THE ECONOMIC DETERMINANTS OF THE BRAZILIAN TERM STRUCTURE OF INTEREST RATES

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Resumo

O propósito do presente artigo é estudar os efeitos da política monetária e outros choques macroeconômicos sobre a dinâmica da estrutura a termo de juros brasileira. Estimamos um modelo near-VAR e o identificamos conforme o esquema proposto por Cristiano *et al*. (1996, 1999). Os resultados se assemelham aqueles encontrados para a economia americana: choques de política monetária tornam a estrutura a termo menos inclinada. No entanto, esses choques explicam uma parcela significativamente maior da variância da estrutura a termo no Brasil. Por fim, estudamos também a importância dos demais choques macroeconômicos, tais como de produto, inflação e, especialmente, choques de risco país para a dinâmica das taxas de juros brasileiras. As evidências empíricas ainda nos permitem afirmar que na medida que a estrutura a termo de juros brasileira se alongar, mais importante serão os choques macroeconômicos na sua determinação.

Palavras-chave: choques de política monetária, estrutura termo taxas de juros.

Abstract

The purpose of the present 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 under the identification scheme proposed by Christiano et al. (1996, 1999). The results resemble that of the US economy: monetary policy shocks flatten the term structure of interest rates. Nevertheless, we find that monetary policy shocks in Brazil appear to explain a significant larger share of the dynamics of the term structure than in the USA. Finally, we also study the importance of standard macroeconomic variables, as GDP, inflation and specially, a measure of country risk for the dynamics of the term structure in Brazil. The empirical evidence allows us to infer that as the Brazilian term structure of interest rates increase its maturities, the more important will macroeconomic shocks be to its determination.

Key words: monetary policy shocks, term structure interest rates.

1. INTRODUCTION

Dates of meetings of the Brazilian Monetary Policy Committee (COPOM) and announcements of targets for the overnight interest rate Selic are special days in the calendar of the Brazilian financial market. Decisions about a new target for the Selic rate frequently cause strong reactions of financial assets, specially the term structure of interest rates. Fleming e Remolona (1997) find that days of announcements of decisions about monetary policy, as well of relevant macroeconomic aggregates, are joined by higher volatility of all markets interest rates of the North American market. The term structure of interest rates in commonly cited as a indicator of monetary policy stance, as well as a leading indicator of economic activity and inflation (e.g., Bernanke e Blinder (1992), Estrella e Hardouvelis (1991), Blanchard (1985), Mishkin (1990, 1997), Hamilton e Dong (2000), among many others). Hence, macroeconomic shocks may also have an important role in explaining the fluctuations of the term structure.

One of the most important reasons to study the factors that impact the dynamics of the term structure lies in its importance 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 of influencing, through the overnight interest rates as well as through indications of future movements of this same rate, the market´s term structure of interest rates. As already highlighted by the Central Bank of Brazil [Inflation Report (Dec/2002) it is the market´s interest rates that influence one of the most important channels of monetary transmission, namely, the aggregate demand channel.

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 vast majority of the literature assumes that movements of the term structure of interest rates are related to non-observable factors[1]. 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 study how observable macroeconomic variables affect 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 autoregression model. The outline of the paper is as follows: the next section briefly describes the main papers that relate macroeconomic variables to the dynamics of the term structure. The third section describes the empirical methodology and discusses the identification of the model. Section four describes the results. Finally, section five concludes.

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[1] See, e.g., Litterman e Scheinkman (1991); Knez, Litterman e Scheinkman (1994); Dai e Singleton (2000), among others.

2. A BRIEF REVIEW OF THE LITERATURE

The literature that relates the dynamics of market´s rates to the macroeconomic factors is relatively recent. In a spirit close to ours, Evans and Marshall (1998) studies to what extends movements of the term structure can be explained by exogenous impulses of monetary policy and other macroeconomic variables, as product and inflation. The authors use a VAR model under different identification schemes, as the one popularized by Christiano *et al*. (1996, 1999) and Galí (1992). Notwithstanding the different identifications schemes, the authors find that impulses to monetary policy have a significant impact on short-term rates. However, monetary policy shocks doe not cause a parallel shift of the term structure, but instead make it flatter. Following that observation, the authors extract 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 verify that monetary policy shocks are responsible to a great extend for the variance of the declivity factor of the term structure

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

Ang and Piazzesi (2003) introduce 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. The authors find 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, those factors move the declivity of the term structure, but not the level of it.

