VERY HIGH INTEREST RATES AND THE COUSIN RISKS: BRAZIL DURING THE REAL PLAN [•]

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ABSTRACT

We compute and estimate the two risks that keep Brazilian interest rates extremely high: the currency and country risks. The Brazil risk is directly measured from fixed income instruments and derivatives, while the currency risk is estimated via Kalman Filter. Results identify a few important components of the Brazil risk, as the convertibility risk and the international financial markets conditions, measured by a credit derivative spread. Preliminary results indicate that the current high domestic interest rates are associated with the uncertainty concerning the current account sustainability. Therefore, export growth is fundamental to achieve lower real interest rates.

Key Words: Interest Rate, Risk Premium, Country Risk, Currency Risk, Convertibility Risk, Brazil

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Executive Summary

We review the arguments in the finance and open macroeconomics literature that are relevant for the Central Bank to set the level of the interest rate in an open economy. The country risk (Brazil Risk) is measured with different financial instruments, and the currency risk is estimated via the Kalman Filter. We show that—besides the currency risk, which is also relevant in developed economies—the country risk is very important in determining domestic interest rates. Both risks have a few causes in common, which explain us calling them the cousin risks. Thus, when and if those common causes are confronted, the fall of domestic interest rates can be substantial, because both currency and Brazil risks may fall at the same time.

Preliminary results identify the components of the Brazil risk, e.g., the fiscal deficits, and the domestic and international financial markets conditions. The convertibility risk, defined as risk associated with possibility of not being able to convert BRLs into foreign currency, showed up as an important cause of the Brazil risk during the international financial crises periods, but has become of negligible importance in the new floating exchange rate regime. Nowadays, the Brazil risk has also decreased significantly, but the same did not happen with the currency risk. One possibility is that the main factor precluding a larger fall in domestic interest rates may be associated with the uncertainty of the future behavior of the balance payments, especially the trade account. As a corollary of this hypothesis, we might speculate that assuring vigorous export growth, without resorting to devaluation, is fundamental to achieve lower real interest rates, compatible with sustained economic growth.

I. INTRODUCTION

The interest rate constitutes one of the most important macroeconomic variables responsible for the economy's good performance. It is essential to have a well-calibrated interest rate, because interest rates play an important role in the determination of several economic variables, e.g., output and employment levels, the exchange rate, and others.

Not surprisingly, it is almost impossible to obtain a consensus about the ideal interest rate level. The fact that Alan Greenspan has a high degree of respectability nowadays is a recent fact in USA. In the beginning of the Volker era, less than 20 years ago, the unemployment associated with the deflationary effort led people to print "Wanted" posters with him and the Fed board of directors! Nowadays, in Brazil, it is not unusual to read in the newspaper complaints about the high level of interest rates.

Figure 1 shows the monthly evolution of Brazilian real interest rates in the last 25 years. The thin (black) line represents the monthly real interest rate (expressed in % p.y.) and the thick (red) line is the respective 12-month moving average (also expressed in % p.y.). The horizontal lines show the real interest rate averages in three periods: the second half of the seventies, the eighties plus a few months, and the opening up of domestic financial markets to international investors (since May 1991). The huge jump in interest rates during the recent financial liberalization period is clear.[1]

The last decade was marked by inflation stabilization that came with the Real Plan in July 1994, and for the trade and financial openness of the Brazilian economy. We adopted May 1991 as the reference date of the financial liberalization, because it coincides with the edition of the famous Annex IV that opened the Brazilian economy to the possibility of external portfolio investments.

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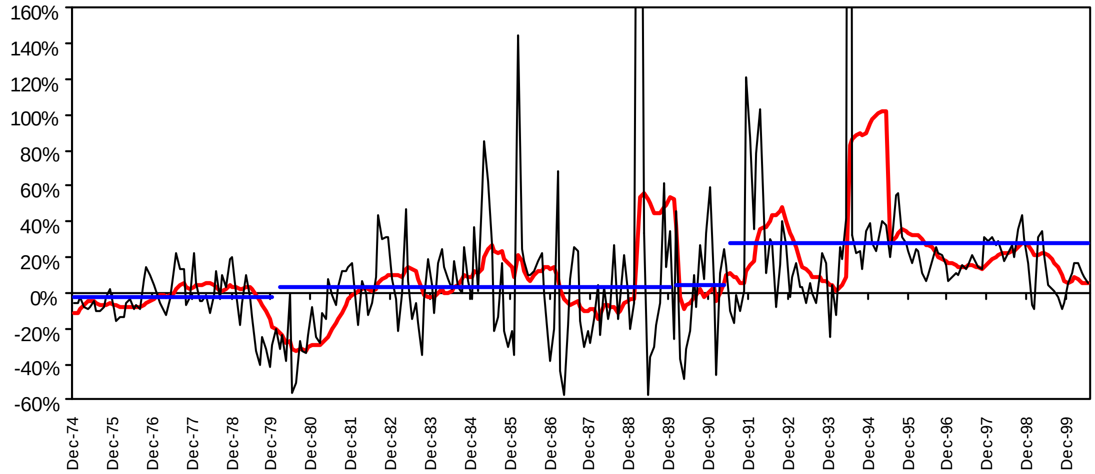
[1] We use here the Selic rate (the analogue of the FED funds rate) deflated by the centered General Price Index (IGP-DI). Therefore, we refer to the very high real interest rates that enter the liability side of the government and of financial institutions. Active interest rates are even higher, given the very high bank spread in Brazil, a phenomenon that is pervasive in Latin America (see Brock and Rojas-Suárez [2000]). We, however, do not analyze the active interest rates behavior in this paper.

Figure 1
Real Interest Rate



When an economy liberalizes its capital account, it loses one degree of freedom to fix its own interest rate. This is due to capital flows. Under a fixed exchange rate regime (or a controlled one), a low interest rate could bring about capital outflows, which cause monetary contraction and a consequent rise in interest rates. Under a flexible exchange rate regime, a low interest rate would cause an incipient capital flight that would depreciate the exchange rate. Between these two polar regimes, there are several of others possibilities, such as a crawling peg *cum* controls over the capital flows. Since the financial liberalization in the beginning of the 90's, Brazil has adopted several different forms of exchange rate regime and controls on capital inflows.

We aim at studying the determinants of interest rates in Brazil since it became a financially open economy. Based on the interest parity conditions, we study the behavior of the cousin risks: the currency risk and the country risk. These two risks are fundamental in the determination of a floor to the domestic interest rate, and reducing them is the main objective if one aim at achieving interest rates compatible with sustained economic growth.

II. COUNTRY RISK AND CURRENCY RISK: WHAT ARE THEY?

II.1. The Country Risk

At present, the developed countries are considered financially integrated. The financial integration, however, was achieved only in the last decades (see, for example, Frankel [1991]). Even the developed economies had severe restrictions on international capital flows in the beginning of the 70s.

For many emerging markets, these restrictions to the international capital flows just began to be withdrawn in the beginning of the 90s, together with the implementation of the Brady Plan. However, despite the increasing financial integration, it cannot be said that there is perfect capital mobility among these countries, as we are going to see next.

Among the several possible measures of perfect capital mobility Frankel [1991] concludes that the most appropriate is the covered parity of interest rates, in which ...*capital flows equalize interest rates among countries when denominated in the same currency*. The covered interest parity differential (CID) is usually known as country risk, because it affects the yields of all financial assets in a certain country. The developed countries do not have CID, i.e., the CID among them is negligible. This means that if a large multinational enterprise wants to make a loan in USD, the interest rate would be the same whether the commercial paper is issued in England or in the US. However, had the bond been floated in an emerging market (without a foreign collateral), the interest rate (in USD) would have been higher. This difference is one possible measure of the country risk.

Because it contaminates all financial assets in a certain country, the country risk cannot be hedged within that country, i.e., it will not be eliminated with investment diversification among the assets in that country. Being a systemic risk, the country risk increases the yield required for all the assets in the country, or, equivalently, it reduces the price of the assets if compared to the identical ones issued in the developed countries.[2]

[2] We acknowledge the fact that the country risk is usually considered a diversifiable risk from the point of

The differential (or deviation) of the covered interest rates parity[3] is the best measure of the lack of perfect capital mobility *...because it captures all barriers to integration of financial markets across national boundaries: transactions costs, information costs, capital controls, tax laws that discriminate by country of residence, default risk, and risk of future capital controls* [Frankel, 1991].

Thus, the country risk is a portrait of the economic and financial situation of a certain country, also showing the political stability and the historic performance in fulfilling its financial obligations.

II. 2. The Currency Risk

The risk aversion that usually characterizes the behavior of investors in financial markets may drive the price of some financial assets away from the relevant expectations. Risk averse investors do not enter in fair gambles (gambles with zero expected value). They require some compensation, which generates a positive expected value for most investments.

Investors in emerging markets currency futures markets require something more than the emerging currency expected currency depreciation to sell their hard currency in the future. There is a currency risk that creates a wedge between the expected price of the hard currency (typically the USD) in the future and the price of that currency in the currency futures or forward market.

Unfortunately, in contrast with what occurs with the country risk, the currency risk is **not** measurable directly through the existing assets' yields. This impossibility of direct measurement is due to the inability of observing the expected depreciation. Here we will use two econometric techniques to uncover the currency risk.

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view of foreign investors. However, the empirical evidence that we will show demonstrates very clearly that the country risk is priced. It is possible that this apparent puzzle be related to another one, the enormous homes bias prevalent in many economies (see, for example, Obstfeld and Rogoff [1996], p. 305).

[3] We are going to define formally in next sections covered interest parity.

II. 3. The Measurement Methods of the Cousin Risks

We will use several securities, especially derivatives, to measure the country and currency risks. Through the USD futures market, at BM&F,[4] it is possible to measure the country risk through the arbitrage concept. The USD futures contracts[5] are contracts between two market players, in which the player with the long position commits to buy from the player with the short position a predetermined amount of USD at a given date in the future paying the agreed delivery price (in BRLs). Conversely, the institution with the short position commits to sell at that future date for that predetermined delivery price the amount of USD previously agreed.[6] Thus, on the futures contract settlement date, if the spot USD costs more than the futures price, the player with the long position wins (because he or she bought the same USD for a lower price than the market price), and the player with the short position loses.

Under perfect capital mobility, the USD futures market allows for arbitrage transactions between the domestic and international interest rates. Through that arbitrage transaction, we are going to extract one of measures of the Brazil Risk.

In the Finance theory, an arbitrage opportunity is a financial transaction in which it is possible to obtain some positive gain without any risk from a zero initial capital/investment. In practice, the arbitrage concept is used to describe low risk transactions, like buy (cheaply) in a market and resell (more expensively) in another market. Thus, the description of that arbitrage transaction requires an analysis of two cases, the first one is when the USD futures contract is expensive, and the second one is when the USD futures contract is cheap. As we will see, we are more interested in the second case, which will originate a positive Brazil Risk.

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[4] BM&F is the Commodities and Futures Exchange in São Paulo, Brazil. It is the main exchange where derivative securities are traded in Brazil.

[5] This Subsection draws heavily from Garcia [1997].

[6] This description is not complete, since we are omitting important operational details like the collaterals required by BM&F, and daily margin settlements. Introducing them in the analysis, however, makes the analysis much more complicated without adding further insights.

1st case) The USD futures contract is expensive [$f > s\,(1+i)/(1+i^*)$]

1.a) Buy US$ 1 in the spot exchange rate market, paying R$ s (s is the USD spot price);

1.b) To pay for that purchase of US$1, a loan of R$ s is needed in the domestic market, accruing interest at rate i, i.e., in the expiry date of the loan, R$ $s\,(1+i)$ will be paid back;

1.c) Invest the US$ 1 bought in the international market, receiving interest of i^*, i.e., in the expiry date of the investment, US$ $(1+i^*)$ will be received;

1.d) Sell in the USD futures market at the prevailing price f the amount that is going to be received for the international investment, US$ $(1+i^*)$, i.e., R$ $f\,(1+i^*)$ is going to be received for the sale of USD in the futures market at the settlement date of the futures contract, which coincides with the loan expiry date;

The transactions (1.a) to (1.d) give a profit of R$ [$f\,(1+i^*) - s\,(1+i)$] at the settlement date of the USD futures contract without the need of any initial capital. Note that there is no risk at all in this whole transaction, because all the prices are known at present time. If the profit is positive, it is said that there is an arbitrage opportunity. If it occurs, it is possible to make a profit following the steps (1.a) to (1.d) without incurring in any risk at all and without any initial capital.

