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# EXTERNAL DEBT SUSTAINABILITY: EMPIRICAL EVIDENCE IN BRAZIL

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**SUMÁRIO**

## 8. ABSTRACT

The purpose of this paper is to investigate the sustainability of the external debt in Brazil, or, in other words, to analyze if Brazilian economy in consideration of its external debt repayments keeps solvent. Tests show that, for different periods and using different models and variables, external debt and current account deficits are not sustainable in the long run, confirming other studies that tested sustainability of the current account and external debt in Brazil.

## 1. INTRODUCTION

In the 1990s Brazil experienced growing deficits in its current account of the balance of payments, mainly after the exchange rate based stabilization plan in 1994, which poses again the question whether the current account deficits are sustainable in the long run[1]. Despite the success of its anti-inflationary plan, the external passive has been growing fast. Once the financial structure of developing countries depends on external capital, their capital supply also depends on the international environment in order to warrant a sustainable path to external debt. This sustainable path is one of the aspects that can be used to prevent balance of payments crises in developing economies. The history of 1980s and the end of 1990s is traumatic to Latin American countries, and especially for heavily indebted countries like Brazil, Argentina and Mexico. Indeed, the relationship among current account deficits, external debt stock, and external interest rates can lead to an unstable path of the external debt in the long run, which can lead to currency crises. The purpose of this paper is to investigate the sustainability of the external debt in Brazil, or, in other words, to analyze if Brazilian economy in consideration of its external debt repayments keeps solvent.

By building models in which external debt, current account, trade balance, and Gross Domestic Product (GDP) are confronted, it is possible to investigate the financial fragility of sustaining capital account surplus, or if capital account is under a Ponzi finance situation. The results can help to analyze economic policy implications of financial liberalization. As a matter of fact, although capital inflows can avoid short-run impediments to growth, as well as guarantee macroeconomic stabilization, a calibration of these inflows is difficult and leads to a knife-edge path, especially for developing economies. While macroeconomic management of capital inflows is central to succeed short-run macroeconomic policy, financing the external debt and dealing with profit transfers abroad are crucial questions, since it is not clear that external savings are perpetual. Therefore, this study contributes to the empirical literature regarding debt sustainability in developing countries.

After triggering a typical exchange rate based stabilization program, there is evidence to suppose that the short-run benefits to financial liberalization in capital dependent countries like Brazil is basically to help the macroeconomic stabilization. In the long run, however, increasing external debt and denationalization of domestic enterprises (by means of mergers and acquisitions, and privatization) can lead to balance of payments difficulties through the effects of net transfer to profits abroad.

This question is extremely important not only due to the features of capital inflows to Brazil in the 1990s (high volume of short-term capital), but also because the balance of payments crisis in the beginning of 1999 confirmed the significance of avoiding speculative capital flows and systematic current account deficits.

Several techniques can be employed to calculate debt sustainability. One procedure is to estimate cointegration regressions among exports, imports, GDP, and interest rates in the fashion of

[1] The first time this issue worried policy makers in Brazil was after the debt crisis in early 1980s.

Hamilton and Flavin (1986), Sawada (1994). Other procedure is to test for unit root or stationary of the discounted debt (Greiner and Semmler, 1999). Studies employing those methodologies for the Brazilian economy are found in Luporini (2000) for internal debt, Ponta (1996), Rocha and Bender (2000), and Carneiro (1997) for external debt and current account. All of them show that external debt in Brazil is unsustainable in the long run.

This study departs from the seminal work of Hyman Minsky (1986) concerning economy's unstable financial positions, as well as the work of McCombie and Thirlwall (1994, 1999) about Balance of payments constraints economic growth in developing countries. I will employ three different methods to test the sustainability of the external debt in Brazil. After testing series for unit roots, the first method is to test cointegration regression between exports of good and services and imports plus interest rates. The other one is to test cointegration regression between trade balance and net external debt. The third method is to test whether the discounted net external debt is stationary. The results show that in each method Brazilian external debt is not sustainable in the long run.

The outline of this paper is as follows. In section 2 I will investigate the Brazilian economy in the 1990s regarding its external features, as this is the basic stimulus for this essay. Section 3 presents the empirical literature about debt sustainability. Section 4 deals with the analytical framework to treat intertemporal budget constraint in an open economy in order to get a statistical testable measurement of solvency. Section 5 deals with the empirical results about the sustainability of capital account in Brazil. Finally the last section includes conclusions.

## 2. ESSENTIALS OF BALANCE OF PAYMENTS IN BRAZIL

### 2.1. Balance of Payments and Capital Flows

During the 1990s, Brazil and other Latin American countries experienced a rush in capital inflows after almost ten years without access to international capital markets. This wave of capital inflows was remarkable different from those ones in 1960s and 1970s[2]. As usual, they brought about external savings and accumulation of reserves that helped not only the short-run growth in GDP, but also the possibility to some countries like Brazil or Argentina of triggering exchange rate based stabilization programs. The positive aspects of capital flows can be, however, opposed to the negative ones. Some of them are related to an increase of stock of external debt, the rapid denationalization of enterprises, and the low impact of Foreign Direct Investment (FDI) over export-industries.[3]

[2] See Blecker (1999b) and Cardoso and Goldfjan (1998) regarding the features of capital inflows in 1990s and their differences from the wave of capital flows in 1960s and 1970s.

[3] Laplane and Sarti (1999) showed that most of the Foreign Direct Investment in Brazil has been used for mergers, acquisitions and privatization, so little effect has been felt over export-industries. Further, the increased denationalization has brought about problems in Current account management due to the increase in non-reinvested profits.

Theoretically, capital flows affect production and macroeconomic management and are related to economy's productive capacity. FDI adds capital stock and thus potentially increases welfare. Further, it can adjoin to competition or improving technology.

On the macroeconomic front, capital flows can bring about several management problems, such as real appreciation of the local currency, as well money sterilization of these flows. Indeed, sterilization of foreign currency calls for high domestic interest rates in order to avoid inflationary pressure. Nonetheless, high domestic interest rates stimulate capital inflows, leading to a vicious circle. Furthermore, high domestic interest rates and current account imbalances create fiscal costs and it also signs a balance of payments crisis. The combination of expected reduced depreciation with high domestic interest rates in relation to interest rates in the United States attracts capital inflows. Real appreciation of the exchange rate leads to current account deterioration.

Under these circumstances, capital control becomes one of the alternative policies to avoid not only currency crises, but also intertemporal non-sustainability of the external debt. As a matter of fact, Cardoso and Goldfajn (1998) showed that countries calibrate their control over capital flows depending on the combination of external vulnerability and internal costs of capital inflows. Even under these circumstances, currency crises could not be avoided. Mexico in 1995, Asia in 1997 and Brazil in 1999 are some important evidence of this vulnerability.

From that, it is possible to divide the factors that encourage or inhibit capital flows into internal and external ones. World interest rates are the most important external factor. On the internal side, factors that attract capital flows include sound monetary and fiscal policies and market-oriented reforms, such as trade and capital market liberalization[4]. Stabilization, in turn, reduces risks and stimulates capital inflows. Falling interest rates in advanced economies have played a role in driving capital to developing countries and those flows have not been restricted to countries, which showed good reform records. Finally, there are contagious effects. Capital flows to a couple of countries in a region generate externalities to neighboring countries and an external crisis in one country may spread to others. Using an OLS regression method to investigate what determines capital inflows to Brazil, Cardoso and Goldjfan (1998) found that external interest rates play an important role to capital inflows, whereas the coefficient for domestic interest rates was positive. In the 1980s, however, none of the above conditions hold for Latin American countries, so it was impossible for them to have access to international capital markets.

Although the above-mentioned reasons to attract capital flows can reveal some important results, it is not clear whether this is valid for some countries. Indeed, Brazil is a good example that stabilization programs and market-friendly reforms were carried out only after the wave of capital flows to that country. Besides, the Real Plan in Brazil has been successful in the short-run due to the accumulation of foreign currency that allowed stabilization of the local currency. In this case, it seems

[4] See Blecker (1999), chapter 2 for critics of these conditions to stimulate capital inflows in developing economies.

much more plausible that capital inflows to Brazil and other Latin American countries were a result of the external environment, and not the cause of liberal reforms.

Once there is credit availability in international capital markets, which warrant capital inflows, the important feature is to manage not only their macroeconomic consequences, such as current account deficits and monetary policy, but also the intertemporal equilibrium of the current account. In fact, high stocks of debt can conduct to the impossibility to finance their flows in the fashion of Minsky (1986) approach. In fact, as long as current account deficits are financed by capital inflows, there is an increase in external debt. In order to avoid speculative and ponzi situation, flows need to be related to the growth rate of GNP, foreign interest rates and current account balance. As Carneiro (1997) emphasized, the problem of the debt appears only when there is a sudden scarcity of resources, as it is common in developing countries and great debtors like Brazil.