Evans and Marshall (2001) seek to identify the effects of macroeconomic shocks on the term structure. For that purpose, the authors estimate a vector-autogression with short and long run restriction, as Galí (1992). The authors also make use of model theoretic measures of shocks, as the one proposed by Basu, Fernald and Shapiro (2001 a,b) for technology shocks, Blanchard and Perotti (2000) for fiscal shocks and, finally, a measure of marginal rate of substitution shocks, similar to the one proposed by Hall (1997).

Diebold *et al* (2005) estimate 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 (level, declivity and curvature) as well as observable macroeconomic factors (economic activity, stance of monetary policy, inflation, etc.). Unlike the other studies of the literature, the model admits a bi-causal relationship between the term structure and the macroeconomic variables. Hence, the authors are able to test if the relation flows from the term structure to the macroeconomic factors or vice-versa. Interestingly, the paper finds strong evidence of the effect of macroeconomic variables on the dynamics of the term structure and much weaker effect of the term structure on the macroeconomic variables.

Lots of other works are related to the literature briefly described above. Leeper, Sims and Zha (1996) and Bernanke, Gertler and Watson (1997), both with the objective of quantifying the effects of systematic monetary policy, also include long-term interest rates in their respective models. In spite of the different objectives and methodologies, those authors found qualitatively similar results with the works described above and the present one.

3. IDENTIFICATION

First, we assume that the monetary policy instrument is the overnight interest rate, Selic, determined by the Monetary Policy Committee (COPOM), which we denote by S_t. we also assume that S_t is determined by a rule of the following form:

$$S_t = \psi(\Omega_t) + \sigma\varepsilon_t \qquad (1)$$

In equation (1), 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, finally, σ is a scalar parameter. The monetary policy reaction function incorporates the preferences of the monetary authority regarding stabilizations policies, inflation aversion etc. The residual, ε_t, reflect random, nonsystematic factors that affect policy decision, as the personalities and view of central bank governors, political factors, as well as technical factors like 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 as well as 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 a nominal interest rate of maturity j. The monetary policy rule (1) can be estimated as one of the equations of the following *near* – VAR:

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

Where 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, $D(L)$ e $C(L)$ are polynomial scalars. The error terms are *i.i.d.* processes of shocks mutually non-autocorrelated, whose variance is an identity matrix and, finally, σ is a diagonal matrix.

Throughout the paper, we assume that $b = 0$ and $B(L) = 0$, such that contemporaneous and past values of the term structure does not enter the other equations of the model. In this way, we assure that the identified monetary policy shocks are invariant to the maturity j of the rate included in the model, as in Marshall and Evans (1998, 2001), 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 the Industrial Production, P denotes the inflation rate measure by the IPCA index, CBOND denotes the spread of the CBOND to the US bond of same maturity as a measure of country risk, S denotes the overnight Selic rate and, lastly, M1 denotes the monetary aggregate M1.

Minella (2003) argues that 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 to external shocks in the recent past. Also, the country risk is a forward looking variable and seems to play the same role as commodity price indexes do on the transmission mechanism of monetary policy in developed countries. As such, the omission of this variable often leads to the so-called price puzzle, that is, a positive reaction of inflation after a monetary policy shock.

So, the reaction function identified under the CEE is given by:

$$S_t = A_4(L)Z_{t-1} - a_{41}PI_t - a_{42}INF_t - a_{43}CBond_t + \sigma_{44}\varepsilon_t^Z \qquad (2)$$

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 side of the equation.

In order to investigate more deeply the effects of macroeconomic variables and, especially that of monetary policy on the term structure, we obtain an approximations of the level, declivity and curvature factors following the methodology of Ang and Piazzesi (2001). The authors use as a measure of the level of the term structure the arithmetic mean of the 1, 12 and 60 months rates. Adapting the structure to our dataset, we use the mean of the 1, 6 and 12 months rate. Our measure of declivity is given by the spread of the 12 months rate to the 1-Month rate. Lastly, the curvature measure is given by the sum of the 1 and 12 rates, less the 6 months rates.

Following, we make use the three factors, the level, declivity and curvature, to infer how monetary policy and the other macroeconomic variables influence the dynamics of the Brazilian term structure of interest rates.