We now analyze the second case of arbitrage, which is symmetric to the first one, thereby occurring when the USD futures contract is cheap.

2nd case) The USD futures contract is cheap [$f < s\,(1+i)/(1+i^*)$]

2.a) Sell US$ 1 in today's market, receiving R$ s (s is the price of USD spot);

2.b) To obtain the US$1 sold in item (2.a), a loan of US$1 is necessary in the international market, paying for that the interest of i^*, i.e., at the expiry date of the loan, US$ (1+i^*) will be paid back;

2.c) R$ s obtained in item (2.a) should be invested in the domestic market, accruing the interest rate i, i.e., in the expiry date of the investment, R$ s (1+i) will be received;

2.d) US$ (1+i^*) will be bought in the USD futures market at the prevailing price f, i.e., the amount that is known that will be paid to the international creditor should be bought and the final price for that purchase is R$ f (1+i^*).

Transactions (2.a) to (2.d) result in a profit of R$ [s (1+i) – f (1+i^*)] at the settlement date of the USD futures contract, without the need of any initial capital. As this is a riskless transaction, because all prices are known at the present time, if the profit is positive, is said that there is an arbitrage opportunity. If that occurs, it is possible to have a profit following the steps (2.a) to (2.d) without incurring in any risk at all and without any initial capital. It should be noted that cases 1 and 2 are mutually exclusive.

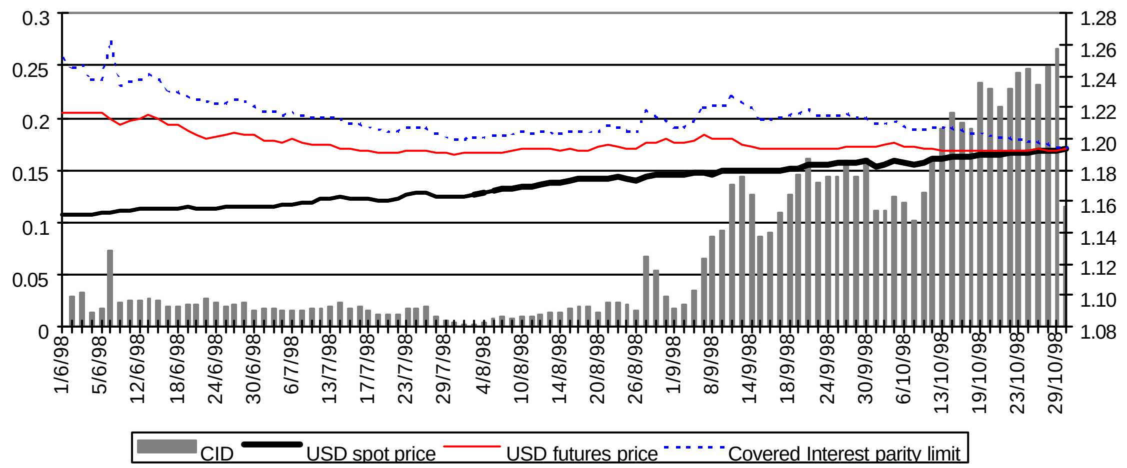
In practice, financial markets are aware of those arbitrage opportunities, thus we can expect that none of the cases above will last for long. Therefore, the very existence of arbitrageurs in financial markets means that there will be a lack of arbitrage opportunities like the two cases described above. The only case in which neither arbitrage opportunity occurs is when:

R$ [f (1+i^*) – s (1+i)] = R$ [s (1+i) – f (1+i^*)] = R$ 0, i.e.,

$$f = \frac{s \cdot (1+i)}{(1+i^*)} \qquad (1).$$

However, in practice, the USD futures price almost always lies below the value of f in equation 1, as it is seen in Figure 2. It portrays the typical behavior of a USD futures contract. The thicker (black) line in the bottom is the exchange rate (USD/BRL), from 6/1/1998 to 11/3/1998 (right-hand-side scale). The solid (red) line in the middle is the futures price for the November futures contract (maturing on the first business day of November, 1998). The upper dotted (blue) line is the theoretical limit established by covered interest parity, i.e., what the futures price would have been had covered interest parity been held. The wedge between the actual futures price and the theoretical one is the CID, which is represented by the bars in % per year (left-hand-side scale).[7] That wedge is the country risk.

Figure 2
Covered Interest Rate Parity Differential (CID)



When the USD future rate lies below limit f, established in equation 1, there is an arbitrage opportunity like the one described in the 2nd case of the last section (when the USD futures contract is cheap). In such environment, foreign investors may resort to a loan in the US, transfer the funds to Brazil and invest them at a fixed interest rate. Simultaneously, the foreign investor hedges himself against currency devaluation in the USD futures market and he can still have a net gain after the repayment of the loan in the USA. In theory, it is possible for the foreign investor to have a positive profit with a zero initial investment without assuming any risk at all, i.e., there would be an arbitrage profit. Indeed, that has been the source of immense profits for many players in the Brazilian financial market in the nineties until the start of the international financial crises.

[7] One should not be very impressed by the increase in the CID a few days before the contract settlement date,

When that arbitrage profit is zero, then the covered interest parity condition holds. Covered interest parity is equivalent to the equation (1) above. However, Figure 2 shows that, in Brazil, that condition was usually violated. There was a covered interest parity differential, described before as a good measure for the country risk. In the next section, we are going to use the covered interest parity condition to analyze the domestic interest rate.

II. 4. Analysis of the Domestic Interest Rate[8]

For emerging markets like Brazil, the domestic interest rate can be analyzed in the following way, according to the definition of covered interest parity adding the country risk:[9]

$$i = i^{*} + (f - s) + cor \qquad (2)$$

Following the same notation used before, i is the domestic interest rate; i^*, international interest rate; f, (in logs) the USD futures price; s, (in logs) the USD spot price and cor, the country risk.

The second term of the equation above is called the **forward premium**, and it is observable through futures market.[10] The forward premium can be analyzed in the following way:

$$(f - s) = E_t(s_T - s_t) + cur \qquad (3)$$

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because, as maturity approaches, the contract loses liquidity and the price is no longer very informative.

8 This subsection is strongly based in Garcia and Olivares [2000]. Here, the meaning of the word analysis is breakdown.

9 From this section on, we start using continuous compounding. We do this to ensure, in the following interest rates decomposition exercises, which the parts are add up to the total. As it is well known, only in continuous compounding and simple compounding, equivalent rates are proportional (i.e., 1% per month corresponds to 12% per year, for example).

10 As we will explain later (Subsection IV.2), the measure of the forward premium also depends on where the contract is traded.

The first term on the right side of the equation above, $\mathrm{E}_t(s_T - s_t)$, is the expected depreciation measured today, i.e., the difference between the (log of) spot USD today, t, and the value of the (log of) spot USD at the end of the period, *T*. The second term, *cur,* is the currency risk premium, i.e., the difference between the USD futures price and the expectation of the spot USD at the settlement date, being the first term usually higher than the second one. As we shall see, at times of uncertainty, this difference increases, decreasing in less turbulent periods.

The problem faced is that currency risk is not measurable in a direct way, because there are no direct measures of expectations. What is registered is the USD futures price, but USD futures are distinct (usually higher) than the expectations of the USD spot in the future.

Therefore, for countries with floating exchange rate regimes, it is interesting to decompose the domestic interest rate according to the following equation:

$$i = i^* + E_t(s_T - s_t) + cor + cur \qquad (4)$$

Based on equation (2), it is possible to obtain the country risk by residual:

$$cor = i - i^* - (f\text{-}s)$$

It is also possible to obtain another measure for the country risk, again by residual, through the yield (usually referred as coupon in the Brazilian market) of USD-linked bonds, which is the rate of return, in foreign currency, of a domestic investment (in Brazil) in a USD indexed bond.[11] It is possible to analyze the yield of this coupon on USD-linked bonds (*cc*):

[11] This rate is traded in BM&F, both through a futures contract (DDI) and a swap contract (Dol x Pre), for different maturities (the swap is longer). The reader should consult the description of BM&F contracts at www.bmf.com.br. For the validity of equation (5), it is necessary that the rate traded in BM&F be converted to continuous compounding.

$$cc = i^{*} + cor \qquad (5).$$

In the following section, we are going to use financial instruments, including derivatives, available in domestic and international financial markets, to measure the components of the right side of equation (4), and proceed to the analysis of domestic interest rates.

III. MEASUREMENT OF CURRENCY RISK AND COUNTRY RISK

In this section, we generate the measures for the country risk and the estimates for the currency risk. Those measures will be used in the analysis of domestic interest rates in the next section.

III. 1. Brazil Risk

We developed several measures of Brazil Risk, computed in different ways for the period January, 1995 to June, 2001.[12] These different measures come from several securities, including derivatives. The country risk measures will vary according to the securities used in its computation. We will now describe the different financial instruments used in the analysis.

III. 1. 1. Swaps

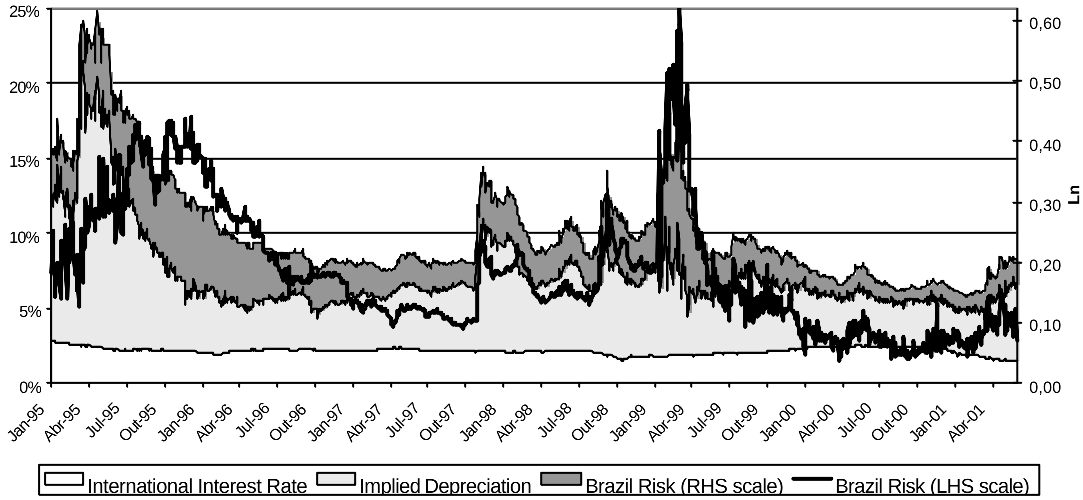
The first approach for the covered interest parity differential for the Brazilian case was made using data from the Brazilian fixed income markets, which capture all the variables involved in this analysis. The following two swap contracts were used: DI X Dol, which is a currency swap, and DI X Pre, which is an interest rate swap. Swaps may be interpreted as a collection of forward agreements. Each of the swaps used here are akin to only one forward agreement, since they involve only one settlement. And since forward contracts are quite similar to futures contracts, our approach will be based in the arbitrage conditions developed in Subsection II.3 for the futures contracts.

[12] For data on the early nineties, see Garcia and Valpassos [2000].

The raw data used in this analysis are one-year contracts, thereby capturing one-year-ahead expectations. Thus, they should reflect one-year expectations for currency depreciation, domestic and international interest rate.[13] We also conducted the same analysis with the other (shorter) time spans available, but opted for the one-year-ahead period (the longest available) because it is less volatile.[14]

The results are displayed in Figure 3. The different areas show the behavior of each of the components analyzed (left-hand-side scale) and the line represents the Brazil Risk (right-hand-side scale).[15] The sum of all areas is the one-year-ahead domestic interest rate, measured by the Swaps DI X Pre contracts (right-hand-side scale).