### 2.2. External Accounts and Capital Flows To Brazil

Ponta (1996) tested, using cointegration, the sustainability of the external debt from 1970 to 1992 (the year that the new wave of external foreign resources started in Brazil). Her conclusions demonstrated the unsustainable intertemporal path of the external debt. The empirical evidence is clear: current account imbalances became impossible to manage in the long run. After 1991, however, capital inflows to Brazil increased dramatically. Capital account surplus rose from US$ 4,148 million in 1991 to US$ 29,820 million in 1995, whereas short-term capital increased from US$ 2,9 million negative to US$ 17,554 million between 1991 and 1995, leading to a fast and dangerous accumulation of external debt.[5]

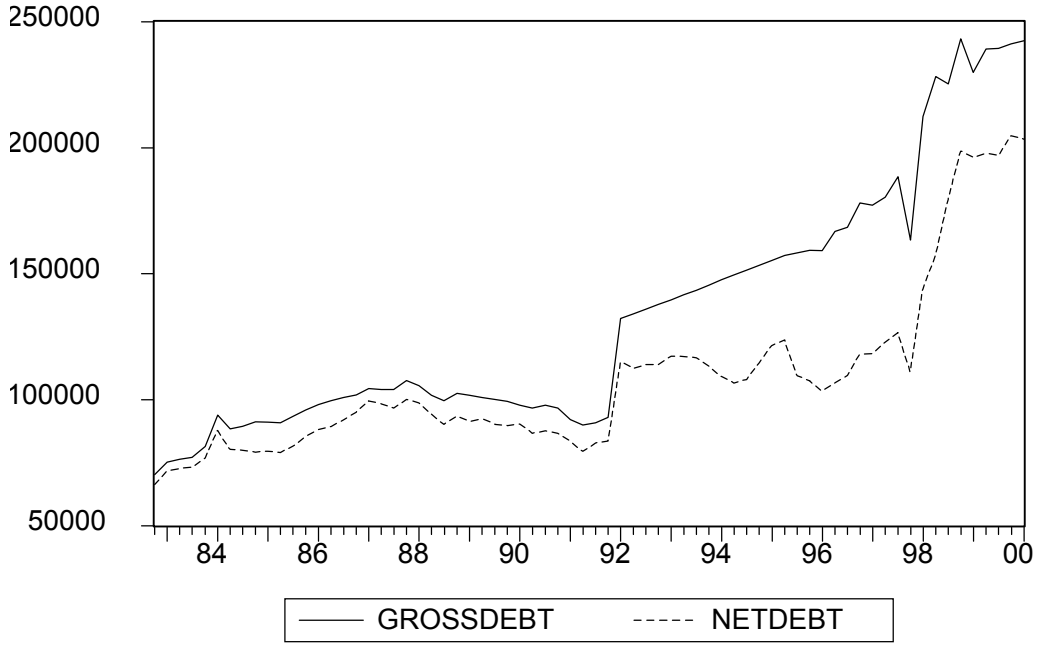
As Sampaio Jr (2000) has pointed out, after spending the 1980s trying to pay the external debt, in 1990 the net external debt in Brazil was US$ 123 billion, or 26% of GDP. In the end of 1999 this amount reached US$ 237 billion, or more than 40% of the GDP. Furthermore, from 1990 to 1999 Brazil sent US$ 117 billion only as of interest payments. Figure 1 shows the pattern of the gross and net external debt in Brazil. While until 1992 its trajectory was stable, after 1992 there is a shift in its level, followed by a change in the slope of the curve after 1998. Indeed, the behavior of the indebtedness after 1992 is closely related to the deepened in financial liberalization carried out by the structural reforms under Fernando Collor's Government (1990-1992). The mainly feature of those reforms is that they increased trade and financial liberalization, by means of decrease average imports tariffs, as well as breaking the barriers to short-run and speculative capital flows. As a result, capital inflows allowed a fast accumulation of foreign reserves, but at a cost of increasing the external passive. Therefore, the net external indebtedness remained almost constant until the Asian crisis in 1998, when Brazilian policy

[5] Cardoso and Goldjfan (1998).

makers implemented new rules for external capital, intensifying the liberalization. Again, the external indebtedness increased, even though the lost of external reserves has been less dramatic.[6]

**FIGURE 1:**

**Gross and Net External Debt in Brazil (1982:04 to 2000:01)**




Source: Central Bank of Brazil Bulletin, several issues

As a matter of fact, external vulnerability in Brazil has been increasing after policies that allowed a fast and systematic accumulation of foreign reserves by means of giving facilities to short-run external capital. The corollary of this feature was a denationalization of firms, as well as a fast accumulation of external debt. As it is well known, the main strategy of the Brazilian political economists after the Mexico crises in 1982 was to recover external balance, since it was impossible to finance current account deficits. By calibrating monetary and exchange rate policy the result was successfully in getting trade balance surpluses, and, then, less dramatic current account deficits. Although the results were convinced on external front, it was at a cost of high inflation and high internal disequilibria.

After 1981 the federal domestic debt as a ratio of GDP increased steadily and assumed an upward trend, as borrowing from the international financial market became virtually impossible after the

[6] It worth note that the Net External Debt remained constant from 1992 to 1998, since the accumulation of external reserves was larger than the indebtedness. Nevertheless, the lost of foreign reserves in 1999's currency crisis led to a faster accumulation of external passive.

Mexico's crash in September 1982. The Central Government's borrowing requirements increased from 4.8% of GDP in 1983 to 12.5% in 1985, 26.6% in 1988, and 48.3% in 1989.[7] These unique deficits were strictly correlated with the indexation process in the Brazilian economy and the difficult in financing the internal debt.[8] Indeed, Brazil started an indexation process in its economy after 1965. If, on the one hand the indexation avoided lost to debtors and gains to creditors when inflation is moderated, as well as avoided a classical hyperinflation as occurred in German 1922 or even in Argentina in the end of 1980s, on the other hand turned out more difficult to control the high inflation process. Inflation rates soared during the 1980s with the annual rate ranging from 110% in 1981 to 2740% in 1990. There is few doubts that the source of the problems in 1980s are strong related to the external crisis and the impossibility to finance the investment by means of external debt, such as occurred in 1970s.

As already said above, the successfully external adjustment was carried out basically by the behavior of exports that allowed getting vast trade surpluses. Exports increased sharply after an exchange rate maxi devaluation in 1983 and imports keep almost constant which allowed the accumulation of trade surpluses until 1994 (Figure 2). This fact was the most important aspect that allowed the success in external front after 1983. By looking at the behavior of the trade surpluses during the 1980s it is easy to see a close relationship between exchange-rate policies and trade balances. After the financial liberalization in 1992 and the explicit aim to let Brazilian currency over valuate after 1994, trade surpluses brought down. There were intense debates in economic policy in Brazil during the 1980s about these surpluses and it is possible to suppose that the import substitution policies in 1970s, after the first oil shock, permitted productivity gains for some industries, allowing them to compete in better conditions in the international market. Those gains of productivity in export competing industries allowed to get impressive export performance in earlier 1980s. On the other hand, short-run exchange rate policies, wage policies, as well as monetary and fiscal policies were organized jointly to get the external equilibrium. The huge decreased in internal absorption by means of recession were the other side of these policies.[9]

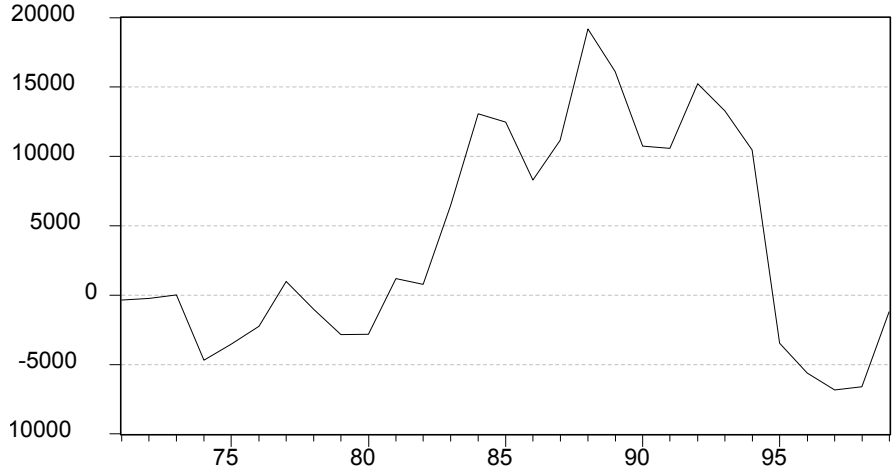
[7] See Luporini (2000) regarding this point.

[8] Oliveira (1988)

[9] See Castro and Souza (1985) for this debate.