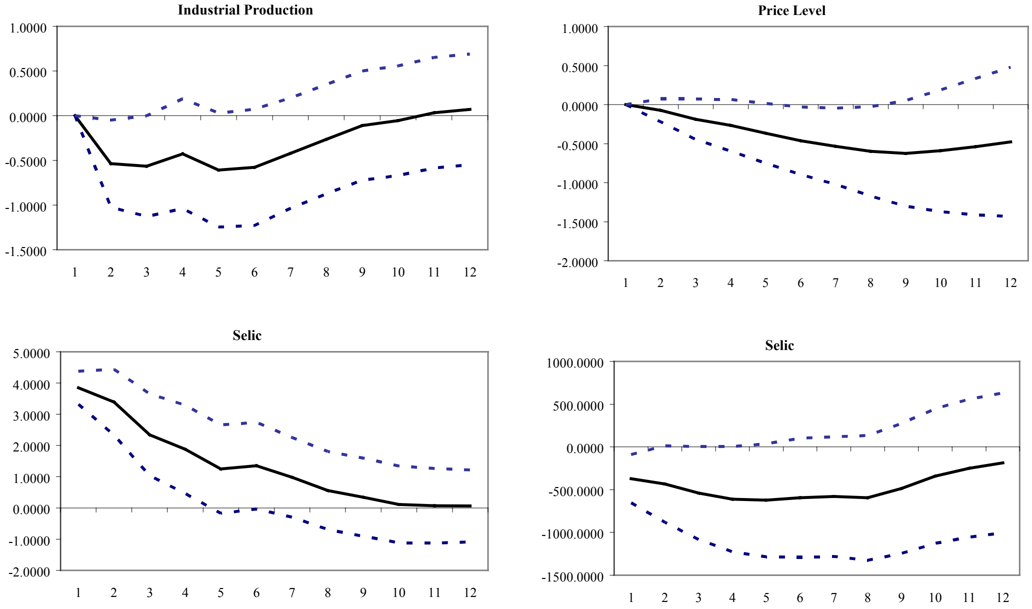
4 RESULTS

The VARs are estimated for the period of Jan/1995 to Dez/2003. Six lags were used in each equation; so as 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 the Macro Variables to a Monetary Policy Shock

In the figures below, we find the effects of a one standard deviation monetary policy shock on the macro variables.

FIGURE 5: Response of Macro Variables to a Monetary Policy Shock



The effects of a monetary policy sharpening are the expected ones, respectively: a Selic rate shock has a negative and significant effect on the 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 statically significant.

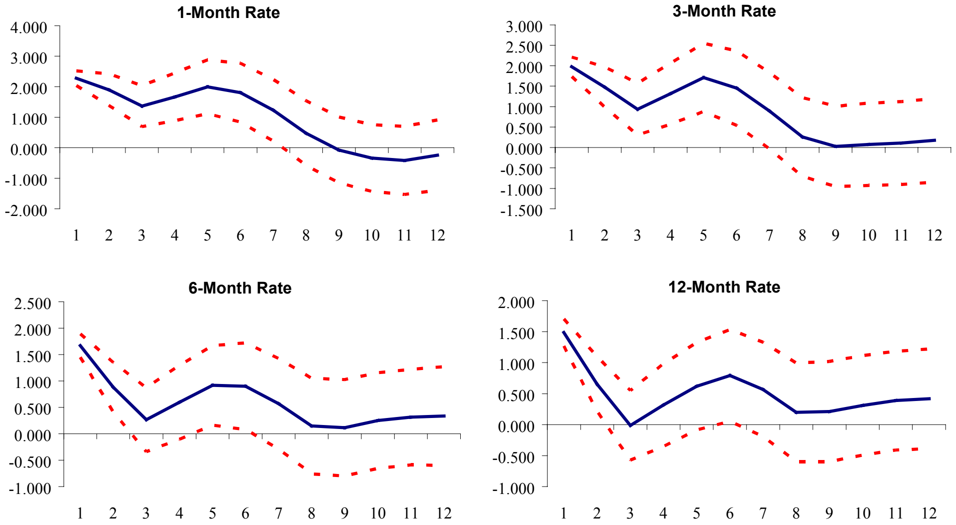
As one would expect, a positive monetary policy shock raises the overnight interest rate, Selic. It is interesting to note that this is significant even after five months after the shock, revealing a high degree of persistence of the overnight interest rate. Lastly, a monetary policy tightening decreases the stock of money in the economy.