Figure 3
Brazil Risk - Swaps



III. 1. 2. Bonds Issued Abroad (Foreign Debt)

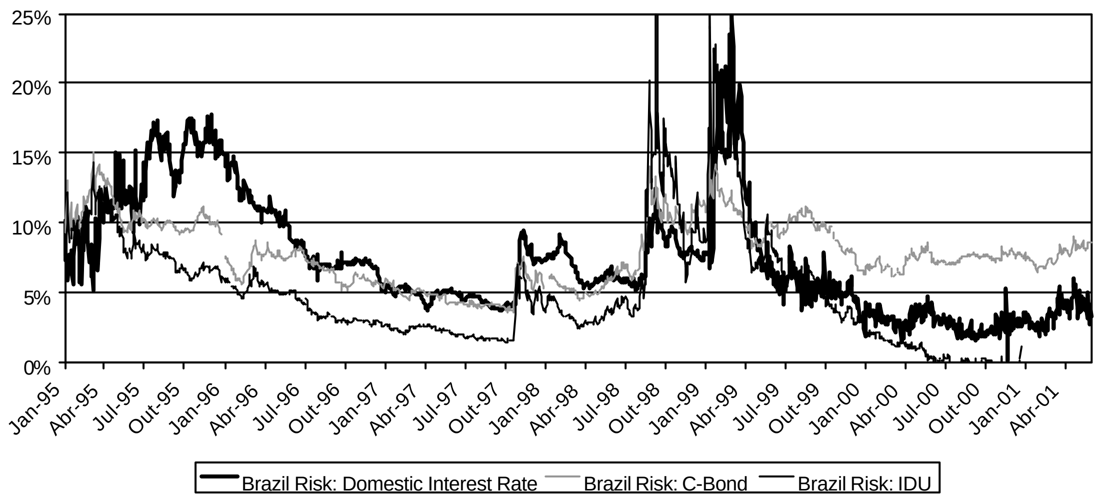
Another way to measure the Brazil Risk is through the Brazilian foreign debt, the majority of which is denominated in USD. Therefore, the measure of Brazil Risk is the difference between the secondary market yield of these bonds and the yield of a risk free bond,

[13] A detailed description of the data set is in Appendix 1.
[14] See Appendix 2 for a comparison between Brazil Risk in the short and medium run.

typically a US Treasury Bond with the same expiry date of swap contracts, i.e. the spread-over-treasury of the bond.

C-Bond and IDU are the Brazilian Bonds considered in this analysis. The IDUs (*Interest Due and Unpaid*) are sovereign bonds issued in November 20, 1992 (US$ 7,100 millions) with expiry date in January 1, 2001, under the terms of the Brady agreement. C-Bonds (*Brazil Capitalization Bond (C)*) are sovereign bonds, which were issued in April 15, 1994 (US$ 7,387 millions) and have a longer life, with expiry date in April 15, 2014. Therefore, the difference in yields between these two bonds reflects, among other effects, the slope of the yield curve. In the beginning of the period analyzed here, IDU bonds were the most traded Brazilian bonds in foreign markets. However, they started to lose liquidity in the market as they approached maturity, and in the last few years, the C-Bond became the most liquid Brady Bond. Figure 4 shows all the measures of Brazil Risk together, allowing a comparative analysis.

Figure 4
Brazil Risk - Bonds



As it can be seen from Figure 4, the measures of Brazil risk move together. After the Mexican crisis (December 1994), all of them were decreasing until the Asian crisis in

[15] The upper area is the same as the line, only in different scales.

October 1997. After that event, all of them started a decreasing trend, although at a level higher than before the Asian crisis, until the start of the Russian crisis and the collapse of Hedge Fund *Long Term Capital Management* in August 1998. The Brazil Risk increased substantially during that period (by all measures) and, again, it decreased after the crisis. However, it remained at an even higher level than before the Russian crisis, which was already higher than before the Asian crisis. The downward trend ended with Brazilian devaluation in January 1999. When it happened, all the three measures exploded and started a soft decline only in the second quarter of 1999. In summary, all these measures show a very high correlation, strongly reacting to the local and international crises. Table 1 shows the estimated first statistical moments of the different measures of the Brazil risk.

TABLE 1
STATISTICS OF BRAZIL RISK´S DIFFERENT MEASURES

CORRELATION

	RB - CBond	RB - IDU	IDU - Cbond
PRECRISES (UNTIL OUT/97)	0,70235	0,64840	0,96563
CONTROLLED EXCHANGE RATE (UNTIL DEZ/98)	0,63865	0,49838	0,90309
FLOATING EXCHANGE RATE (SINCE JAN/99)	0,76184	0,86569	0,88780
FLOATING EXCHANGE RATE (SINCE JUN/99)	0,76010	0,85229	0,79566
CRISES (CONTROLLED EXCHANGE RATE) (UNTIL DEC/ 1998)	0,67948	0,75570	0,91039

MEANS

	Swaps	C-Bond	IDU
PRECRISES (UNTIL OUT/97)	0,09047	0,07455	0,05077
CONTROLLED EXCHANGE RATE (UNTIL DEZ/98)	0,08564	0,07484	0,05512
FLOATING EXCHANGE RATE (SINCE JAN/99)	0,05302	0,08421	0,04342
FLOATING EXCHANGE RATE (SINCE JUN/99)	0,03736	0,08001	0,02328
CRISES (CONTROLLED EXCHANGE RATE) (UNTIL DEC/ 1998)	0,07166	0,07320	0,06279

VOLATILITIES (STANDARD DEVIATIONS)

	Swaps	C-Bond	IDU
PRECRISES (UNTIL OUT/97)	0,04061	0,02637	0,02903
CONTROLLED EXCHANGE RATE (UNTIL DEZ/98)	0,03581	0,02601	0,03516
FLOATING EXCHANGE RATE (SINCE JAN/99)	0,04408	0,01576	0,05183
FLOATING EXCHANGE RATE	0,01387	0,01148	0,02545

(SINCE JUN/99)			
CRISES (CONTROLLED EXCHANGE RATE) (UNTIL DEC/ 1998)	0.01562	0.02574	0.04507

Although they are extremely positively correlated, the differences among the different measures are not negligible. Some of the reasons for these differences are the existence of different kind of risks inherent to any of the financial instruments used in the analysis, different tax treatment among them, and the fact that these instruments have different maturities and durations (they are at different points of the yield curve).

Another important reason to explain the difference between the Brazil Risk measure derived from the domestic interest rate and the others derived from the secondary market yields of the foreign debt (*Stripped Spread C-Bond* and *IDU/Libor*) is the fact that domestic interest rates in the short run are somewhat under the Central Bank's control. The others just reflect just expectations of agents expressed by the secondary market yield of these bonds. For example, the Central Bank might fix the domestic interest rate at a higher level than what the risk perception of foreign investors would require to maintain their funds in domestic bonds. In this case, which actually occurred from mid-1995 until the Asian crisis, and again during the first four months of 1998, there were huge capital inflows, causing large accumulations of foreign reserves (which seemed to be one of the Central Bank's policy objectives during those periods).

Therefore, the Brazil Risk measured through domestic interest rates (*Swaps*) measures how much yield the domestic fixed return assets **offers** to cover the Brazil Risk. The Brazil Risk measured through the yields of external debt bonds (*Stripped Spread C-Bond* and *IDU/Libor*) measures the yield **required** by investors to cover the Brazil Risk. When the former measure was bigger than the latter one, there was a capital inflow. And, in the same way, when the former was smaller, there was a capital outflow.

This situation, however, seems to have changed recently. As shown in Figure 4, the Swaps line has been systematically below the *Stripped Spread C-Bond* line without causing further depreciation.[16] Probably, this new dynamics is associated with more inflow of direct investments in Brazil, which are much less sensitive to the interest rates than the short run capital that has entered (and left) until the BRL's devaluation of January, 1999. Now, we turn to the currency risk estimation.

III.2. Currency Risk

As noted before, the currency risk cannot be measured directly through financial instruments: currency risk is non-observable. In a classic paper, Eugene Fama [1984] derived and tested a model for the joint measurement of the currency risk premium variation and the expected depreciation variation of forward rates. He used data from nine of the most internationally traded currencies in the period of August 1973 – December 1982, and he found evidence that both components of forward rates vary with time. The two main conclusions of Fama's paper are the following:

1. The currency risk premium and the forward market's expected depreciation rates are negatively correlated, and

2. Movements in the forward rates are mostly due to risk premium variations.

Garcia and Olivares [2000] check the validity of these "fundamentals" conclusions of Fama for Brazil, using data of the USD futures market of BM&F from April 1995 –December 1998, a period in which was adopted a controlled exchange rate regime. The first of Fama's conclusions – the expected depreciation covaries negatively with the risk premium – was refuted, with the estimates indicating a positive correlation between them. The second of Fama's conclusions – the largest part of futures price variations is due to risk premium variations – was corroborated by the point estimates, although it has not been possible to reject the hypothesis that the variance of risk premium was equal to the variance of expected depreciation rate. Therefore, Fama's [1984] framework corroborated the importance of the currency risk in the determination of USD futures price in Brazil, and consequently, as a component of domestic interest rates.

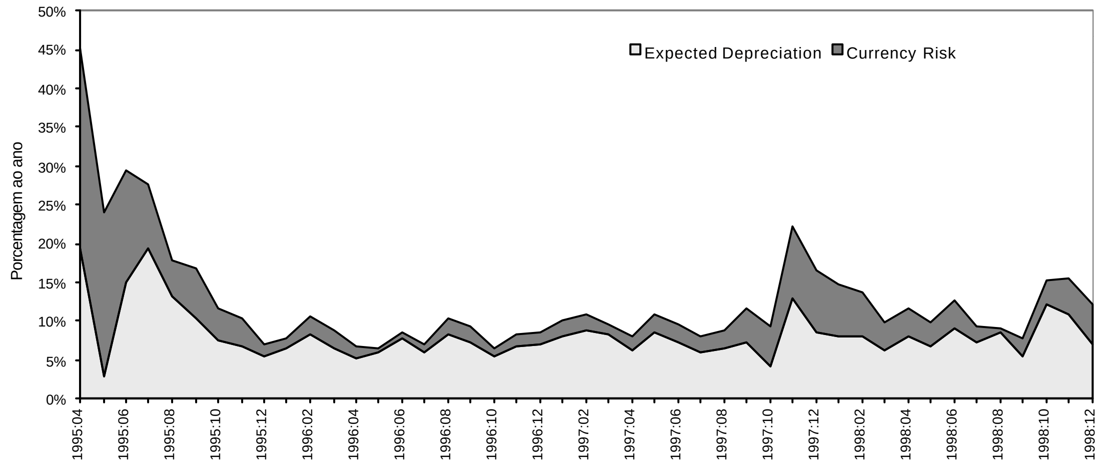
[16] For the recent period, *IDU* has become less relevant because it lost liquidity due to its short maturity.

The same analysis was undertaken with another data set. This alternative data set contains daily data for one-month-ahead currency swap contracts traded in BM&F (akin to one-month-ahead forward contracts). The available data cover December 10, 1997 to November 19, 1999. The results obtained show that, before the floating of the BRL in January 1999, the estimates of the slope coefficient of Fama's regression were not usually negative, however they were close to zero. When the turbulent period of January and February of 1999 were included in the regression, that slope coefficient drastically increased, and after that period, they decreased and oscillated around the (positive) value of one. This change in level can be explained by change of exchange rate regime. Brazil abandoned the crawling-peg regime--where the variance of risk premium was at least as much, if not even more important than the variance of the expected devaluation rate--for the floating exchange rate, in which the variance of the expected depreciation became higher than the variance of risk premium.

Garcia and Olivares [2000] go beyond the indirect measurement of the expected depreciation and currency risk premium shares allowed for by Fama's framework, and use an econometric technique aimed at estimating a non-observable variable – the Kalman Filter – to estimate the currency risk and the expected depreciation (these two add up to the forward premium).

The resulting estimates for the currency risk and for the expected depreciation obtained by Garcia and Olivares [2000] are shown in Figure 5 below. After estimating the currency risk, the expected depreciation is obtained by subtracting the currency risk from the forward premium. Figure 5 shows the analysis of forward premium. This analysis is very useful to examine the domestic interest rate, which is the subject of the next section.