**FIGURE 2:**

**Brazil: Annual Trade Balance (1971-1999) in US$ million**




Source: Central Bank of Brazil Bulletin, several issues

Tables 1 and 2 show the behavior of external accounts between the decade of 1980 and 1990s. The strong deterioration in current account and trade balance after 1990 can be explained by the strategy to expose Brazilian economy to external environment. Brazilian policy makers launched a fast and deep process of trade and financial liberalization, as well as privatization and other liberal policies. The results in terms of GDP and GDP per capita growth were somewhat disappointed, although the high inflation could be brought under control after the successfully exchange rate based stabilization plan in mid-1994[10]. The corollary of the stabilization was the high current account deficits, an interest rates trap to warrant capital inflows, overvalued exchange rate until the 1999 crisis, unprecedented rates of unemployment and modest economic growth. Besides, the strategy of the Central Bank to keep the exchange rate overvalued brought about a strong vulnerability of the balance of payments, so that the currency crisis in January 1999 was more than expected. The current account deficit as a percentage of GDP fluctuated from -0.30% in 1994 to -4.4% in 1998. Indeed, the literature about currency crisis has pointed out that one important indicator of the deterioration of the external front, as well as the basic source of speculative attack, is the deficit as proportion to GDP.[11]

[10] Similar behavior occurred in others Latin American Countries. See Frenkel and Rozada (1999) for Argentina and Ros and Lustig (1999) for Mexico.

[11] See Krugman (1999), Blecker (1999b), Rodrik and Velasco (1999), Curado (2001) among others.

**TABLE 1**

**Balance of Payments of Brazil's: Selected items**

| Year | Trade Balance US$ million | Balance of Services | Current Account Balance US$ million | Capital Account Balance US$ million | International reserves US$ million International liquidity *(End of period)* |
|---|---|---|---|---|---|
| **1980-84*** | 3743 | -13400 | -9529 | 6531 | 6501 |
| **1985-89*** | 13453 | -13936 | -355 | -2084 | 8929 |
| **1990** | 10753 | -15369 | -3788 | -5567 | 9973 |
| **1991** | 10579 | -13542 | -1408 | -4148 | 9406 |
| **1992** | 15239 | -11339 | 6089 | 6570 | 23754 |
| **1993** | 13307 | -15585 | 20 | 7685 | 32211 |
| **1994** | 10466 | -14743 | -1153 | 14294 | 38806 |
| **1995** | -3352 | -18594 | -18136 | 29658 | 51840 |
| **1996** | -5539 | -21707 | -23602 | 34446 | 60110 |
| **1997** | -8957 | -27286 | -33840 | 26467 | 52173 |
| **1998** | -6611 | -30670 | -33611 | 20232 | 44556 |
| **1999** | -1206 | -25884 | -24339 | 16557 | 36342 |

Source: Central Bank of Brazil Bulletin, several issues and Rocha and Bender (2000) for the two first rows
* Annual averages of the period.

**TABLE 2**

**Balance of Payments of Brazil's: Selected items (in %GDP)**

| Year | Trade Balance US$ million | Balance of Services | Current Account Balance US$ million | Capital Account Balance US$ million |
|---|---|---|---|---|
| **1990** | 2.44 | -3.49 | -0.86 | -1.07 |
| **1991** | 2.75 | -3.52 | -0.37 | -1.08 |
| **1992** | 4.04 | 3.01 | 1.63 | 6.70 |
| **1993** | 3.04 | -3.55 | -0.14 | 2.31 |
| **1994** | 1.85 | -2.61 | -0.30 | 2.53 |
| **1995** | -0.47 | -2.59 | -2.51 | 4.09 |
| **1996** | -0.74 | -2.90 | -2.51 | 4.58 |
| **1997** | -1.07 | -3.50 | -4.29 | 3.34 |
| **1998** | -0.82 | -3.89 | -4.48 | 3.39 |
| **1999** | -0.21 | -4.52 | -4.38 | 2.97 |

Source: Central Bank of Brazil Bulletin, several issues

The explicit strategy in keeping the Brazilian currency (Real) overvalued has brought about several problems that reached the currency crisis. In January 1999 the Brazilian Central Bank had to change its monetary and exchange rate policies, first by devaluating the Brazilian currency, and second

letting the currency float.[12] Bonomo and Terra (1999) showed an historical relationship between political cycles and exchange rate. It seems reasonable to suppose that the strategy in keeping the Real overvalued has had the explicit purpose to warrant the reelection of President Cardoso in November 1998.[13]

There are several ways to verify the path of Current account and its possibility to lead to an unsustainable path in the long run. One important measure is the current account deficit as a proportion of GDP. Others are the exchange rate dynamic, the contagious effect and the excess of short-run capital flows. All of these indicators seemed to hold after the exchange rate based stabilization program in Brazil. As Rocha and Bender (2000) revealed, it is possible to evaluate the effect over current account imbalance by means of a simple indicator that can be compared with the actual data.

From the identity of the external debt, we get:

$$D_{t+1} = (1+r_t)D_t - TB_t \qquad (1)$$

Where $D_t$ is the external debt, $r$ is the interest rate, and $TB$ is the trade balance. Dividing everything by $Y_t$, the nominal GDP, we have:

$$d_{t+1} = \left[\frac{1+r_t}{Y_t}\right] d_t - tb_t \qquad (2)$$

Where the small letters represent a proportion to GDP. Taking $g$ as the growth rate of GDP $((Y_{t+1} - Y_t) / Y_t)$, from (2) we get:

$$(1+g)d_{t+1} = (1+r_t)d_t - tb_t \qquad (3)$$

If we assume a stable debt/GDP ratio ($d_{t+1} = d_t$), we have:

$$tb_t^R = (r_t - g)d_t \qquad (4)$$

The trade surplus that solved equation (4) is the *Required Trade Surplus*, which represents the trade surplus compatible with a stable debt/GDP ratio over time. The difference between the *Required Trade Surplus* and the observed trade balance is the *Balance of Resources Gap*. Table 3 shows this balance for the Brazilian economy from 1990 to 1999 and shows how this gap enlarged after 1994, when the trade balance changed its signal. Indeed, while in 1994 the gap was negative in US$ 4128

[12] After an unsuccessful experience of controlling the exchange rate in January and February 1999, the Central Bank imposed a dirty flexible exchange rate regime.

[13] Bonomo and Terra (1999) demonstrated the effects over government popularity in keeping the currency overvalued, since real wages, in an open economy, tend to be higher than real wages under the equilibrium exchange rate.

million, in 1995 its signal changed drastically. The gap was more than US$ 11000 million, keeping an upward trend until 1999, when the currency crisis imposed a changed in the exchange-rate policy. It worth note that the Balance of Resources Gap increased even under a decreasing required surplus as a percentage of GDP in 1994-1997. A devaluation of more than 20% in 1999, followed by a dirty floating exchange rate regime and tight fiscal and monetary policies, led to a decrease in the rate of the change of this gap. This behavior clearly suggests that the short-run exchange policy plays an important role in avoiding the increase of the deterioration of external accounts in Brazil, since the change in exchange rate policy led to a decreasing in the *Balance of Resources Gap.*

**TABLE 3**

**Required Surplus and Trade Balance GAP (in US$ Millions and %GDP)**

| Year | Required Surplus US$ million | Required Surplus (% GDP) | GAP US$ million | GAP (%GDP) |
|---|---|---|---|---|
| **1990** | 9748 | 2.10 | -831 | -0.18 |
| **1991** | 8621 | 2.13 | -1938 | -0.48 |
| **1992** | 7253 | 1.81 | -7986 | -2.00 |
| **1993** | 8280 | 1.89 | -5027 | -1.14 |
| **1994** | 6338 | 1.16 | -4128 | -0.76 |
| **1995** | 8158 | 1.15 | 11510 | 1.63 |
| **1996** | 9840 | 1.26 | 15379 | 1.98 |
| **1997** | 10390 | 1.29 | 18762 | 2.33 |
| **1998** | 12100 | 1.62 | 18530 | 2.47 |
| **1999*** | 12700 | 1.68 | 13906 | 1.84 |

Source: Central Bank of Brazil Bulletin, several issues, Rocha and Bender (2000) for the eighth first rows, and my own estimative in 1999.
* Preliminary

A simple forward-looking exercise was performed to estimate the required surplus in trade balance for the next ten years. Table 4 examines these estimations for four GDP growth rates for Brazil, keeping constant the external interest rates and the Gross External Debt at the 1999 level (US$ 211,442 million).[14] The results show that the required surplus in trade balance depends on the GDP growth rate. Table 5 shows these results as a proportion of GDP, and the required surplus largely varies as a proportion of GDP. Looking at the experience of the last 10 years there is no room for optimism.

[14] The interest rate was obtained by the five years average Prime Rate.

