	10.85 (4.66)	1.53 (1.37)
2	21.92 (8.35)	12.13 (5.48)	2.87 (2.00)
3	27.16 (9.91)	13.05 (6.54)	3.32 (2.61)
4	26.15 (10.36)	12.61 (6.73)	2.76 (3.44)
5	25.29 (10.34)	12.00 (6.68)	2.62 (4.69)
6	26.06 (10.73)	12.18 (6.69)	2.50 (5.42)
7	27.51 (11.27)	12.04 (6.62)	2.48 (5.84)
8	28.61 (11.45)	11.98 (6.50)	2.60 (5.99)
9	29.15 (11.36)	11.95 (6.45)	2.66 (5.95)
10	29.15 (11.08)	12.47 (6.57)	2.69 (6.07)
11	28.90 (10.80)	13.15 (6.73)	2.68 (6.25)
12	28.73 (10.52)	13.86 (6.93)	2.71 (6.40)
24	29.02 (10.50)	17.63 (8.32)	2.80 (7.87)

- Standard Errors obtained by Monte Carlo Simulation (10.000 repetitions)

Table 5: Proportion of Variance due to a Product Shock

	1-Month	3-Month	6-Month	12-Month
1	10.90	11.12	9.54	7.80
	(4.91)	(4.91)	(4.23)	(4.06)
2	17.45	17.39	13.29	11.33
	(6.08)	(6.04)	(4.75)	(4.74)
3	21.95	23.91	17.98	16.48
	(7.24)	(7.55)	(6.07)	(6.05)
4	24.22	26.98	19.80	19.00
	(7.74)	(7.83)	(6.18)	(6.30)
5	24.00	26.39	19.74	19.14
	(7.71)	(7.42)	(5.84)	(6.02)
6	23.32	26.10	20.12	19.15
	(7.71)	(7.27)	(5.79)	(5.97)
7	22.68	25.51	20.27	18.95
	(7.68)	(7.16)	(5.77)	(5.85)
8	22.20	25.02	20.29	18.85
	(7.61)	(7.13)	(5.90)	(5.90)
9	22.01	24.79	20.13	18.69
	(7.64)	(7.24)	(6.09)	(6.08)
10	22.00	24.81	19.97	18.52
	(7.82)	(7.50)	(6.38)	(6.34)
11	21.85	24.81	19.85	18.38
	(9.34)	(7.73)	(6.62)	(6.54)
12	21.54	24.75	19.80	18.27
	(8.27)	(7.89)	(6.79)	(6.61)
24	20.04	24.50	20.42	18.98
	(8.21)	(8.05)	(7.22)	(6.99)

- Standard Errors obtained by Monte Carlo Simulation (10.000 repetitions)

TABLE 6: Proportion of Variance of Twelve-Month Rate Due to Macro Shocks

Brazil	USA (Evans and Marshall)	USA (Ang and Piazzesi)
84.25%	92%	85%

TABLE 7: Proportion of Variance of the Brazilian Term Structure due to Macro Shocks

1-Month	3-Month	6-Month	12-Month
54.66	62.35	78.93	84.25