Figure 5
Forward Premium Analysis



IV. ANALYSIS OF THE DOMESTIC INTEREST RATE

IV.1. Breakdown of the Domestic Interest Rate

From the results obtained by Garcia and Olivares [2000], it is possible to analyze the domestic interest rate. Based on what was seen (see equation (4)), the domestic interest rate can be decomposed as the sum of the following components:[17]

- International interest rate;
- Currency expected depreciation;
- Currency risk;
- Country risk.

Figure 6 shows this analysis. To understand the joint behavior of those components, it is interesting to study the correlation between our estimates of currency risk, expected devaluation rate and the covered interest parity differential (the Brazil risk). Table 2 shows

[17] It should be remembered that the adoption of continuous compounding allows us to express the domestic

the correlation between the variables. Observe that there is a positive correlation between the currency risk premium and expected depreciation rate, which is consistent with the results of Garcia and Olivares [2000] using the Fama methodology.[18] On the other side, the covered interest parity differential (the Brazil risk) shows a much higher correlation with the currency risk premium than with expected devaluation, the latter being almost null. This indicates that some of the factors that explain the currency risk could be the same as some of the factors that explain the Brazil risk. This is why we call those two risks the cousin risks.

Figure 6
Analysis of Domestic Interest Rate

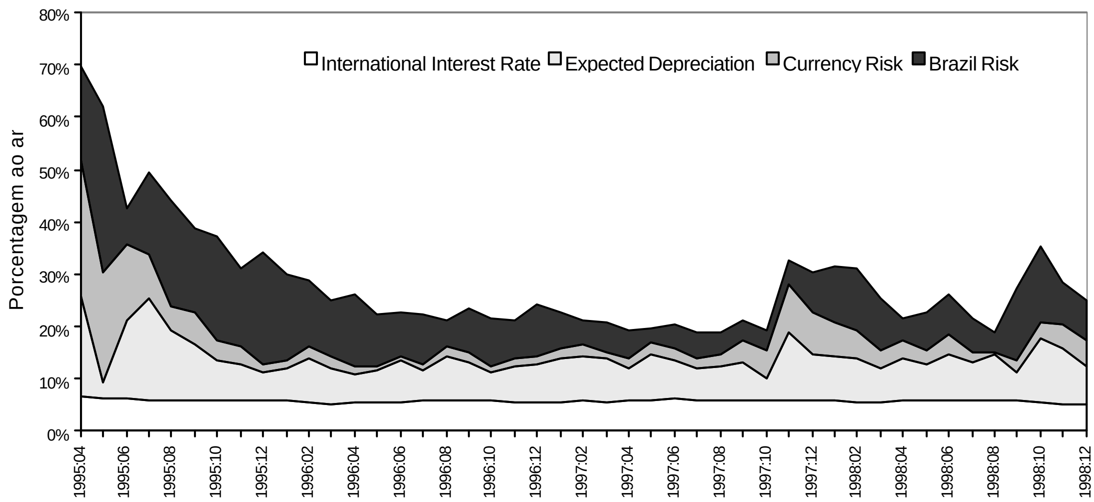


TABLE 2

CORRELATION BETWEEN ESTIMATES

Period 1995:04 - 1998:12

	Exp. Dev.	Currency Risk	Brazil Risk
Exp. Dev.	1,000	0,505	0,066
Currency Risk		1,000	0,499
Brazil Risk			1,000

interest rate as sum of its components.

[18] Remember that the so called *forward premium puzzle* (negative slope coefficient in Fama's regression) is implied by the existence of a negative correlation between the risk premium and the expected depreciation rate, but Garcia and Olivares [2000] have not found a negative coefficient to Brazil.

In summary, when using the estimate for the currency risk premium obtained via the Kalman filter, it was possible to estimate the expected devaluation rate. Garcia and Olivares [2000] calculated, thus, the covered interest parity differential, or Brazil Risk. The interest rate decomposition exercise showed not only that the covered interest parity cannot be verified in the Brazilian case, but also that covered interest parity differential constitutes a sizeable component of the domestic interest rate. There is a positive correlation between the currency risk and the expected depreciation rate. The Brazil risk shows a high correlation with the currency risk and is almost orthogonal to the expected depreciation, which is an indication that both risks are mostly explained by common macroeconomic factors. In the next section, some preliminary attempts are made at identifying some macroeconomic factors that lie behind the cousin risks.[19]

IV.2. The Determinants of the Cousin Risks

In this section, a preliminary analysis will be undertaken to identify some of the determinants of Brazil Risk and currency risk. It could be argued that the currency risk premium is due to the fact that it is a systemic risk associated to the inability to diversify relatively to the exchange rate. This risk is associated, as is Brazil Risk, to the domestic macroeconomic fundamentals and to the external shocks.

An interesting political economy question is which factors among the macroeconomic fundamentals that affect both the currency and the Brazil risks are more important, because it is exactly these that should be confronted to allow a more effective fall in interest rates. For example, if Brazil Risk and currency risk are both determined by fragile fiscal fundamentals, an improvement in these conditions would bring about a substantial fall in interest rates. But, if these risks are mainly determined by doubts about balance of payments sustainability, it will not be an improvement in fiscal situation that would bring a significant decrease in interest rates. We now turn to the study of these determinants.

[19] The objective is to investigate the determinants of both the Brazil Risk and the currency risk. However, we still do not have any reliable estimate of currency risk for the period after the BRL devaluation, restricting Subsection IV.2.

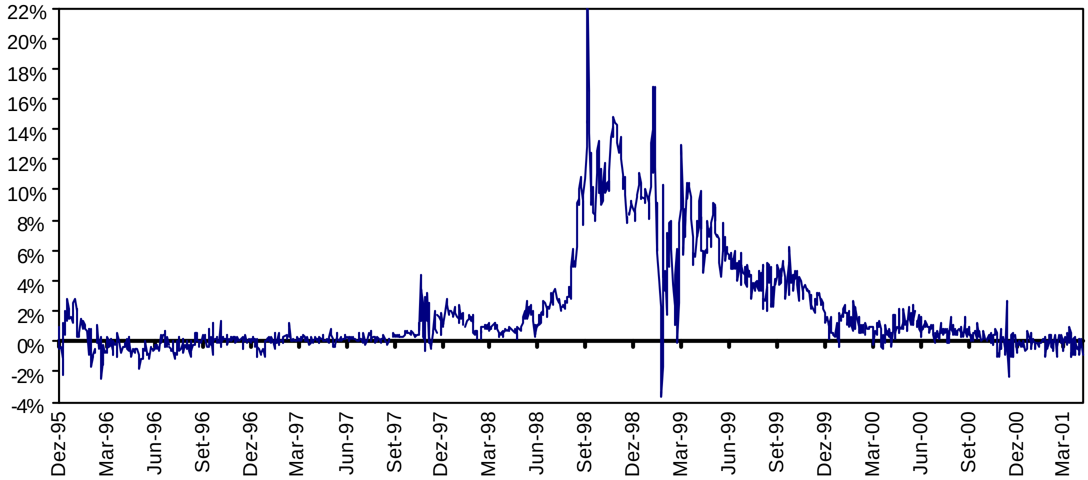
One of the main determinants of a country's (say, Brazil) Risk is the convertibility risk, i.e., the risk associated with the possibility of not being able to convert BRLs into foreign currency. This risk encompasses the possibility that capital controls may be introduced preventing the international transfer of funds, but do not include the default risk (which is included in the country risk).

To obtain one measure of this convertibility risk, a data set of implied currency depreciation in BRLs' non-deliverable forwards contracts (NDF) traded in New York was used, subtracting the expected depreciation measured by swap contracts from the NDFs, as was done to calculate one of the measures of Brazil Risk. So, the difference between these expected depreciations is a proxy for the convertibility risk.[20]

In other words, a NDF contract is essentially the same as the currency swap (or futures) contract traded in BM&F in São Paulo, except for the fact that the contract traded in NY is settled in USD and the contract traded in São Paulo is settled in BRL. For example, an investor that had bet on the BRL devaluation before January 1999 would have made a lot of money, but his gain would have been paid in USD in NY and in BRL in Brazil. Under free convertibility, both gains would be the same, because it would be possible to obtain USD with the equivalent sum of BRLs. However, if any controls on the remittance of USD to the foreign country after the devaluation were imposed, the two amounts would not be the same. The investor that traded in São Paulo would receive BRLs (nominally) equivalent to the USD, but he would not be able to receive the equivalent amount in USD. In the past, when this kind of situation happened, the so-called black market of USD traded at a huge premium. It is because of this convertibility risk that the price of USD in the NDFs (measured by the inverse of the price of BRL-NDF) is higher than the USD futures traded in the BM&F in São Paulo. The difference between prices is transformed into annual yields, with the results shown in Figure 7A.

[20] All data are daily and relative to the one-year period covering from December 1995 to June 2001.

Figure 7A
Convertibility Risk



In this Figure, it is possible to observe that a learning process concerning the pricing of the convertibility risk occurred. Until the Asian crisis, the convertibility risk was around zero, i.e., the markets were not pricing the convertibility risk. Therefore, during this period until the first crisis, the Asian crisis, the convenience yield—the yield that reflects the differences between the prices of contracts traded in NY and São Paulo—did not reflect the convertibility risk.

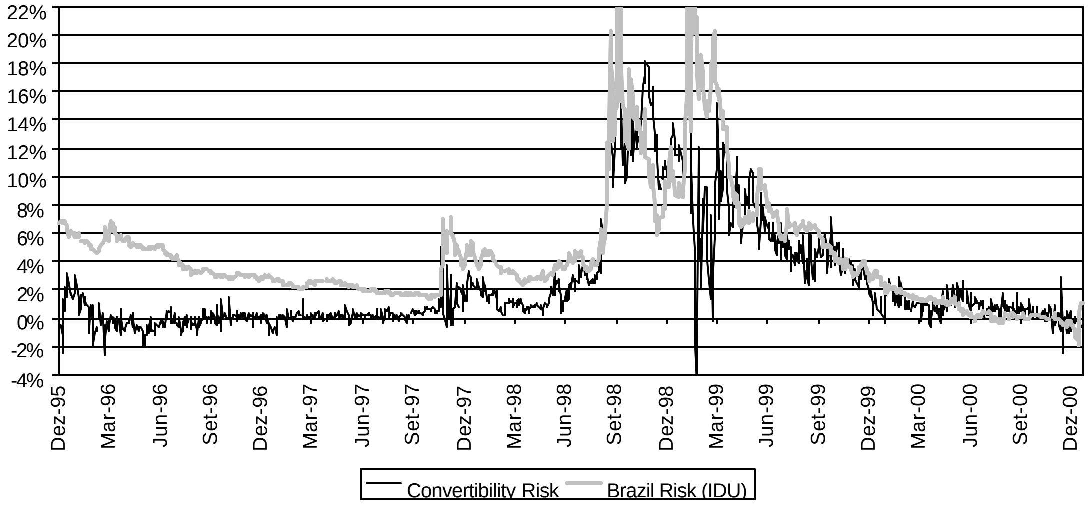
When the Asian crisis erupted in October 1997, the market suddenly learned that those two contracts were not equal, i.e., the contracts traded in SP had a higher risk than the NDFs traded in NY, namely, the convertibility risk. At that time, there were stories flying about arbitrageurs that sold USD futures in NY and bought them in SP, thinking that they were completely hedged in their investments. When the Asian crisis happened, and they found out that they were carrying risks and not arbitraging, they rushed to close out their positions, selling in SP and buying in NY, which might have originated the sudden jump in the convertibility risk that is seen in Figure 7A.[21]

Since the convertibility risk is one of the components of the country (Brazil) risk, it is interesting to compare the behavior of the two risks. In Figure 7B, the Brazil risk is

[21] Brazilian tax laws could potentially have played a role, as well as fears that the possible bankruptcy of many institutions could threaten the clearinghouse solvency.

measured by the Brazil Risk (IDU) measure, whose duration is shorter than that of the C-Bond. In Figure 7C, the Brazil risk is measured by the stripped spread of the C-Bond (Brazil Risk: C-Bond) and the Brazil Risk: Domestic Interest Rate.