**TABLE 4**

**Required Surplus simulations with different average growth of the GDP**

| Year | Required Surplus (US$ million) | | | |
|---|---|---|---|---|
| | (2%) | (3%) | (4%) | (5%) |
| **2000** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2001** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2002** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2003** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2004** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2005** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2006** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2007** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2008** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2009** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |
| **2010** | 10572.10 | 8457.68 | 6343.26 | 4228.84 |

Admitting an interest rate by 7% a.a. over the external debt, and keeping constant the Gross External Debt or keeping Debt/GDP ratio decreasing.

**TABLE 5**

**Required Surplus simulations with different average growth of the GDP**

| Year | Required Surplus (% GDP) | | | |
|---|---|---|---|---|
| | ( 2%) | (3%) | (4%) | (5%) |
| **2000** | 1.3710% | 1.0862% | 0.8068% | 0.5327% |
| **2001** | 1.3441% | 1.0545% | 0.7758% | 0.5074% |
| **2002** | 1.3178% | 1.0238% | 0.7459% | 0.4832% |
| **2003** | 1.2919% | 0.9940% | 0.7172% | 0.4602% |
| **2004** | 1.2666% | 0.9650% | 0.6896% | 0.4383% |
| **2005** | 1.2418% | 0.9369% | 0.6631% | 0.4174% |
| **2006** | 1.2174% | 0.9096% | 0.6376% | 0.3975% |
| **2007** | 1.1935% | 0.8831% | 0.6131% | 0.3786% |
| **2008** | 1.1701% | 0.8574% | 0.5895% | 0.3606% |
| **2009** | 1.1472% | 0.8324% | 0.5668% | 0.3434% |
| **2010** | 1.1247% | 0.8082% | 0.5450% | 0.3271% |

Admitting an interest rate by 7% a.a. over the external debt, and keeping constant the Gross External Debt, or keeping Debt/GDP ratio decreasing.

The next step is to build an analytical framework to test the sustainability of the external debt for Brazil.

## 3. EMPIRICAL LITERATURE ABOUT DEBT SUSTAINABILITY

Studies involving sustainability of public debt became an important issue in economic policy mainly after the 1980s, stimulated by the increasing US fiscal deficits as well as the debt crisis that affect Latin American countries. Recently this subject has come up again for Europe after the unification and for heavily indebted developing countries. For the latter, not only the external debt, but also the internal debt have stimulated applied macroeconomic studies.

The first concept of sustainable fiscal policy is due to the work of Harrod and Domar. Minsky (1986) first pointed out the importance of taking care the financial sustainability of fiscal policy in order to avoid reaching a no sustainable structure coming from a Hedge position to Ponzi finance. Eisner and Pieper (1984) also pointed out the importance in analyzing the question of the Federal debt and its long run sustainability for the United States.

From the work of Hamilton and Flavin (1986) several tests of sustainability were carried out by using similar methodology of them, or by including other tests. Hamilton and Flavin (1986) employs tests of stationarity over the discounted debt factor using Dickey-Fuller tests for unit roots as well as restricted and generalized Flood-Garber tests for stationarity[15]. The basic idea is that any debt will be sustainable in the long run if its discounted factor is stationary. Applying these methodologies to the US data from 1960 to 1981, these authors have found that the US Budget balance presented a long run sustainable path, despite its systematic budget deficits.

Wilcox (1989) extended the work of Hamilton and Flavin (1986) in order to allow for stochastic real interest rates and for nonstationarity in the no interest surplus. His work has power against stochastic violations of the borrowing constraint, whereas at least two of the tests of Hamilton and Flavin assumed that any violation of the borrowing constraint would be stochastic.

Greiner and Semmler (1999) tested the sustainability of the public debt for Germany in order to find if the unification has caused any violation of the long run path of the public debt. Indeed, the unification has risen the debt to GDP ratio from 44% to 58% in 1995 and this behavior could bring some problems to the European Union (EU), since one important aspect of the EU was exactly warrant a balance fiscal policy. Their conclusions suggest that the public debt in Germany does not meet the requirements to warrant a sustainable fiscal policy in the long run.

These authors have taken annual data from 1955 to 1994 and used both Flood-Garber test, and ADF tests for unit root in the series of discounted net debt, showing that internal debt series were nonstationary. The restricted Flood-Garber tests confirm that outcome. After also testing the sustainability before and after the unification of the Germany the results suggest an unsustainable path started in 1989.

Sawada (1994) explored the case of external debt sustainability of heavily indebted countries using a different approach to that one used by Hamilton and Flavin (1986), and Greiner and Semmler

[15] See Hamilton and Flavin (1986) to an explanation of the methodology employed.

(1999). While the latter have employed the discounted debt to test, the former tests use current account balance. Indeed, the methodology employed by Sawada (1994) does not need to make a discounted debt. If the series employed have a unit root, the solvency condition is met whether the series are cointegrated. His results demonstrated that only the Asian countries (Korea, Indonesia, Malaysia and Thailand) have been solvent for the period 1955 to 1990. All of Latin American countries did not meet the solvency condition for the same period. Ponta (1996) using quarterly data from 1970 to 1992 has also found the unsustainability of the external debt in Brazil. Rocha and Bender (2000) made similar exercise testing Brazilian current account sustainability using annual data from 1947 to 1997 and also concluded that the current account deficits in Brazil do not meet the requirements to warrant a sustainable path in the long run. Both authors used cointegration. They have also performed unit root tests in the presence of structural break, although the equations they used were slightly different from each other. Ponta (1996) tested cointegration between net external debt and trade balance whereas Rocha and Bender (2000) used exports and imports of goods and services including net interest.

By working in a different way, Carneiro (1997) did not find a sustainable path. Luporini (2000) has performed test of sustainability of the fiscal policy using the discounted debt and found that the fiscal policy in Brazil was sustainable before 1980 and unsustainable after that period.

## 4. THE ANALYTICAL FRAMEWORK OF CRITICAL DEBT AND DEBT DYNAMICS

The intertemporal budget constraint has already been largely discussed in theoretical and empirical literature (Minsky, 1986, Eisner and Pieper, 1984, Hamilton and Flavin, 1986, Trehan and Walsh, 1991, Wilcox, 1989, Hakkio and Rush, 1991, Greiner and Semmler, 1999, and Greiner and Semmler, 2000). Similar work analyzing the Brazilian case can be seen in Simonsen (1985), and Luporini (2000). For the sustainability in an open economy see Sawada (1994), Carneiro (1997), Ponta (1996), and Rocha and Bender (2000).

This paper presents three analytical approaches to get a testable equation in order to confirm the results. The first one departs from Sawada (1994), Wilcox, (1989), and Hamilton and Flavin, (1986). The second one departs from the net external debt and it shows only simple differential equations to get a basic framework to test sustainability. The third one also departs from Hamilton and Flavin (1986), and it gets a testable equation by using the discounted debt (Greiner and Semmler, 1999).

### *Model 1*

The first useful model to get a feasible empirical estimation equation comes from the work of Sawada (1994), Wilcox (1989) and Hamilton and Flavin (1986). It departs from the basic account identity for an open economy during a period *t*:

$$Y_t + (D_t - D_{t-1}) + TR_t = A_t + rD_{t-1} + \Delta RE_t \qquad (5)$$

Where $Y$ is the GDP, $D$ is the net external debt (gross external debt minus international reserves), $TR$ is the net transfer receipts, $A$ is the domestic absorption, $r$ is the nominal interest rate and $\Delta RE_t$ is the change in foreign reserves.[16] As usual in accounting identities, the left side hand of equation (5) represents the economy's aggregate income whereas the right hand side is the total expenditure.
From the income identity in an open economy we get:

$$X_t - M_t = Y_t - A_t \qquad (6)$$

Where $X_t$ are the nominal exports of goods and services and $M_t$ are the nominal imports of goods and services at time $t$. From (5) we can get the trade balance of this economy:

$$TB_t = X_t - M_t = rD_{t-1} - (D_t - D_{t-1}) - TR_t + \Delta RE_t \qquad (7)$$

The evolution of the external debt is:

$$(D_t - D_{t-1}) = rD_{t-1} - [TB_t + TR_t - \Delta RE_t] \qquad (8)$$

Letting $S_t = [TB_t + TR_t - \Delta RE_t]$, we can translate this identity as the net external surplus that can be used to meet the external debt repayments. Since (8) is a differential equation we can solve it recursively to get the forward-looking solution in terms of the net external debt ($D_t$):

$$D_t = \lim_{N\to\infty} \frac{D_N}{\prod_{j=1}^{N-t}(1 + r_{t+j})} + \sum_{j=t+1}^{\infty} \frac{S_j}{\prod_{i=1}^{j-t}(1 + r_{t+i})} \qquad (9)$$