It is worth noting that a tightening of monetary policy cause the so-called Liquidity Effect, since money and interest rates respond in opposite ways after the shock, as discussed in Christiano *et al* (1999).

4.2 The Impact of Monetary Policy Shocks on the Term Structure:

In this section, we trace the response of the term structure of interest rate to the monetary policy shocks identified above. For that purpose, we use 1-Month, 3-Month, 6-Month and 12-Month nominal fixed swap rates.

FIGURE 8: Response of the Term Structure to Monetary Policy Shocks



As one can observe from the figures above, the impact of a monetary policy shock decreases as we consider rates of longer maturities. But the larger difference between the estimates lies in its statistical significance. The monetary policy shocks have a statistical significant impact on the 1-Month interest rate for more than 5 months. On the other hand, the significance of the impact on the 12-Month interest rate barely last 2 months.

Summarizing, there is not a parallel shift in the term structure following a monetary policy shock. On the contrary, shocks have a stronger and 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) find 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 below the results of the forecast error variance decomposition.

Table 1: Proportion of Variance Explained by the Selic Rate

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

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

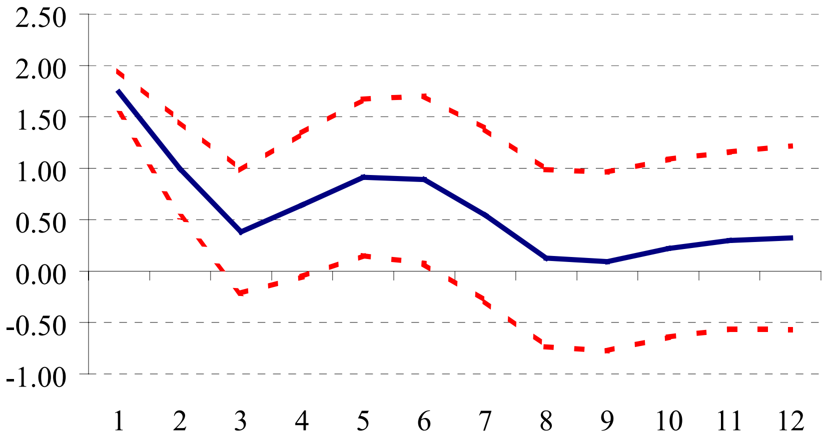
According to the table above, monetary policy shocks are responsible for almost three quarters of the conditional variance of the 1-Month interest rate one month after its initial impact. If we interpret the two-year ahead conditional variance as a proxy for the unconditional variance, we see that monetary policy shocks are responsible for nearly half of the long-term variance of the 1-Month rate. Those numbers are considerably larger than the ones of the USA economy. Evans and Marshall (1998), e.g., find that monetary shocks are responsible for only 7% of the unconditional variance of 1-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 12-Month interest rate. For that maturity, we find an initial percentage of 35% that falls to 12% after two years. In general, monetary policy shocks seem to be relatively more important to explain the dynamics of the Brazilian term structure than the U.S. one.

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, below we find the impulse response functions as well as the variance decompositions of the factors that compose the term structure of interest rate - level, declivity and curvature as decomposed by Ang and Piazzesi (2001).

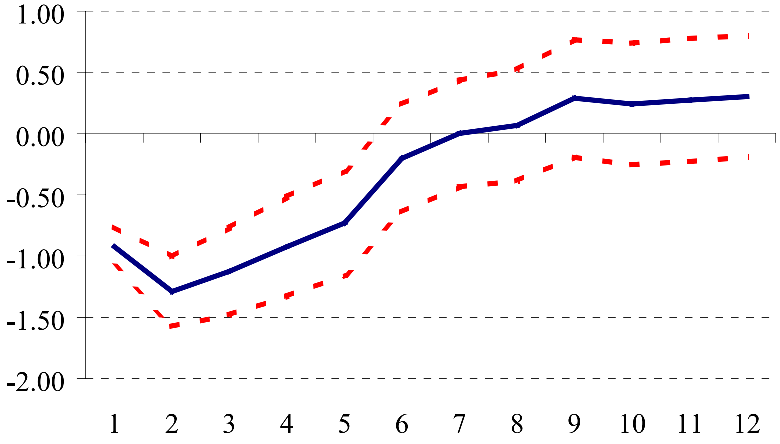
FIGURE 9: Response of Level Factor to a Monetary Policy Shock



As the graphic above indicates, the response of the level factor to an exogenous impulse in monetary policy is very similar to the one of the 1-Month interest rate. That is, a monetary policy shock has a positive effect on the level of the term structure that last approximately for 6 months.