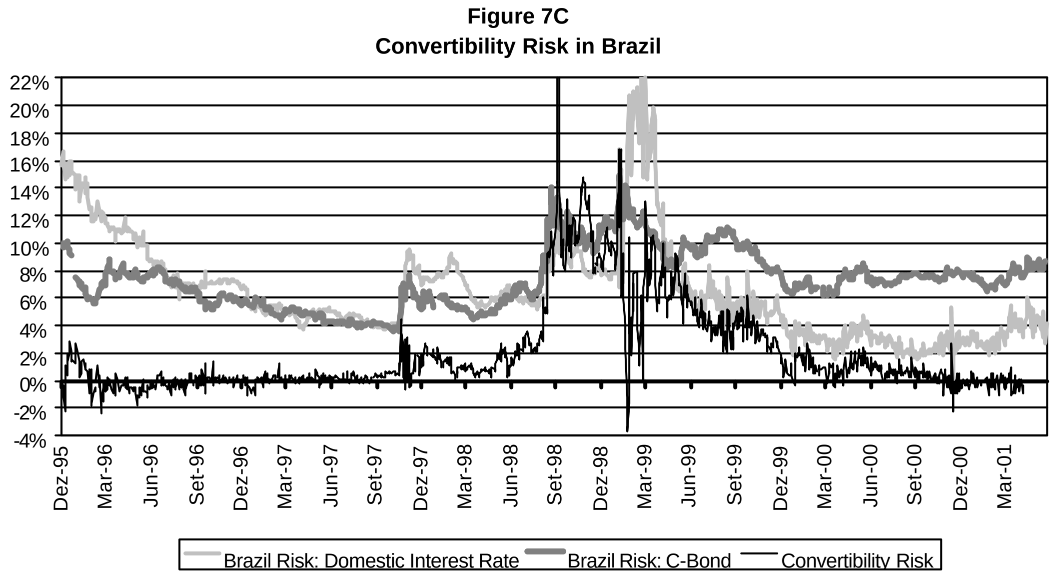
Figure 7B
Convertibility Risk and Country Risk



Note that after the Asian crisis, the convertibility risk became closer to the country risk, but now at a positive level, in contrast with the earlier period. Thus, after the Asian crisis, convertibility risk and country risk started to move together.

During the Russian crisis (August 1998) and the fall of LTCM, the convertibility risk jumped again, rising to extremely high levels in comparison to the preceding periods. Then, it became of similar magnitude of the country risk, and in the subsequent very turbulent periods, it became even higher than the latter.

Thus, after the Asian crisis, markets learned to price convertibility risk. It then became an important component of the country (Brazil) risk, and both risks started to exhibit similar behavior. The worse the crisis, the more important the convertibility risk became in explaining country risk. When the economic environment improved after the devaluation, the convertibility risk started a soft fall, although it has not returned to negligible levels previous to the Asian crisis, remaining at a positive, although lower, level.



Now, we are going to analyze another determinant of Brazil Risk, the situation of the external fixed return market. Different kinds of financial instruments have different kinds of credit risk, with US Treasury Bonds having zero credit risk. The "appetite" of international markets for credit risk (inversely related to the degree of risk aversion for credit risk) varies over time. For example, the collapse of the Hedge Fund *Long Term Capital Management* (LTCM) started a process of flight to quality, in which the investors, suddenly, became more risk averse, and tried to sell all their riskier assets to invest the funds in safe US Treasury Bonds. This movement affected Brazilian bonds in a negative way, despite the remarkable improvements in domestic fundamentals that followed the IMF agreement in the last quarter of 1998.

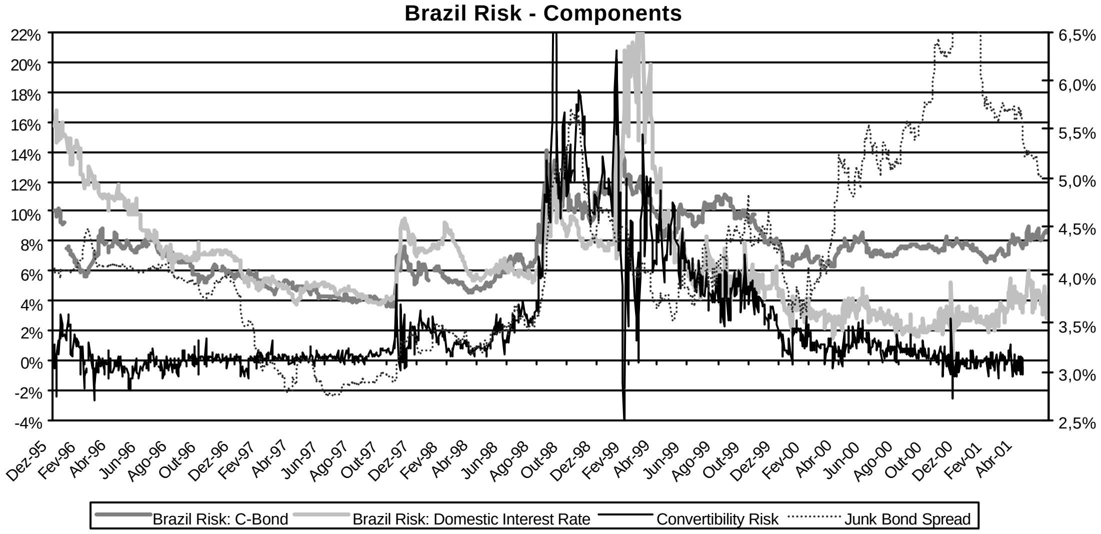
To measure the demand side for the Brazilian bonds, or the degree of risk aversion, the *US 10-Year Junk Bond Spread*[22] was used. In this spread, all US Junk Bonds whose credit rating is the same as Brazilian sovereign debt are included, i.e., bonds that have lower

[22] Data are obtained from Bloomberg.

ratings - below Baa (or BBB or B2, in the case of private bonds), according to the credit rating agencies like Standard and Poor's and Moody's.[23]

Therefore, the *US 10-Year Junk Bond Spread* measures the appetite for risk of the US fixed rate market; the higher the spread is, the lower is the appetite for risk. Figure 8 shows the *US 10-Year Junk Bond Spread* data (on the right-hand-side scale) together with the other measures of country risk and convertibility risk (on the left-hand-side scale). Observe that the demand for riskier bonds in USA worsened after LTCM collapsed after the Russian crisis, improved after that, worsening again in 2000, reaching the same levels as during the 1998 crisis. This is a factor of utmost importance affecting Brazilian bonds' prices and, through capital flows, also domestic interest rates. Needless to say that it is impossible to have any control over that important demand-side variable.

Figure 8
Brazil Risk - Components



To improve the comparison, we calculated the correlations between the *Stripped Spread of C-Bond* (C-Bond), Brazil Risk measured with *Swaps* (RB), Convertibility Risk (RC), *Junk Bond Spread* (JBS) and implied depreciation present in swap contracts – called the *forward*

[23] For a detailed analysis of the relation between the ratings of these credit rating agencies and country risk, see Appendix 3.

premium (FP). These correlations were computed for different subsamples, with the results displayed in Table 3.

Table 3 corroborates our previous conclusion that the market did not price the convertibility risk until the Asian Crisis, since its correlation with Brazil Risk (in both measures used) was very small. However, as the period increases (including the period until December 1998), this correlation becomes stronger, especially when the correlation between the Convertibility Risk with Stripped Spread of C-Bond is considered. The strong correlation between Convertibility and Brazil Risk is maintained (and it becomes even higher with RB) in the period when the Brazilian economy was under a floating exchange rate regime, after the crisis period (since June 1999). In the crises periods, the strong positive correlation with Brazilian Risk is maintained. However, observing the correlation between convertibility risk and one year expected depreciation measured by Swaps contracts traded on BM&F, it can be seen that this increases with time. The correlation, with a maximum value of 0.67, however, does not become stronger.

TABLE 3

	C-BOND - RC	RC – FP	C-BOND - FP	RB - JBS	C-BOND - JBS	RB - RC
PRECRISES (UNTIL OUT/97)	-0,1302	0,1619	-0,3946	0,7835	0,8327	0,0766
CONTROLLED EXCHANGE RATE (UNTIL DEZ/98)	0,7399	0,4399	0,2467	0,6409	0,8626	0,1689
FLOATING EXCHANGE RATE (SINCE JAN/99)	0,68227	0,4193	0,79327	-0,45289	-0,40608	0,70091
FLOATING EXCHANGE RATE (SINCE JUN/99)	0,77216	0,67391	0,75058	-0,51784	-0,31865	0,87168
CRISES (CONTROLLED EXCHANGE RATE) (UNTIL DEC/ 1998)	0,8984	0,0303	0,1595	0,6633	0,8848	0,6186

Thus, two important results associated to the relevance of convertibility risk can be observed through these comparisons. The first one is related to the learning process that has occurred with Non-Deliverable BRL Forward contracts traded in NY. The second result is related to changes in the composition of Brazil Risk in crises periods, during which the convertibility risk becomes the most important component.

Another important and interesting result is the increase in the correlation between the forward premium and Brazil Risk measured through *C*-Bonds after the adoption of a floating exchange rate. One possible conjecture is that, with a floating exchange rate regime, the increase in country risk affects not only currency risk, as occurred in the controlled exchange rate period, but also the expected currency depreciation, resulting in a higher correlation with the forward premium (which is the sum of expected depreciation and currency risk).

However, it is clear that these are not the only determinants of currency and Brazil risks. Truly, these are only two of the determinants of them. Variables that reflect the expected future behavior of fiscal and balance of payments accounts, as well as variables that reflect the degree of domestic financial market instability should also be considered in an analysis of this kind.

TABLE 4

Dependent Variable: CBOND_SPREAD
Method: Least Squares
Sample (adjusted): 2 108
Included observations: 107 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.318114	0.412696	-0.770820	0.4426
CBOND_SPREAD (-1)	0.703871	0.082745	8.506485	0.0000
NFSP_EXP1Y(-1)	-4.361887	1.521859	-2.866158	0.0051
JBS(-1)	0.137766	0.061659	2.234344	0.0277
IBOVESPA_USS(-1)	-0.082399	0.087554	-0.941121	0.3489
CA_EXP1Y(-1)	0.164463	0.137141	1.199226	0.2332

R-squared	0.888529	Mean dependent var	2.072420
Adjusted R-squared	0.883011	S.D. dependent var	0.142416
S.E. of regression	0.048711	Akaike info criterion	-3.151362
Sum squared resid	0.239654	Schwarz criterion	-3.001484
Log likelihood	174.5979	F-statistic	161.0129
Durbin-Watson stat	1.937170	Prob (F-statistic)	0.000000

Table 4 shows the preliminary results obtained from a regression analysis with the purpose of explaining Brazil Risk measured by the Stripped Spread of C-Bonds. The sample period is the floating exchange rate period, from May 1999 to June 2001, with weekly data. The variables included in the regression are:

- One-year-ahead expected domestic fiscal conditions (NFSP_EXP1Y – public sector borrowing requirements, in % of GDP);
- One-year-ahead expected Current Account (CA_EXP1Y);
- International financial markets conditions, measured by the a credit derivative that provides the spread between high-yield US corporate bonds and the US Treasury bond of equivalent duration (JBS – Junk bond spread); and
- Domestic financial markets conditions, measured by the domestic stock exchange return in US$ (IBOVESPA_USS).

The one-year-ahead expected variables come from a weekly survey conducted by the Brazilian Central Bank with Brazilian major financial institutions.[24] Using them on the regression analysis, we try to capture the market expectations that are essential in the perception of a country risk. All variables are lagged one week to prevent inconsistency.

The preliminary results are quite good. All variables included in the regression have the right sign. The R-squared is quite high and the regression passed both autocorrelation and normality tests[25].

An important thing to be noticed is the CBOND_SPREAD lagged component. If it is excluded from the regression, as in Table 5, in spite of the fall on R-squared, all coefficients become significant and, all variables but CA_EXP1Y have the right sign. Thus, not only this CBOND_SPREAD lagged component is relevant in the analysis but also all the other variables analyzed. Nevertheless, given the small sample (64 observations), further testing is needed.