Taking expectation operator in both right hand equations we can determine that the solvency condition is satisfied when:

$$D_t = E \sum_{j=t+1}^{\infty} \frac{S_j}{\prod_{i=1}^{j-t}(1 + r_{t+i})}$$

Or, if

$$D_t = E \lim_{N\to\infty} \frac{D_N}{\prod_{j=1}^{N-t}(1 + r_{t+j})} = 0 \qquad (10)$$

This is the no Ponzi condition, in which external debt repayments are sustainable, or that the amount a country borrows (lends) in international market equals the present value of future trade surpluses. If

[16] Sawada (1994) admits that there is an interest rate over reserves, so $\Delta RE_t$ *is* $[RE_t - (1+i)\, RE_{t-1}]$, where $i$ is the interest rate on this reserves. The results do not present differences if we skip the interest rates over external reserves.

equation (10) is greater than zero, the country is paying the old maturity debt by issuing new debt, which reveals that external debt is not sustainable in the long run.[17]

Assuming that the interest rate is stationary, with a unconditional mean equal to *r*, we can subtract *rDt-1* from equation (8) to get:

$$E_t + (1+r)D_{t-1} = EX_t + D_t \qquad (11)$$

Where $EX_t = X_t + TR_t + RE_{t-1}$, $IM_t = M_t + RE_t$, *and* $E_t = IM_t + (r_t - r)\, D_{t-1}$. Taking the first difference, we have:

$$\Delta D_t = \Delta E_t + (1+r)\,\Delta D_{t-1} - \Delta EX_t \qquad (12)$$

Solving this equation forward to get:

$$MM_t = EX_t + \lim_{i\to\infty} \frac{\Delta D_{t+1}}{(1+r)^i} + \sum_{j=t+1}^{\infty} \frac{\Delta EX_j - \Delta E_j}{(1+r)^{j-t}} \qquad (13)$$

Where $MM_t$ is defined as $(M_t + rD_{t-1})$.
From the assumption that $EX_t$ and $MM_t$ follow a random walk with drift, or in other words, both series are non-stationary and have an intercept, we can obtain an empirical testable equation. This equation follows:

$$EX_t = a + bMM_t + u_t \qquad (14)$$

If *MM* and *EX* are nonstationary process, then the null hypothesis to be tested is that *MM* and *EX* are cointegrated, and that $b=1$.[18] Therefore, *MM* and *EX* have to be cointegrated in order to reach the necessary condition for the country to be solvent.

Basically, two values are said to be cointegrated when each variable taken separately is nonstationary, I(1) process, while a linear combination of them is stationary. There may be a number, *b*, such that $EX_t - a - bMM_t = u_t$ is stationary. After checking whether $EX_t$ and $MM_t$ each have a unit root, it will be employed the Johansen testing procedure to estimate the cointegration regression (14).

[17] This is the case in which a country is bubble financing its external debt. (Sawada, 1994).

[18] See for this condition Hakkio and Rush (1991). See, also, Rocha and Bender (2000) regarding the need in supposing that b should be equal to 1 in order to meet the requirements for sustainability when both variables are cointegrated. Although Hakkio and Rush (1991) point out that b could be less than one, this requirement is not sufficient to meet the sustainability condition in case of the external debt is positive.

***Model 2***

An alternative methodology to treat debt sustainability departs from this basic equation

$$d = \frac{D}{Y} \qquad (15)$$

Where D is the stock of external indebtedness of the country and Y is the GNP. Taking time derivatives we can get:

$$\frac{\dot{d}}{d} = \frac{\dot{D}}{D} - \frac{\dot{Y}}{Y} \qquad (16)$$

We know that

$CA = -B + rD$

Where $CA$ is the Current Account deficit, $B$ is Current Account surplus excluding net interest payments and $r$ is the interest rates paid on external debt. From that we have:

$$\dot{D} = -B + rD$$

$$\frac{\dot{D}}{D} = \frac{-B + rD}{D}$$

$$\frac{\dot{d}}{d} = -\frac{B}{D} + r - g$$

Where $g$ is the growth rate of GNP.

$$\frac{\dot{d}}{d} = (r - g) - \frac{B}{D} \qquad (17)$$

Of course if $r = g$, it follows that

$$\frac{\dot{d}}{d} = \frac{-B}{D} \qquad (18)$$

If $r = g$ external indebtedness will be growing relative to GNP when the non-interest current account is in deficit. On the other hand, if $r$ exceed $g$ and, for an external debtor, external debt will be rising relative to GNP when the non-interest current account is not in sufficiently large surplus relative to the

stock of external debt. Therefore, the sustainable path is what the ratio of external debt to GNP is $\dot{d}/d = 0$.

If $\dot{d} = 0$, $\dot{d}/d = 0$. Therefore

$$-\frac{B}{D} = -(r - g)$$

Once $d = \frac{D}{Y}$, we can reach that

$$\frac{D}{Y} \cdot \frac{B}{D} = (r - g)d$$

$$d^* = \left(\frac{B/Y}{r - g}\right) \qquad (19)$$

If $r > g$, it is not possible to find the sustainable deficit in current account compatible with the stock of the external debt, foreign interest rates, and growth of GNP. Therefore, it is necessary a trade surplus for $d^* > 0$.

One way to find the sustainable path of the external debt in Brazil is by means of simulations with Brazilian data using equation (19) in the fashion of Carneiro (1997). However, unit root and cointegration tests have provided useful tools in gaining insight into the long-run implications of a government's fiscal and the financial policy in a given time-horizon. This method, therefore, will be employed to test the sustainability of the external debt.

***Model 3: Discounted debt***

From Model 1 we can redefine the discounted factor that appears in the denominator of equation (9) and (10) in order to get a testable equation using the discounted debt.
From equation (9) we get:

$$D_t = (1+r_t)D_{t-1} - S_t \qquad (20)$$

Assuming that $Q_t = \prod_{j=0}^{t-1}(1+r_j)^{-1}$; $Q_0 = 1$, we can multiplying (20) by the discounted factor:

$$D_t Q_t = Q_{t-1}D_{t-1} - Q_t S_t$$

Using small letters:

$$d_t = d_{t-1} - s_t \qquad (21)$$

Recursive substitution leads to:

$$d_t = \sum_{j=1}^{N} s_{t+j} + d_{t+N}$$

Assuming $d_n$ going to zero, we get:

$$d_t = E\sum_{j=1}^{N} s_{t+j} \qquad (21')$$

Which determines the discounted equation to be tested.

## 5. DATA SOURCE AND EMPIRICAL RESULTS

As stated in the last item, I will test the sustainability of the external debt and current account in Brazil taking into consideration three models. The aim is to get as much as possible accurate result.

The data set was obtained from the Brazilian Central Bank Monthly Bulletin and consists of quarterly observations for Gross External Debt, Foreign Reserves, Current account, Exports of goods and services, Imports of goods and services, External Interest Rates (Prime Rate), and Trade Balance. All data, except Gross External Debt and External Interest rates are quarterly basis from 1969 to 2000. Regarding to gross external debt, the model that use this variable will be performed from 1982 to 2000, while for that one which work with Prime Rate, I will perform the tests from the first quarter of 1970. All tests will be performed with nominal and non-seasonally adjusted data.[19]

### *Model 1*

As it has already presented in the last section, the following equation will be tested:

$$EX_t = a + bMM_t + u_t \qquad (14)$$

The necessary and sufficient condition to the Current Account be sustainable is that the series in equation (14) are cointegrated and $b = 1$. Therefore, as usual, the first step is to perform tests for stationarity of the variables. Dickey and Fuller (1979) suggested that the following equation is estimated by OLS to test for the presence of a unit root in any $x_t$ series:

$$\Delta x_t = \beta_0 x_{t-1} + \sum_{i=1}^{p} \beta_i \Delta x_{t-i} + \varepsilon_t$$

[19] In fact, the Imports plus interest rates variable presents seasonal pattern after 1990. The tests applied with the series without seasonality do not presented substantial change in the results.

The Augmented Dickey-Fuller (ADF) test for unit root consists of testing whether the coefficient on $x_{t-1}$ is zero. The inclusion of higher-order autoregressive terms in the regression controls for serial correlation of the disturbance term. Under the null $H_0: \beta_1 = 0$, the series $x_t$ contains a unit root and therefore is nonstationary. Under the alternative $H_1: \beta_1 < 0$, the series is stationary.

The Akaike criterion places a penalty on extra coefficients, so one has to be careful when select the lag length of the variables. The Phillips-Perron test (PP) was also performed. This unit root test, developed by Phillips and Perron (1988), corrects the statistics for serial correlated and possibly heteroskedastic error terms.