As the impulse response functions indicate, a monetary policy shock does not have a symmetric impact upon the term structure, since shocks to long-term interest rates have significantly smaller effects than on short-term interest rates. As such, it is to expect that monetary policy shocks flatten the term structure. The figures below show the response of the declivity factor to an impulse in monetary policy.

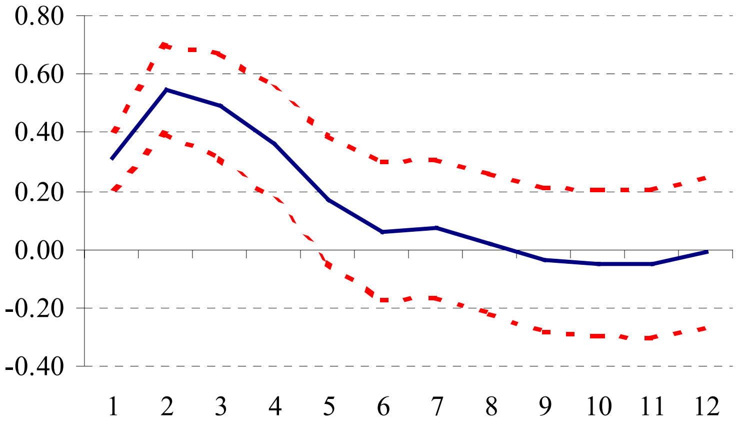
FIGURE 10: Response of Declivity Factor to a Monetary Policy Shock



As anticipated, a shock to monetary policy reduces the declivity of the term structure. The effect seems to last from four to six months, approximately the same extent of the monetary policy effect on short maturity rates, as the 1-Month one.

Finally, we present the impulse response functions of the curvature to the monetary policy shocks identified.

FIGURE 11: Response of Curvature Factor to a Monetary Policy Shock



The figures above indicate a small increase in the curvature of the term structure following a monetary policy shock, as in Evans and Marshall (1998) and Wu (2003).

We may 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. The table below shows the share of the conditional variance of the term structure that can be attributed to monetary policy shocks.

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)

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

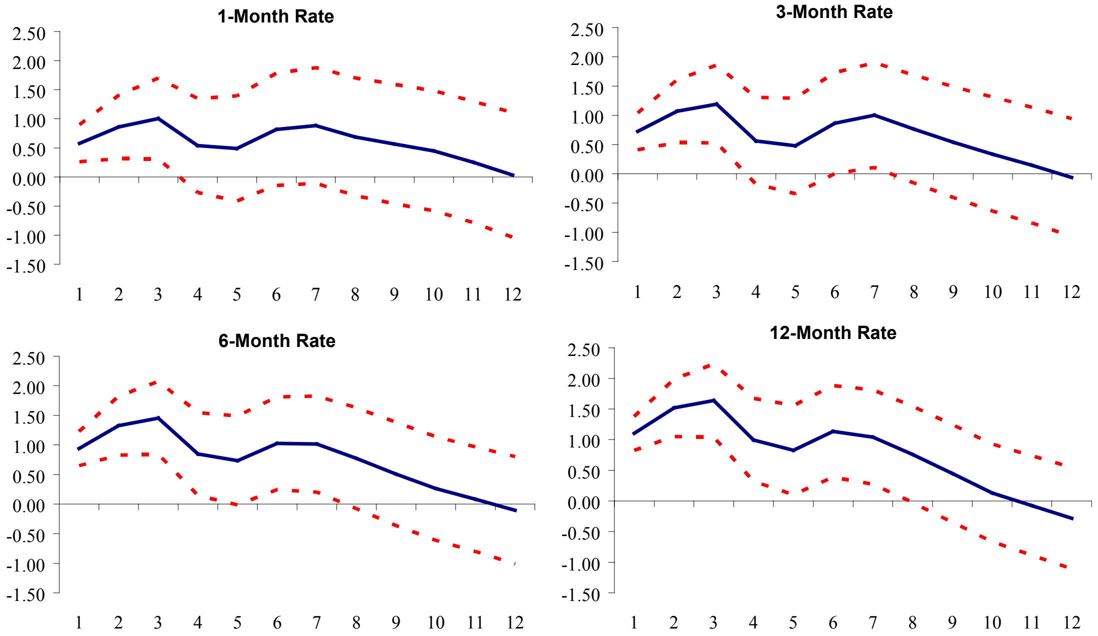
4.3 – The Importance of other Macroeconomic Variables

In this section we study the contribution of other macroeconomic variables to the dynamics of the term structure.