[24] These data are available at the Central Bank website: www.bcb.gov.br.
[25] See Appendix 4 for statistical tests on those variables to corroborate these estimations.

Table 5

Dependent Variable: CBOND_SPREAD

Method: Least Squares
Sample (adjusted): 2 108
Included observations: 107 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.058657	0.012964	-4.524503	0.0000
NFSP_EXP1Y (-1)	-1.195732	0.074293	-16.09484	0.0000
CA_EXP1Y (-1)	-0.002177	0.000418	-5.208881	0.0000
JBS (-1)	0.669787	0.086830	7.713766	0.0000
IBOVESPA_USS (-1)	-0.028364	0.007513	-3.775551	0.0003

R-squared	0.795497	Mean dependent var	0.077147
Adjusted R-squared	0.787478	S.D. dependent var	0.011016
S.E. of regression	0.005079	Akaike info criterion	-7.681993
Sum squared resid	0.002631	Schwarz criterion	-7.557094
Log likelihood	415.9866	F-statistic	99.19274
Durbin-Watson stat	0.800505	Prob (F-statistic)	0.000000

V. CONCLUSION: WHAT ARE THE DETERMINANTS OF SUCH HIGH REAL INTEREST RATES?

This article reviews the arguments in the finance and open macroeconomics literature that are relevant for the Central Bank to set the level of the interest rate in an open economy. Several of relevant concepts were shown and analyzed through several financial instruments traded in domestic and international markets, specially, financial derivatives. Country risk (Brazil Risk) was measured with different financial instruments and currency risk was estimated through the Kalman Filter.

We show that—besides the currency risk, which is also relevant in developed economies—the country risk (Brazil Risk) is important to determine the domestic interest rates. Brazil Risk and currency risk have a strong positive correlation (0.5) for the controlled exchange rate period of the Real Plan (the estimates for the period after the floating of the BRL are still being carried out). This demonstrates that both risks share common causes, being, therefore, called the cousin risks. Thus, when and if the common causes are confronted, the fall of domestic interest rates can be substantial, because both currency and Brazil risks may fall at the same time.

Although have not yet been able to provide reliable estimates for currency risk from the floating exchange rate period, the fact is that the correlation between Brazil risk and the forward premium (which is the sum of currency risk and expected depreciation) significantly increased after the change of the exchange rate regime. I.e., in the current exchange rate regime, the determinants of Brazil risk seem to affect the exchange rate (via currency risk and via expected depreciation) and the domestic interest rates much more strongly.

Preliminary results identify the components of Brazil Risk, e.g., the fiscal results, and the domestic and international financial markets conditions. The convertibility risk, defined as risk associated with possibility of not being able to convert BRLs into foreign currency, showed up as an important cause of Brazil risk during the international financial crisis periods, but is no longer relevant.

If one assumes that the real exchange rate will remain constant, it is possible to have and educated guess of the currency risk size, and to compare it to the Brazil risk. Doing so will reveal a currency risk above 5% (for one year), while the Brazil risk will hover below 3%. The currency risk remains quite high, despite the floating regime, while the country risk has been substantially reduced. Therefore, it seems that the principal benefits of the battle for a fall in domestic real interest rates are in the determinants of currency risk which should be associated to the sustainability of the balance of payments, especially the behavior of the current account and, thus, the behavior of imports and exports. It is in that direction that this research should continue.

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Appendix 1 – Data Set

Domestic Interest Rate

The domestic interest rate used is the swap DI x Pre for 360 days. Swap is an exchange of risk, without the transfer of principal, and what matters is the difference between the yields of each side of the contract traded. It is possible to say that they are really forward contracts. In an interest rate swap, which in this case is the swap DI x Pre, when an investor buys one contract, he is investing his money at a floating interest rate (CDI/CETIP – DI variation) and paying a fixed interest rate (Pre side). The quotation of those contracts is given by the Pre rate (based on 360 days) which is used in the calculation of Brazil Risk.

International Interest Rate

The country chosen as representative of the rest of the world was the USA and as a proxy for international interest rates that captures expectations for 1 year, 1-Year Treasury Constant Maturity Rate was used (published by Federal Reserve Board of Governors of the USA). This 1-year expected interest rate, composed of the yields of traded bonds in the US financial market, is adjusted to reflect this constant maturity of one year. The adjustment used interpolations of daily yield curves, based on the yields (bid yields of end of the day – closed market) of US Treasury Securities traded in the so-called over-the-counter market (for example, when a contract is dealt by phone, i.e., it is settled directly by traders and not through a financial institution). These yields are calculated through the composition of prices obtained by the Federal Reserve Bank of New York. Therefore, even if there is no bond with this maturity, through this methodology it is possible to obtain a price for a bond with that maturity.

Expected Devaluation and Currency Risk Premium

To measure the expected devaluation in a certain period, the Dol X Pre currency swap rate would be the correct one to use. However, these contracts don't have enough liquidity to reflect accurately economic agents' expectations. Thus, the information in DI x Pre and DI x Dol interest rate swap contracts[26] are analyzed together and could give us the information in the Dol X Pre currency Swaps. Swaps contracts were explained before, and because they are very similar to forward contracts, we can use them as a good indication of the market's expected devaluation. Among the most liquid contracts, there are these two just cited above, if the period since 1999 was considered. So, this calculation is not just an abstract way of measurement of expected devaluation in economy, it should be very close to the true measure of it. One of the advantages of this data set could be the reduction of costs associated to this kind of transaction through the aggregate of all these costs (transaction costs, borrowing costs and the cost of hedging) into just two contracts.

In a DI X Dol currency swap contract, there is an exchange of two floating rates. Who takes the long position in this contract receives the yield of DI and pays USD depreciation in the period of the contract sum up to a known fixed interest rate (known as coupon on USD-linked bonds). The price of that contract is given by that interest rate, being linear and based on a 360-days basis[27].

[26] Considering, as an example the data set of May 2000, the number of opened Swap DI X Pre contracts was 4.875.496, reflecting a financial traded volume of US$ 24.440.704, with 893.820 traded contracts. Of the DI X Dol Swaps contracts, 1.304.542 contracts were opened, reflecting a traded volume of US$ 7.086.790, with 259.237 traded contracts, while only 1.127 contracts were opened for Dol X Pre swap contracts and none of them was traded.

[27] For a detailed description of these contracts, see BM&F's site.

Thus, the USD expected devaluation was calculated through the difference between the quotations of DI X Pre and cleaned coupon on USD-linked bonds[28] of DI X Dol swap contracts. However, in the expected devaluation measured through Swaps contracts there is a risk premium inherent to these contracts. And that risk premium can give a biased estimate of expected devaluation if compared to what really is going to occur in the period.

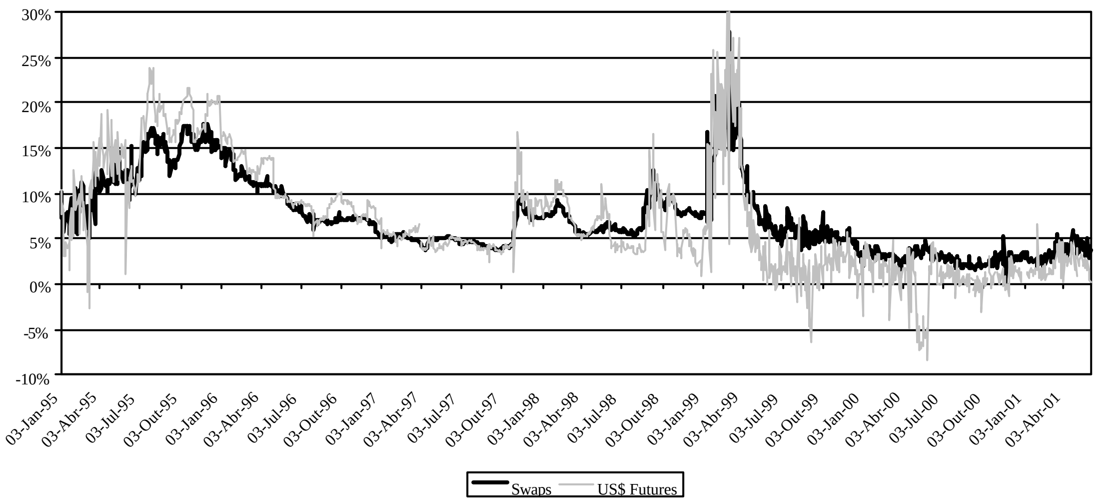
[28] CUMPOM CAMBIAL data were cleaned through the methodology described in Lemgruber [1999].

Appendix 2 – Brazil Risk – Short Run X Medium Run

Figure below shows Brazil Risk as analyzed before through swap contracts and a measure of the short run[29], 3 months, calculated in the same way as the other measure, although it uses USD futures market traded in BM&F. Thus the differences between these two measures of Brazil Risk reflect basic differences due to the short and medium run. An evident fact of this comparison that can be seen in the Figure is the higher volatility of short run measure. The volatility of the short run measure, for the period of January 1995 – June 2001, is 6.2%, being higher than the volatility of the other measure (that reflects 1 year Brazil Risk), which is 4.2%. This reflects the fact that short run expectations are more sensitive to daily changes in financial markets. Generally, these fluctuations are due to very specific factors that might have affected the expectations just in that specific day, but they are associated just to very short run expectations and are not supposed to affect the medium and long run economic conditions. Therefore, the analysis of Brazil Risk measured with Swaps is much more interesting and adequate in comparison to the other measure with USD futures contracts.

[29] This Brazil Risk measure was used in Garcia and Valpassos (1999).

Brazil Risk - Short Run X Mediun Run



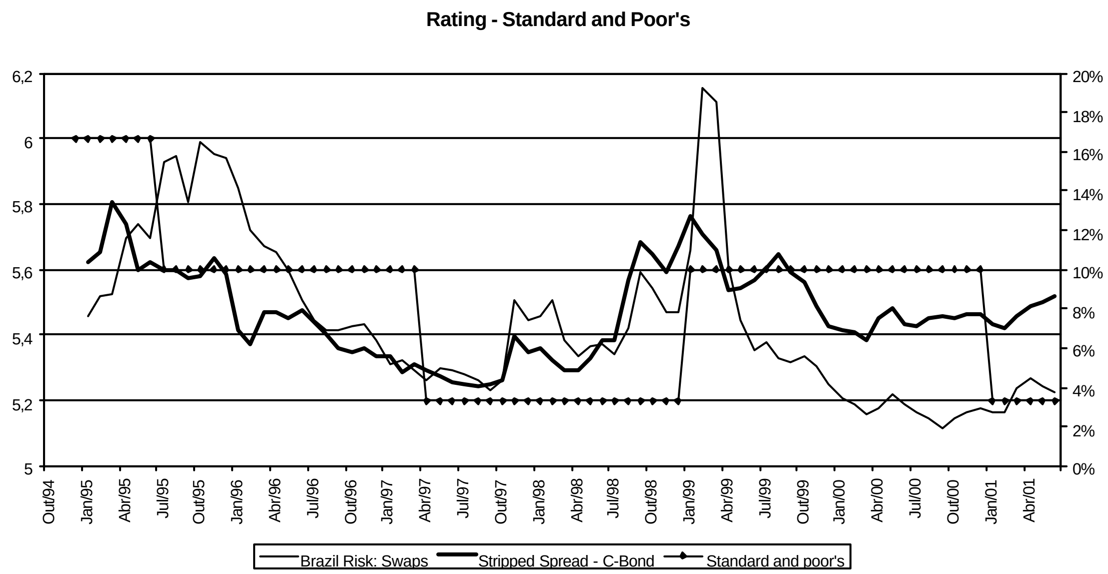
Appendix 3 – Credit Rating Agencies

The risk of a bond issued by any government in a foreign currency is related to the fact that this government could possibly not be able to issue money to pay its debt. Therefore, the role of a credit rating agency is to try to analyze the ability and willingness of the governments to generate foreign exchange enough to pay back its obligations. In this way, the sovereign rating should be the highest in a certain country, and any other private emission should not be able to receive a higher classification than that sovereign ceiling. This is due to the fact that the government has the legal power to intervene through currency controls in the capacity of all private firms to meet its obligations denominated in foreign currency. Fitch IBCA Ratings, for example, considers in its analysis not only public obligations, but also private ones denominated in foreign currencies to analyze the need of a certain country to generate foreign exchanges. This is due to the fact that in 80's there was a renegotiation of external debts by several governments that took responsibility for the private sector debt too.