Firstly, it will be performed a test for unit roots on each of the variables utilized, *EX*, previously defined, and Imports of goods plus net interest expenditures (*MM*) from the first quarter of 1969 to the first quarter of 2000.[20] The ADF and PP tests results are summarized in table 6. For the whole series (1969 to 2000), exports and imports plus net interest payments present unit root. Using different lag length, both tests could not reject the null hypothesis of unit root at 1% level. It worth note that different lag length in ADF tests were performed, although the Akaike information Criterion (AIC) and Schwarz Criterion (SC) suggest 4 lags.[21]

The PP tests also do not reject the null hypothesis of unit root for exports (*EX*) at 1% level of significance (-0.94). Nevertheless, using PP tests, imports plus net interest expenditures (*MM*) have rejected the null hypothesis of unit root, so this series seems to be stationary in this test. PP tests were carried out only with 4 lags, since the Newey-Nest tests suggest this lag length. These mixed results do not, however, lead to problems, since the stationarity tests are only the first step to test sustainability. Once *MM* seems to be stationary while *EX* does not, there is reason to suppose that the series are not cointegrated, which will be checked later.

**TABLE 6**

**Test of the Unit Roots (1969:01 to 2000:02): Intercept no Trend**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | PP(4) |
|---|---|---|---|---|---|
| *EX* | -1.275757 | -0.555763 | -0.256172 | -0.522069 | -0.938500 |
| *ΔEX* | -15.59541* | -13.03227* | -4.906907* | -6.263054* | -13.89360* |
| *MM* | -0.463032 | -0.432442 | -0.110328 | -0.040111 | -3.756565* |
| *ΔMM* | -11.03059* | -9.644773* | -7.652966* | -6.537170* | - |

MacKinnon critical values for rejection of hypothesis of a unit root –3.48 (1%), –2.58 (5%), -2.88 (10%)
* Significant at 1% level
** Significant at 5% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 3 truncation lags.
Since the model presented has only an intercept no trend, the other tests have not been performed (no intercept and intercept and trend).
AIC and SC suggests 5 the best lag utilized for *EX* and 4 lag for *MM*

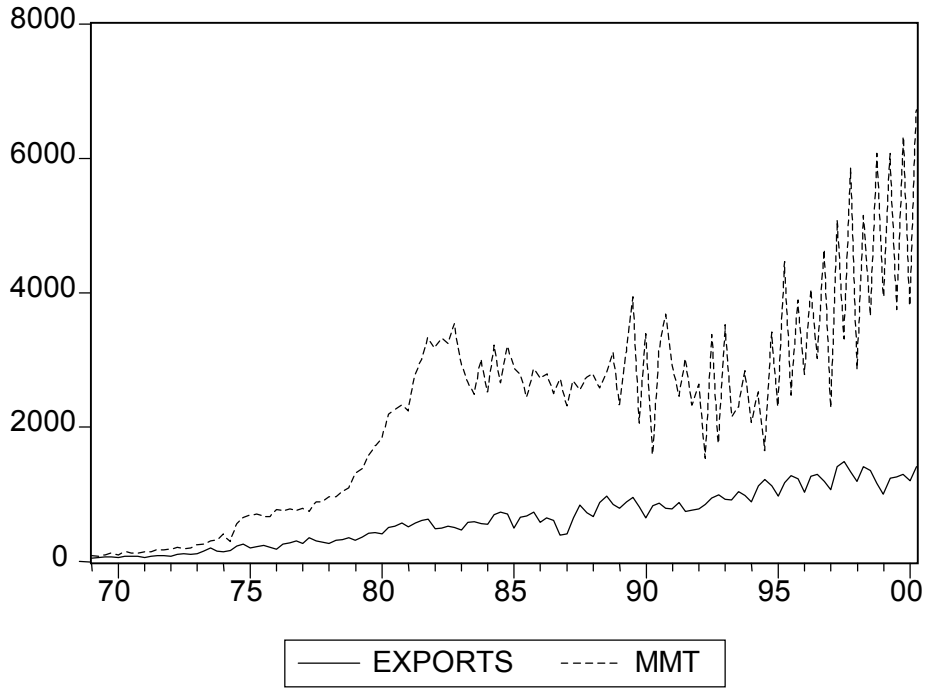
[20] I will use Trade Balance instead of $Ex_t$ in this model, since services free of interest rates present the same behavior of trade balance. There is no lost of information. See Ponta (1996).

[21] As well known in the empirical literature, the optimal lag length is obtained after checking the value that minimizes AIC and SC.

Before testing for cointegration in these series, it worth note that, due to different economic policies that occurred in Brazil and others heavily indebtedness countries, it is convenient to divide the whole sample in sub samples and to perform both the unit root and cointegration tests for selected periods. Besides, figure 3 suggests that *MM* series present a break point in 1983, as well as a seasonable behavior after 1990, whereas the exports series do not seem any break. Therefore, it is also suitable to employ the technique developed by Perron (1989) to test the series for Unit Root in presence of structural break. Thus, these tests are also performed.

**FIGURE 3:**

**Total Exports and Imports plus Net Interest Rates (1969 to 2000)**
**US$ Million**




Source: Brazilian Central Bank, monthly bulletin, several issues

Until the debt crisis in the third quarter of 1982, the external economic policy in Brazil was characterized by strong external indebtedness to finance the "economic miracle" in early 1970s and the import substitution strategy after the first oil shock in 1973. Afterwards, stop and go policies characterized the 1980s while the structural reforms such as privatization, trade and financial liberalization characterized the 1990s. Therefore, I selected three sub samples to analyze the sustainability of the Brazilian Current Account in these periods. The first come from 1969 to 1983, covering the period of sustaining economic growth and external indebtedness policies to finance the development. This period ends in the aftermath of Mexico crisis in September 1982, when capital flows were cut for heavily indebtedness countries. Stop and go policies characterized the second period (1984

to 2000). Finally, the last sub sample covers the period after the structural reforms in Brazil (1990 to 2000), in which privatizations, trade and financial liberalization took place. This stage also presented the recovery of capital inflows to Latin America countries after a decade without them voluntarily.

Table 7 presents the unit root tests for *EX* and *MM* from 1969 to 1983. The null hypothesis of unit root could not be rejected in any variable for ADF and PP. The presence of two unit roots occurs in ADF tests for 3, 4, and 5 lags for imports plus net interest expenditures. Tables 8 and 9 show the unit root tests for the same variables for the other sub samples. Again, PP tests for variable *MM* in both periods 1984 to 2000 and 1990 to 2000 could not rejected the null hypothesis of unit root, so there is room to suppose that this variable can be stationary in this period.

**TABLE 7**

**Test of the Unit Roots (1969:01 to 1983:04): Intercept no Trend**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | ADF (5) | PP(3) |
|---|---|---|---|---|---|---|
| *EX* | -0.484098 | -0.090292 | 0.010161 | -0.454621 | -0.205319 | -0.328603 |
| *ΔEX* | -7.908494* | -6.824640* | -2.986820** | -3.607650* | -3.268628** | -9.894356* |
| *MM* | 0.236592 | -0.015912 | 0.802845 | -1.266794 | -1.263966 | 0.291868 |
| *ΔMM* | -4.115107* | -5.471192* | -1.872799 | -1.750760 | -1.834763 | -7.126390* |
| *ΔΔMM* | - | - | -6.032214* | -4.531684* | -2.831904** | - |

MacKinnon critical values for rejection of hypothesis of a unit root –3.48 (1%), –2.58 (5%), -2.88 (10%)
* Significant at 1% level
** Significant at 5% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 3 truncation lags.
Since the model presented has only an intercept no trend, the other tests have not been performed (no intercept and intercept and trend).
AIC and SC suggests 5 the best lag utilized for *EX* and 4 lag for *MM*

**TABLE 8**

**Test of the Unit Roots (1984:01 to 2000:02): Intercept no Trend**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | ADF (5) | PP(3) |
|---|---|---|---|---|---|---|
| *EX* | -1.783644 | -0.779153 | -0.523418 | -0.883511 | -0.717009 | -1.245455 |
| *ΔEX* | -11.51789* | -9.614436* | -3.508281* | -4.628750* | -4.537156* | -11.03723* |
| *MM* | -0.388646 | -0.136420 | 0.570944 | 0.995685 | 1.526711 | -6.893219* |
| *ΔMM* | -8.608560* | -7.647218* | -6.301856* | -5.708974* | -3.793864* | - |

MacKinnon critical values for rejection of hypothesis of a unit root –3.48 (1%), –2.58 (5%), -2.88 (10%)
* Significant at 1% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 3 truncation lags.
Since the model presented has only an intercept no trend, the other tests have not been performed (no intercept and intercept and trend).
AIC and SC suggests 5 the best lag utilized for *EX*

**TABLE 9**

**Test of the Unit Roots (1990:01 to 2000:02): Intercept no Trend**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | PP(3) |
|---|---|---|---|---|---|
| *EX* | -1.799435 | -0.716805 | -0.338962 | -0.813086 | -1.396741 |
| *ΔEX* | -9.565808* | -8.318481* | -2.694210** | -3.657705* | -9.991806* |
| *MM* | -0.257906 | -0.240540 | 0.296071 | 0.764490 | -5.798946* |
| *ΔMM* | -6.413976* | -5.896891* | -5.223405* | -4.487391* | - |

MacKinnon critical values for rejection of hypothesis of a unit root –3.48 (1%), –2.58 (5%), -2.88 (10%)
* Significant at 1% level
** Significant at 5% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 3 truncation lags.
Since the model presented has only an intercept no trend, the other tests have not been performed (no intercept and intercept and trend).
AIC and SC suggests 4 the best lag utilized
Due to seasonally behavior in the EX series after 1990, I used a seasonally adjusted version of the series, but the ADF and PP tests do not present significatively changes.