4.3.1 The Impact of Country Risk

We may use the model described in section two to study the effects of other macroeconomic shocks that may influence the dynamics of the term structure. In the graphics below, we show the impact of a country risk shock, measured by the spread of the C-Bond.

FIGURE 13: The Response of the Term Structure to a Country Risk Shock



The figures above indicate that the relative importance of country risk shocks increase monotonically along the 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 1-Month interest rate is significant for only approximately four months, the 12-Month interest rate presents a significant response for about eight months.

The table underneath illustrates the percentage of the forecast error variance decomposition due to the country risk shock.

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

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

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

As it is shown, the relative importance of country risk shocks to the dynamics of interest rates grows monotonically as we increase the maturity of the interest rate analyzed. While country risk shocks explain approximately 10% of the unconditional variance of 1-Month rates, this percentage hits as much as 40% to the 12-Month rate. Hence, country risk shocks seem to be the most important determinant of 12-month rates in Brazil.

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

As we may see on table 4 in the appendix, country risk shocks seem to be an important feature for the determination of the level of interest rates in Brazil. The two other factors, declivity and curvature, do not seem to be significantly explained by shocks to the country risk.

It is interesting to note that country risk shocks have exactly the opposite effect of monetary policy shocks on the term structure. As such, they make the term structure more inclined. A first explanation to 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 devaluations of the exchange rate.

4.4.2 The Impact of Product and Inflation

Evans and Marshall (1998, 2001) and Wu (2001, 2004) find that a noteworthy share of long-term interest rates may be explained by product shocks. Those authors find that circa 20% of the unconditional variance of the 12-Month interest rate could be attributed to product shocks. As we can see below, this share is very similar to the Brazilian case.

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)

It is interesting to note that the proportion of variance due to the product shock is very similar across the term structure.

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

Bearing in mind the results of this section, it would be interesting to discriminate the share of the unconditional variance of the 12-Month interest rate of Brazil that may be explained by macroeconomic shocks. The table below compares the results for the Brazilian and US economy, as found by Evans and Marshall (2001) and Ang and Piazzesi (2003).

TABLE 6: Proportion of Variance of 12-Month Rate Due to Macro Shocks

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

The contribution of macroeconomic shocks for the variance of the 12-Month interest rate is very similar across both economies. It is appealing that the importance of macroeconomic shocks increases as we consider rates of longer maturities. Table 7 reveals the variance attributed to macroeconomic variables for the Brazilian term structure.

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

While macroeconomic shocks are responsible for about 55% of the variance of the 1-Month rate, this shares increases to almost 85% for the 12-Month rate. Hence, we may conclude that, as the term structure of interest rates in Brazil increases its maturity, the greater the importance of macroeconomic factors will be to its dynamics.

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 estimated a near – VAR model, where the macroeconomic block has an effect on the term structure, but the latter is not allowed to impact the first. Thus, we assure that the monetary policy and macroeconomic shocks are invariant to the maturity and factors of the term structure. We find that monetary policy shocks are responsible for an important share of the Brazilian term structure dynamics. Those shares are, in general, significantly larger than the ones of the US economy. In accordance with the international literature, we find 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.

Lastly, the importance of other standard macroeconomic variables, like country risk and industrial production was presented. Among the standard macroeconomic variables responsible for the dynamics of the Brazilian term structure, industrial production shocks seem to be the most important ones. The paper also calls great attention to shocks that typically affect emerging market economies, as country risk shocks.

Future extensions of the current paper may opt for different identification structures, as the one proposed by Galí (1992). By using a vector autoregression approach, we aimed at identifying 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 was 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 better understand the dynamics of the Brazilian term structure.

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APPENDIX 1

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

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

- Standard Errors obtained by Monte Carlo simulation.