To Moody´s and Standard and Poor's, the credit rating is an opinion about the future ability, legal obligation and willingness of the issuer in make all the payments. Therefore, its objective is strictly to analyze the credit conditions of the issuer and the possibilities of default, considering the guarantees given by the issuer and the size of the possible losses for someone who buys that credit instrument. To analyze the so-called sovereign ceiling, the agencies consider the macroeconomic fundamentals of a certain economy, including implied volatility in the economy. To do that, they consider variables that could, in a certain way, foresee possible problems in the future like growth, inflation, current account, unemployment level and other not-so-evident variables such as the flexibility of an economy and its openness. However, these credit ratings do not measure, for example, risks related to the lost of market value of these credit instruments and risks related to bilateral conflicts between the issuer's country and the institution's country where the issue took place. Another risk that is not incorporated in these ratings is convertibility risk, i.e., if the payment of a certain obligation would be affected or not by any kind of control adopted by the government in relation to the currency of denomination.

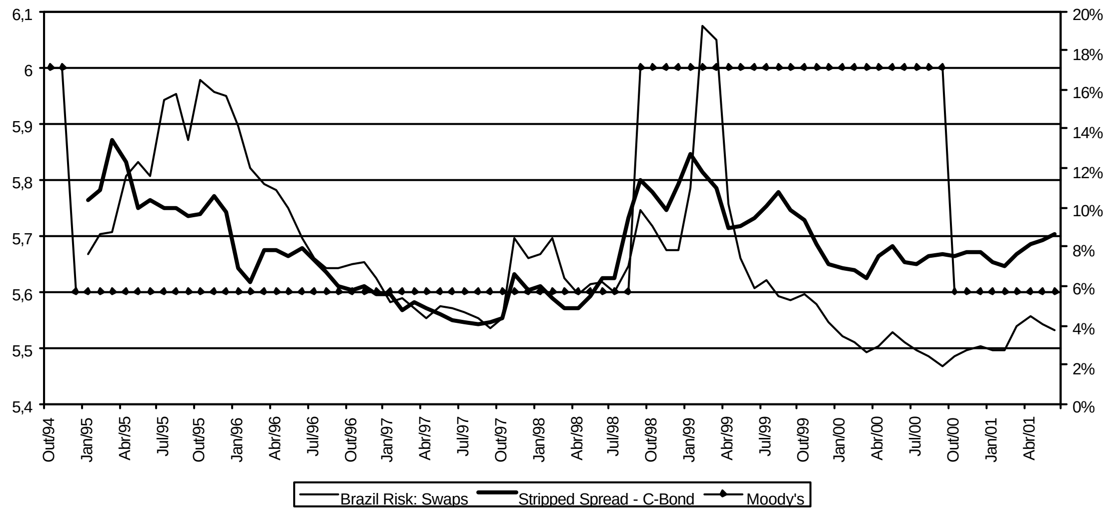
Observe in the following figures the actions related to Brazilian long debt denominated in foreign currency of the three credit rating agencies: Standard and Poor's, Moody's and Fitch IBCA, for the period of the Real Plan. It should be observed the lagged behavior[30] of these agencies in comparison to the behavior of Brazil Risk, measured by Swaps (before developed) and the Stripped Spread of the C-Bond.

Through these Figures, it is possible to see the conservative behavior of certain agencies like Moody's. That one, 18 months after the adoption of a floating exchange rate regime in Brazil, in January of 1999, still did not change Brazilian's long-term debt denominated in foreign currency, classified as B2. However, Fitch IBCA already changed its rating twice in the same period, improving its rating from B, in January 1999, to BB+, nowadays.

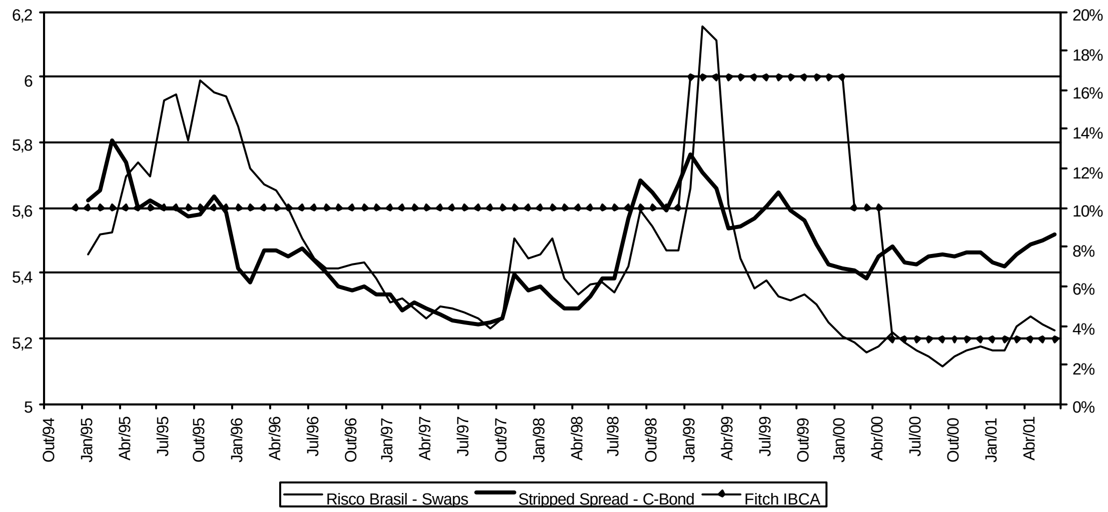


[30] Credit rating agencies classify in a very similar way long run debts denominated in foreign currency of countries. To transform these ratings into values that could be observed in a Figure, a scale from zero to ten was created, tem being the worst possible classification. I.e., the values were arbitrary in such a way that when there is an improvement in credit rating of the country, in the figure, it would be shown by a decline in the relative values of this classification. In that way, there is going to be a positive correlation between country risk and these ratings.

Rating - Moody's

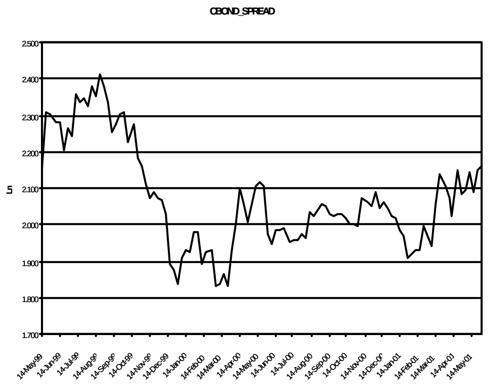


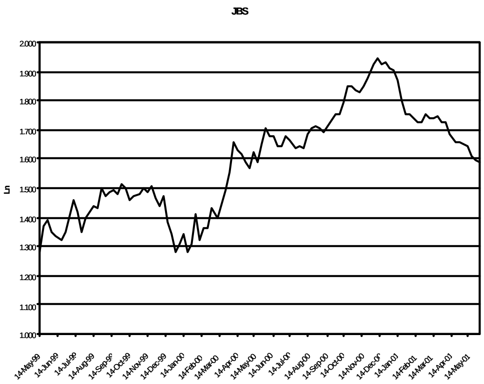
Rating - Fitch IBCA

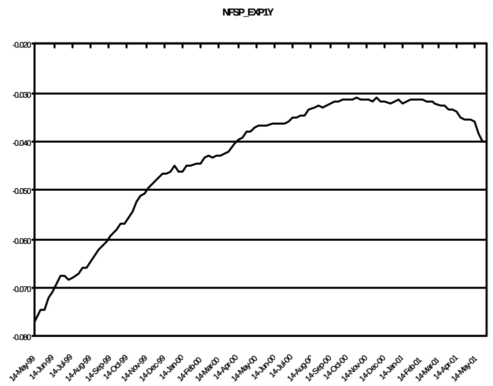


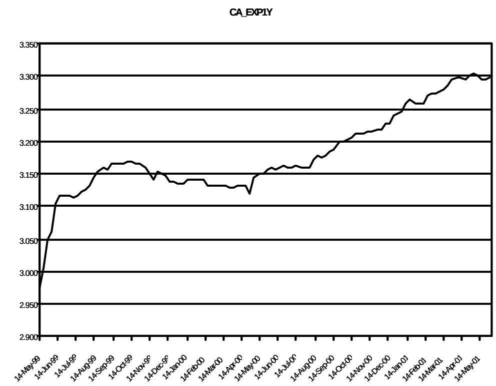
APPENDIX 4 – STATISTICAL TESTS

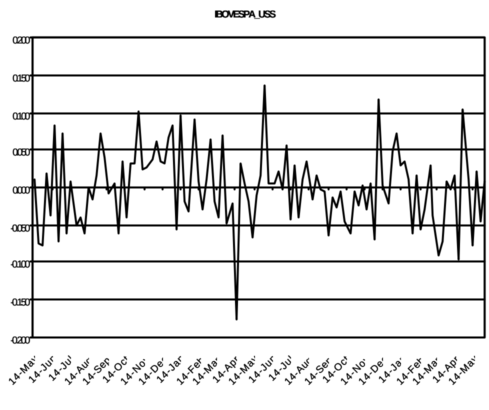
In this appendix, it is analyzed causality, unit roots and possible co-integration relationships among those variables used in the regression analysis. Next, there are the graphs of those time series data, from May - 1999 to June - 2001.











To test the existence of a unit root on those variables, it were done Augmented Dickey-Fuller Tests, using 4 lags and, without a Constant nor a trend (DF), with a Constant but without a Trend (DFc) and, with a Constant and a Trend (DFc,t). The results are in the following tables:

TABLE 1: Unit Root Test on CBOND_ SPREAD

	Test Statistics	*Critical Value*[*]
DF	-0,4067	-1,9432
DFc	-1,8008	-2,8895
DFc,t	-1,3113	-3,4535

[*] MacKinnon critical values for rejection of hypothesis of a unit root

TABLE 2: Unit Root Test on NFSP_EXP1Y

	Test Statistics	*Critical Value*[*]
DF	-0,9949	-1,9432
DFc	-2,2712	-2,8895
DFc,t	1,0982	-3,4535

[*] MacKinnon critical values for rejection of hypothesis of a unit root

TABLE 3: Unit Root Test on CA_EXP1Y

	Test Statistics	*Critical Value*[*]
DF	2,4719 *	-1,9432
DFc	0,6896	-2,8895
DFc,t	-1,1640	-3,4535

[*] MacKinnon critical values for rejection of hypothesis of a unit root

TABLE 4: Unit Root Test on IBOVESPA_USS

	Test Statistics	*Critical Value*[*]
DF	-3,4747 *	-1,9432
DFc	-3,4558 *	-2,8897
DFc,t	-3,6570 *	-3,4535

[*] MacKinnon critical values for rejection of hypothesis of a unit root

TABLE 5: Unit Root Test on JBS

	Test Statistics	*Critical Value*[*]
DF	0,4487	-1,9432
DFc	-1,6515	-2,8895
DFc,t	-1,0975	-3,4535

[*] MacKinnon critical values for rejection of hypothesis of a unit root

Some of these variables have a unit root, thus, to test co-integration with the dependent variable CBOND_SREAD is essential. We proceed on this through Johansen Co-

Integration Test with 4 lags and another test assumption is a linear deterministic trend in the data.