After performing the unit root tests for the variables in this model, since both variables are I(1) in some cases, or at least one of the variables is always I(1), we need to perform the cointegration tests to check the sustainability of the current account in Brazil. The necessary condition to warrant that these variables are sustainable in the long run is that they need to be cointegrated.

Table 10 presents the Johansen cointegration tests for distinct sub samples. The regression suggests cointegration from 1969 to 1983. There is at least one cointegrated vector at 5% of significance. Nevertheless, *b* should be statistically equal to one in order to warrant a sustainable path of the current account.[22] The normalized coefficients in the cointegrated equation show that *b = 0.1525,* which means that the sufficient condition for the sustainability of the external debt has not been met.[23]

This result is not surprising, since the economic policy in Brazil during the 1970s was intensely based on external indebtedness to finance the development. Highly indebtedness and accumulation of external reserves characterized the first half of that decade whereas trade balance and current account were sometimes in deficit or balanced. In the second half of 1970s, however, even after the first oil shock, Brazilian policy makers maintained the same policy of indebtedness, but now to pay the debt services and finance the import substitution strategies based on public investments. This policy has warranted positive and significant GDP growth rates.

[22] If b<1, and the initial external debt is positive, the real value of the ratio debt/GNP diverges to infinite. In this case, the external debt is not sustainable. (Rocha and Bender, 2000).

[23] The normalized coefficients of the cointegrated vector are: Exports 1.00000, MMt 0.152483, C 1105944. The log likelihood is –1735.332

Table 10 also shows that for the whole sample (1969-2000) the cointegration between these variables does not hold, suggesting that the current account is unsustainable. Besides, the other sub samples, 1984-2000 and 1990-2000, present similar results. Therefore, the 1980s crisis and the 1990s attempt to recover economic growth by means of structural reforms do not lead to a long run sustainable path of the external accounts in Brazil. Therefore, these results show that external constraints to development keep being an issue for policy makers.[24]

**TABLE 10:**

**Johansen Cointegration Equation for the Relationship between *EX* and *MM***
**No deterministic trend in the data.**

| Sample | Eigenvalue | Likelihood ratio |
|---|---|---|
| (1969:01 – 2000:02) | 0.040831 | 5.093299 |
| | 0.000405 | 0.049075 |
| (1969:01 – 1983:04) | 0.251822 | 16.85581 |
| | 0.000503 | 0.029166 |
| (1984:01 – 2000:02) | 0.067762 | 5.412487 |
| | 0.011770 | 0.781431 |
| (1990:01 – 2000:02) | 0.257588 | 12.54650 |
| | 0.000875 | 0.036754 |

Critical values for likelihood ratio, so LR tests indicates at leas one cointegration vector are: 15.41 and 3.76 (5%), respectively, and 20.04 and 6.65 (1%), respectively.

As argued by Perron (1989, 1994) if there is a break in the determinist trend in any time-series, unit root tests will lead to a misleading conclusion that there is a unit root, when in fact there is not. Therefore, further unit root tests have to be performed if the researcher supposes the series have structural break. Net interest payments series in Brazil seem to be at least one break in 1983, when the economic policy changed to adjust the external environment of the break in external capital flows. Perron (1989) suggested a test of unit root in the presence of a break point, which allows the possibility of a one-time structural change in the trend functions. The changes considered were three kinds: a change in intercept, a change in slope, and both. Perron (1989) test suppose, then, one known breakpoint, so the first step to make his test is to find the break point. Since 1982/1983 is the year in

[24] A long span of data is more appropriate to test sustainability by means of cointegration. Therefore, dividing the whole period in sub samples, although economically relevant, is econometrically problematic. One can avoid it by testing structural breaks instead of dividing the whole period in sub samples. This alternative was also tested, as it will be described latter.

which the Mexico crisis imposes several constraints to Latin American countries, as well as when Brazilian policy makers elected the external equilibrium as the political economy's target, it seems reasonable to test whether there was a break point in both series in this period.

The usual test to find a known break point is the Chow test, in which the break is tested against the alternative hypothesis of no break point. Chow breakpoint test (not reported) suggests 1983:02 as the break point for *MM* series, whereas for *EX* series there is no break point.[25] Therefore, it is important to test for unit root the series *MM* under the presence of a known break point. Furthermore, it was carried out cointegration tests in the presence of structural break.[26]

The additive outlier model can be employed in the series after knowing the break point. These models are specified for each of the three specifications of the types of change occurring at the break date ($T_b$) as follows:

*Equation 1:* $Y_t = \mu_1 + \beta t + (\mu_2 - \mu_1)DU_t + \nu_t$
*Equation 2:* $Y_t = \mu_1 + \beta_2 t + (\mu_2 - \mu_1)DU_t + (\beta_2 - \beta_1)DT_t + \nu_t$
*Equation 3:* $Y_t = \mu + \beta_1 t + (\beta_2 - \beta_1)DT_t + \nu_t$

Where $DU_t = 1$, $DT_t = t - T_b$ *if* $t > T_b$ and 0 otherwise. The noise component $\nu_t$ is in the form *A(L)* and *B(L)* $p^{th}$ and $q^{th}$ order polynomials, respectively of the lag operator *L*. The innovation series $\{\nu_t\}$ is taken to be of the *ARMA(p,q)* type with the orders *p* and *q* possibly unknown. This postulate allows for a series $\{y_t\}$ to represent quite general processes. The null hypothesis specifies that a unit root of the autoregressive polynomial is one, i.e. that we can write *A(L) = (1-L)A*(L)* where the roots of *A*(L)* are outside the unit circle.

Equation 1, then, allows for a change in intercept, whereas equation 2 describes a change in the slope, and equation 3 both changes. These models were then tested to additive outlier model. The test is procedure in two steps. In the first step, the trend function of the series is estimated and removed from the original series via regressions presented in equations 1, 2, and 3 above. For equation 1 and 2, the procedure is based on the value of the t-statistic for testing that the sum of the autogressive coefficients is equal to 1 ($\alpha = 1$) in the following autoregression applied to the estimated noise component $\nu_t$:[27]

$$\nu_t = \alpha \nu t - 1 + \sum_{j=0}^{k} d_j D(t_b)_{t-j} + \sum_{i=1}^{k} a_i \Delta \nu_{t-1} + \varepsilon_t \qquad (22)$$

For equation 3 the second step regression is in the form:

[25] Chow breakpoint test was carried out by E-views 3.0.

[26] See Mandala and Kim (1998), especially part IV, for a discussion about tests for break in time-series. They also point out the limitations of Perron (1989) model, as well as models, which work with exogenous break point.

[27] Perron (1994).

$$v_t = \alpha v_{t-1} + \sum_{i=1}^{k} a_i \Delta v_{t-i} + \varepsilon_t \qquad (23)$$

All tests were carried out using 1983:02 as the break date for *MM* series. The results confirm that the series, even with the break, kept their non-stationary feature. The residual equations (22) and (23) have a residual that has to be a white noise to become a stationary series. Table 11 shows the results of the unit root tests for the residuals of equation (22) and (23). The unit root tests in presence of a breakpoint suggests, also, mixed results. Indeed, while PP test shows for both models that both series are stationary, ADF results suggest that one cannot reject the hypothesis of unit root in the residuals series in equation (22) (dummy in intercept). With regard the other model (dummy in slope), ADF tests for one and two lags reject the null hypothesis of unit root. The conclusions, then, imply that the unit root in the imports plus net interest rates in the whole sample (1969-2000) was biased for the break point in 1983:02. Cointegration results, not reported, show that both series are not cointegrated, such as demonstrated in the series not controlled for a break point. This result confirms the unsustainable path of the current account in Brazil from 1969 to 2000.