TABLE 6: Johansen Co-Integration Test on CBOND_SPREAD and NFSP_EXP1Y

Test assumption: Linear deterministic trend in the data

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.086386	11.41116	15.41	20.04	None
0.020233	2.105354	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. rejects any cointegration at 5% significance level

Unnormalized Cointegrating Coefficients:

CBOND_SPREAD	NFSP_EXP1Y
0.762842	15.42873
0.841066	0.118837

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	C
1.000000	20.22533	-1.209678
	(7.09556)	
Log likelihood	790.4427	

TABLE 7/8 (overprinted): Johansen Co-Integration Test on CBOND_SPREAD and CA_EXP1Y / JBS

Test assumption: Linear deterministic trend in the data

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
[illegible]	[illegible]	15.41	20.04	None
[illegible]	[illegible]	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. rejects any cointegration at 5% significance level

Unnormalized Cointegrating Coefficients:

CBOND_SPREAD	CA_EXP1Y / JBS
[illegible]	[illegible]
[illegible]	[illegible]

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

CBOND_SPREAD	CA_EXP1Y / JBS	C
1.000000	[illegible]	[illegible]
	[illegible]	
Log likelihood	[illegible]	

As seen above, none of them is co-integrated with CBOND_SPREAD. We go further on this test now, testing co-integration among all variables:

TABLE 9: Johansen Co-Integration Test on CBOND_SPREAD and all non-stationary variables

Series: CBOND_SPREAD NFSP_EXP1Y CA_EXP1Y JBS
Test assumption: Linear deterministic trend in the data

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.188756	55.35344	47.21	54.46	None **
0.155371	33.80721	29.68	35.65	At most 1 *
0.131520	16.41488	15.41	20.04	At most 2 *
0.018189	1.890741	3.76	6.65	At most 3

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	
-1.294544	-16.12693	3.134402	-0.177473	
-1.006411	-27.70021	-1.505606	1.192773	
0.707320	17.14818	-1.624548	-1.017857	
0.936122	4.388785	0.775442	-0.491296	

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	12.45761	-2.421240	0.137093	5.953661
	(2.96176)	(0.78587)	(0.29086)	
Log likelihood	1435.729			

Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	0.000000	-5.660270	1.230425	13.99288
		(1.84461)	(0.45310)	
0.000000	1.000000	0.260004	-0.087764	-0.645325
		(0.09860)	(0.02422)	
Log likelihood	1444.425			

Normalized Cointegrating Coefficients: 3 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	0.000000	0.000000	2.273365	-5.703225
			(1.71257)	
0.000000	1.000000	0.000000	-0.135672	0.259413
			(0.07460)	
0.000000	0.000000	1.000000	0.184256	-3.479711
			(0.29593)	

Log likelihood	1451.687			

Now, considering IBOVESPA_USS as an exogenous variable, the results change. However, it should be considered the fact that these results shown to be extremely sensitive to changes in test specifications.

TABLE 10: Johansen Co-Integration Test on CBOND_SPREAD and all other variables

Series: CBOND_SPREAD NFSP_EXP1Y CA_EXP1Y JBS
Exogenous series: IBOVESPA_USS
Warning: Critical values were derived assuming no exogenous series
Lags interval: 1 to 5

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.193686	46.98539	47.21	54.46	None
0.110699	25.02656	29.68	35.65	At most 1
0.098439	13.05996	15.41	20.04	At most 2
0.024116	2.489945	3.76	6.65	At most 3

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. rejects any cointegration at 5% significance level

Unnormalized Cointegrating Coefficients:

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	
-0.422508	-21.21360	-1.095836	1.524325	
1.977097	34.35756	-1.690820	-0.760444	
-0.605164	-3.979539	3.599759	-0.011429	
-0.800673	-3.141669	-1.285331	0.594393	

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	50.20876	2.593646	-3.607802	-2.432886
	(37.9038)	(4.10887)	(3.40430)	
Log likelihood	1467.769			

Normalized Cointegrating Coefficients: 2 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	0.000000	-2.680716	1.321434	4.358563
		(1.30675)	(0.46733)	
0.000000	1.000000	0.105049	-0.098175	-0.135264
		(0.05954)	(0.02129)	
Log likelihood	1473.753			

Normalized Cointegrating Coefficients: 3 Cointegrating Equation(s)

CBOND_SPREAD	NFSP_EXP1Y	CA_EXP1Y	JBS	C
1.000000	0.000000	0.000000	1.766327	-4.894315
			(1.11631)	
0.000000	1.000000	0.000000	-0.115609	0.227326
			(0.04594)	

0.000000	0.000000	1.000000	0.165961 (0.25954)	-3.451644
Log likelihood	1479.038			

To analyze causality in that data set, we used Granger causality tests, as seen below:

TABLE 11

Granger Causality Test

Null Hypothesis	1Lag F-Statistics	Prob	2 lags F-Statistics	Prob	3 Lags F-Statistics	Prob
NFSP_EXP1Y does not Granger Cause CBOND_SPREAD	4.3133	**0.0403**	2.0968	0.1282	1.5335	0.2106
CBOND_SPREAD does not Granger Cause NFSP_EXP1Y	2.4915	0.1175	1.7708	0.1754	0.5316	0.6617
JBS does not Granger Cause CBOND_SPREAD	0.5968	0.4415	0.0566	0.9451	0.9010	0.4436
CBOND_SPREAD does not Granger Cause JBS	0.1704	0.6806	3.1713	**0.0462**	2.4096	0.0716
CA_EXP1Y does not Granger Cause CBOND_SPREAD	0.7729	0.3814	0.0036	0.9964	0.2195	0.8827
CBOND_SPREAD does not Granger Cause CA_EXP1Y	6.0365	**0.0157**	3.1786	**0.0458**	1.1433	0.3356
IBOVESPA_USS does not Granger Cause CBOND_SPREAD	0.0053	0.9422	0.3187	0.7278	0.3157	0.8140
CBOND_SPREAD does not Granger Cause IBOVESPA_USS	0.0435	0.8351	0.2400	0.7871	0.5322	0.6613

These Granger causality tests did not indicate any bivariate causality in this data set. However, this test does not fit entirely to our analysis. Thus, it follows a VAR analysis:

TABELA 12: VECTOR AUTOREGRESSION ESTIMATES

Standard errors & t-statistics in parentheses

	CBOND_SPREAD	NFSP_EXP1Y	JBS	IBOVESPA_USS	CA_EXP1Y
CBOND_SPREAD(-1)	0.703871 (0.07634) (9.22060)	-0.000110 (0.00095) (-0.11532)	0.043853 (0.05603) (0.78267)	0.118794 (0.08236) (1.44233)	-0.008379 (0.01113) (-0.75268)
NFSP_EXP1Y(-1)	-4.361887 (1.32023) (-3.30387)	0.975192 (0.01651) (59.0633)	1.374335 (0.96903) (1.41826)	2.272939 (1.42444) (1.59567)	-0.426761 (0.19252) (-2.21669)
JBS(-1)	0.137766 (0.05822) (2.36628)	0.000931 (0.00073) (1.27818)	0.938885 (0.04273) (21.9710)	-0.107905 (0.06282) (-1.71779)	0.029231 (0.00849) (3.44294)
IBOVESPA_USS(-1)	-0.082399 (0.09634)	0.001649 (0.00120)	-0.129833 (0.07071)	-0.029575 (0.10395)	-0.026565 (0.01405)

	(-0.85528)	(1.36835)	(-1.83606)	(-0.28453)	(-1.89089)
CA_EXP1Y(-1)	0.164463	-0.005362	-0.184405	-0.056495	0.958375
	(0.12198)	(0.00153)	(0.08953)	(0.13161)	(0.01779)
	(1.34827)	(-3.51482)	(-2.05966)	(-0.42927)	(53.8783)
C	-0.318114	0.015062	0.654957	0.202177	0.087589
	(0.36379)	(0.00455)	(0.26702)	(0.39251)	(0.05305)
	(-0.87444)	(3.31065)	(2.45286)	(0.51509)	(1.65108)
R-squared	0.888529	0.997820	0.961066	0.035016	0.987604
Adj. R-squared	0.883011	0.997712	0.959138	-0.012755	0.986990
Sum sq. resids	0.239654	3.75E-05	0.129109	0.278980	0.005096
S.E. equation	0.048711	0.000609	0.035753	0.052556	0.007103
F-statistic	161.0129	9244.298	498.6257	0.732991	1609.374
Log likelihood	174.5979	643.4226	207.6897	166.4689	380.6107
Akaike AIC	-3.151362	-11.91444	-3.769901	-2.999419	-7.002069
Schwarz SC	-3.001484	-11.76456	-3.620023	-2.849540	-6.852191
Mean dependent	2.072420	-0.043153	1.593734	-0.001709	3.181802
S.D. dependent	0.142416	0.012735	0.176872	0.052224	0.062277
Determinant Residual Covariance		5.62E-20			
Log Likelihood		1612.297			
Akaike Information Criteria		-29.57564			
Schwarz Criteria		-28.82625			

TABELA 13: VECTOR ERROR CORRECTION ESTIMATES

Standard errors & t-statistics in parentheses

Cointegrating Eq:	CointEq1
CBOND_SPREAD(-1)	1.000000
NFSP_EXP1Y (-1)	20.01013
	(8.00168)
	(2.50074)
JBS (-1)	-0.642291
	(0.52773)
	(-1.21707)
IBOVESPA_USS (-1)	12.78519
	(10.5027)
	(1.21732)
CA_EXP1Y(-1)	1.675910
	(2.40669)
	(0.69636)
C	-5.491498

Error Correction:	D(CBOND_SPREAD)	D(NFSP_EXP1Y)	D(JBS)	D(IBOVESPA_USS)	D(CA_EXP1Y)
CointEq1	-0.010477	-0.000244	-0.007553	-0.064499	-0.002484
	(0.01246)	(0.00017)	(0.00907)	(0.01344)	(0.00169)
	(-0.84087)	(-1.46892)	(-0.83240)	(-4.80035)	(-1.47161)
D(CBOND_SPREAD(-1))	-0.118460	-0.002959	0.113034	0.054974	0.028305
	(0.12505)	(0.00166)	(0.09107)	(0.13485)	(0.01694)
	(-0.94732)	(-1.77713)	(1.24118)	(0.40766)	(1.67060)
D(NFSP_EXP1Y(-1))	-9.703188	0.358455	4.360157	-9.753747	1.435692
	(6.37812)	(0.08492)	(4.64504)	(6.87829)	(0.86418)
	(-1.52132)	(4.22108)	(0.93867)	(-1.41805)	(1.66134)
D(JBS(-1))	-0.023747	-0.001776	-0.018655	-0.019148	-0.017223
	(0.13937)	(0.00186)	(0.10150)	(0.15030)	(0.01888)
	(-0.17039)	(-0.95716)	(-0.18380)	(-0.12740)	(-0.91206)
D(IBOVESPA_USS(-1))	0.049725	0.001890	0.006971	-0.188543	0.022820
	(0.09793)	(0.00130)	(0.07132)	(0.10561)	(0.01327)
	(0.50774)	(1.44941)	(0.09774)	(-1.78520)	(1.71974)
D(CA_EXP1Y(-1))	-0.383412	0.019937	-0.470655	-0.388544	0.314041
	(0.64371)	(0.00857)	(0.46880)	(0.69419)	(0.08722)
	(-0.59563)	(2.32619)	(-1.00396)	(-0.55971)	(3.60067)
C	0.003241	0.000147	0.002076	0.005349	0.001363
	(0.00554)	(7.4E-05)	(0.00404)	(0.00598)	(0.00075)
	(0.58479)	(1.99848)	(0.51448)	(0.89507)	(1.81477)
R-squared	0.041020	0.267400	0.074135	0.536010	0.266713
Adj. R-squared	-0.017100	0.223000	0.018022	0.507889	0.222271
Sum sq. resids	0.243030	4.31E-05	0.128900	0.282641	0.004462
S.E. equation	0.049546	0.000660	0.036083	0.053432	0.006713
F-statistic	0.705784	6.022533	1.321169	19.06108	6.001409
Log likelihood	171.7271	629.5324	205.3370	163.7245	383.6051
Akaike AIC	-3.108058	-11.74589	-3.742208	-2.957065	-7.105756
Schwarz SC	-2.932170	-11.57001	-3.566320	-2.781178	-6.929869
Mean dependent	-0.001395	0.000327	0.002102	0.000812	0.002750
S.D. dependent	0.049128	0.000748	0.036413	0.076167	0.007612
Determinant Residual Covariance		5.85E-20			
Log Likelihood		1595.071			
Akaike Information Criteria		-29.34096			
Schwarz Criteria		-28.33589			