**TABLE 11**

**Test of the Unit Roots (Intercept no Trend) for the residuals in equation (3.20) and (3.21)**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | ADF (5) | PP(4) |
|---|---|---|---|---|---|---|
| $\varepsilon$ *(22)* | -2.280202 | -1.986778 | -1.476962 | -1.298380 | -1.104188 | -12.85214* |
| $\Delta\varepsilon$ | -12.13860* | -10.26608* | -8.144750* | -7.207863* | -4.599810* | -72.99817* |
| $\varepsilon$ *(23)* | -4.217569* | -3.331324** | -2.445611 | -2.094463 | -1.645113 | -17.52302* |
| $\Delta\varepsilon$ | -14.03938* | -11.81225* | -9.314922* | -8.899124* | -5.883054* | -100.7874* |

MacKinnon critical values for rejection of hypothesis of a unit root –3.48 (1%), –2.88 (5%), -2.58 (10%)
* Significant at 1% level
** Significant at 5% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 4 truncation lags.
Since the model presented has only an intercept no trend, the other tests have not been performed (no intercept and intercept and trend).
AIC and SC suggests 4 lags

***Model 2***

This model contributes to analyze the sustainability of the current account and external debt in Brazil from other perspective. A testable equation employed in this model intends basically to find a vector of cointegration between net external debt and trade balance. The data set covers 1982 to 2000 in

quarter base. Following the empirical tradition, net external debt and trade balance, both in level, will be tested by cointegration.[28]

The first step consists of performing the unit root tests for net external debt and trade balance as described in table 12. Although the Akaike information criterion and the Schwarz criterion suggest 4 lags, the ADF tests were also performed with one, two, and three lags, whereas Phillips-Perron test were performed only for three truncation lags, as suggested in Newey-West tests. Both variables are nonstationary in level and stationary at first difference. Variables have, therefore, to be cointegrated to meet the sustainability condition. Tests show that both variables are I(1), which means that one could not reject the null hypothesis of unit root. In order to find whether the external debt is sustainable in the long run it is necessary to perform the cointegration tests for both variables in level.

**TABLE 12**

**Test of the Unit Roots of net external debt (*D*) and trade balance (*X-M*) (1982:04 to 2000:01): Intercept no Trend**

| Variable | ADF (1) | ADF (2) | ADF (3) | ADF (4) | PP(3) |
|---|---|---|---|---|---|
| *D* | 0.651972 | 0.152077 | 0.279015 | 0.969867 | 0.532047 |
| *ΔD* | -4.552334* | -4.077316* | -4.162259* | -3.439611** | -7.611444* |
| *X-M* | -2.570143 | -1.312021 | -1.364938 | -1.453781 | -2.120320 |
| *Δ(X-M)* | -10.14365* | -5.998124* | -4.478910* | -4.741917* | -8.142626* |

MacKinnon critical values for rejection of hypothesis of a unit root –3.53 (1%), –2.90 (5%), -2.59 (10%)
* Significant at 1% level
** Significant at 5% level
ADF (d) Augmented Dickey-Fuller test, null of Unit roots, lag (d)
PP (d) Phillips-Perron test, null of unit root, lag truncation (d). As the Newey-Nest test suggests, PP tests were carried out with only 4 truncation lags.
Since the model presented has only an intercept no trend, the other tests do not performed (no intercept and intercept and trend). AIC and SC suggests 4 the best lag utilized

The Johansen cointegration tests were performed for these variables allowing for linear determinist trend and non-determinist trend in the data. In all cases, these variables do not cointegrated, suggesting that the external debt is not sustainable for 1982:04-2000:01 period (table 13). Analyzing data from 1970 to 1992, Ponta (1996) has also showed the unsustainability of the external debt for Brazil. After 1992 the net external debt kept constant due to the accumulation of foreign reserves, but from 1998 to 2000 both gross and net external debt increased sharply. Furthermore, after 1994 the current account and trade balance changed their signal, along with a low level of GDP growth. This behavior explains the unsustainable path of the external debt. Model 2 also shows the same pattern of model 1 regarding the unsustainable path of the external debt, using different database and variables. This result, therefore, confirms the other empirical estimations.

[28] For the reason already explained, I will test trade balance instead of balance of goods and services.

**TABLE 13:**

**Johansen Cointegration Equation for the Relationship between *D* and *(X-M)***
**No deterministic trend in the data.**

| Sample | Eigenvalue | Likelihood ratio |
|---|---|---|
| (1982:04-2000:01) | 0.070645 | 5.008381 |
| | 0.001486 | 0.099665 |

Critical values for likelihood ratio, so LR tests indicates at leas one cointegration vector are: 15.41 and 3.76 (5%), respectively, and 20.04 and 6.65 (1%), respectively.

***Model 3***

The third model was carried out using equation (21'). This equation is straight, since it represents the discounted value of the net external debt. The estimation is done by performing unit root tests over the discounted debt. The necessary condition to the external debt be sustainable is that the discounted debt is stationary. Equation (21') is obtained by the discounted factor $Q_t = \prod_{j=0}^{t-1}(1+r_j)^{-1}$ and *r* is the Prime Rate quarterly data from 1982:04 to 2000:01.[29]

The ADF tests were performed allowing for trend and intercept, no trend and intercept, and no trend and no intercept. The results show that the null hypothesis of unit root cannot be rejected in neither models, so the version of discounted debt is unsustainable from the period 1982 to 2000, confirming the results obtained in model 2. Indeed, since the discounted debt is nonstationary, the net external debt is unsustainable in the long run. Once again, the management of economic policy in Brazil has to take in consideration this feature (table 14).

[29] It is important to stress that the interest rate has to be stationary. Tests of Unit Root for Prime Rate confirm its stationarity.

**TABLE 14:**

**Unit Root tests for discounted net external debt ( $d_t = E\sum_{j=1}^{N} s_{t+j}$ ) (1982:04 - 2000:01)**

$$\Delta d_t = \alpha_1 + \gamma d_{t-1} + \alpha_2 t + \sum_{i=2}^{4} \delta_i d_{t-i+1} + \varepsilon_t$$

| | (1) | (2) | (3) |
|---|---|---|---|
| $d_{t-1}$ | -0.037132 | 0.039366 | 0.018143 |
| | (0.068876) | (0.044244) | (0.010292) |
| $\Delta d_{t-1}$ | 0.064429 | 0.026544 | 0.048494 |
| | (0.138921) | (0.137644) | (0.129433) |
| $\Delta d_{t-2}$ | 0.215628 | 0.181558 | 0.199544 |
| | (0.136081) | (0.135223) | (0.129393) |
| $\Delta d_{t-3}$ | -0.024082 | -0.078390 | -0.053855 |
| | (0.144027) | (0.140262) | (0.130322) |
| $\Delta d_{t-4}$ | -0.168979 | 0.142965 | -0.196391 |
| | (0.146841) | (-1.570653) | (0.130251) |
| $\alpha$ | 1034.610 | -2097.799 | |
| | (4741.901) | (4251.853) | |
| T | 117.4718 | | |
| | (81.56689) | | |
| ADF Stat | -0.539116 | 0.889751 | 1.762835 |
| ADF (5%) | -3.4790 | -2.9062 | -1.9454 |
| PP Stat | -0.958938 | 0.588649 | 1.854611 |
| PP (5%) | -3.4749 | -2.9035 | -1.9451 |

Standard Errors in parenthesis.
AIC and SIC tests suggest 4 lags

## 6. CONCLUSIONS

This paper has studied the sustainability of the external debt in Brazil from 1969 to 2000. In the seventies, positive and significant growth rates of GDP and GDP per capita were associated with capital inflows and indebtedness. In the eighties, the debt crisis lead to a break in capital flows to heavily indebtedness countries, particularly for Latin American ones. The outcome was high inflation, fiscal crisis and low GDP growth, along with several failure attempts to stabilize prices. In the nineties, the return of Brazil and other Latin American countries to international capital markets were shared by trade and financial liberalization, as well as capital inflows, mainly short-run ones. While in the seventies, capital inflows helped Brazil to keep the import substitution policies, in the eighties, the indebtedness in the previous decade led to highly external vulnerability. Facing the impossibility to finance current account deficits by more indebtedness, the economic policy carried out export-led policies, which allowed to achieve massive trade balance surpluses.

After the adjustment in eighties, in which the external equilibrium was achieved, but at a cost of stagnation and highly inflation, Brazil return to voluntary capital markets in nineties, which allowed faster accumulation of international reserves. This fact contributed to trigger an exchange rate based

stabilization plan in 1994. Although capital inflows have had important role in short-run management of macroeconomic policy, basically allowing exchange rate to be used as the main policy variable, the indebtedness poses the problem of repayments of debt in the long run. The currency crisis in January 1999 illustrated the problems related to systematic current account deficits and overvaluated exchange rates. The external front, therefore, keeps being a concern for economic development in Brazil.

Sustainability tests showed that, for different periods and using different models and variables, external debt and current account deficits are not sustainable in the long run. By dividing the whole period in sub samples, it has showed that even from 1969 to 1983, when the necessary condition for sustainability was accomplished, the sufficient condition did no meet. The crisis in early 1980s was closely related to the external vulnerability presents in indebtedness policy. The high stock of external debt facing the interest rates shock and the break in capital inflows impose a difficult management of current account deficits, and the impossibility to make external debt repayments.

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