

# Sustainability of the Brazilian Fiscal Policy and Central Bank Independence\*

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Summary: 1. Introduction; 2. Sustainability of fiscal policy: analytical framework; 3. Sustainability of the Brazilian fiscal policy: econometric tests and results; 4. Sustainability and central bank independence; 5. Concluding remarks.

Key words: fiscal policy; federal debt; central bank independence; Brazil.

JEL Codes: E5 and E62.

This paper analyzes the sustainability of fiscal policy in Brazil since the financial reform of 1965 and discusses how the relationship between the Treasury and the Central Bank has determined the federal government's capacity to finance itself. A sustainable policy is defined as one such that the discounted government debt as a ratio to the GDP is backed by expected primary surpluses of equal present-value. In the context of an infinite-horizon framework, sustainability is tested through the mean-zero stationarity of the discounted debt/GDP ratio. Although the overall results indicate sustainability, tests on subsamples show that the fiscal policy was sustainable prior to 1980, but it assumed an unsustainable path during the 80's and early 90's.

Este artigo analisa a sustentabilidade da política fiscal brasileira desde a reforma financeira de 1965 e discute como o relacionamento entre o Tesouro e o Banco Central tem determinado a capacidade do governo federal brasileiro de se financiar. A política fiscal governamental pode ser considerada sustentável se o valor descontado de sua dívida mobiliária como fração do PIB for respaldada por superávits fiscais primários de mesmo valor-presente. Em um quadro analítico de horizonte-infinito, a sustentabilidade da política fiscal brasileira é testada através da estacionaridade da razão dívida/PIB ao redor da média zero. Embora os resultados gerais indiquem sustentabilidade, os testes implementados em dois subconjuntos da amostra sugerem que a política fiscal assumiu um padrão insustentável após 1981.

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\* *This paper was received in Mar. and approved in Dec. 1999. The author would like to thank Afonso Ferreira and two anonymous referees for their helpful comments. The opinions and conclusions expressed here are, however, the author's sole responsibility.*

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## 1. Introduction

The purpose of this paper is to analyze the sustainability of fiscal policy in Brazil from 1966 to 1996 and to discuss how the institutional setting shaping the relationship between the Treasury and the Brazilian Central Bank has determined the government's capacity to finance itself.

Since the financial reform of 1965, the Brazilian government has often run budget deficits financed through issues of government bonds. Before then, deficits were primarily financed through money creation. Until 1980, the federal domestic debt as a ratio to the GDP increased steadily and, after 1981, it assumed an unprecedented upward trend, as borrowings from the international financial market became increasingly more difficult in the aftermath of the first oil shock. The central government's borrowing requirements increased from 4.8% of the GDP in 1983 to 12.5% in 1985, 26.6% in 1988, and 49.3% in 1989. Inflation rates also soared during this period, with the annual rate ranging from 110% in 1981 to 2,740% in 1990. Between 1981 and 1996, the Brazilian federal domestic debt averaged 24.08% of the GDP, which is not particularly large when compared to that of other countries, but the pattern of fiscal deficits has raised concern amongst policymakers: can the Brazilian government continue to operate this fiscal policy indefinitely or is the accumulation of fiscal deficits bringing the domestic debt to an unsustainable path?

The problem of consistently running budget deficits is twofold. First, as deficits approach the government's collateral or future taxing capacity, the interest rate tends to rise, affecting investment and consumption behaviors. Second, the counterpart of budget deficits is the accumulation of government debt. As debt accumulates, as a result of the ongoing fiscal policy, the question of whether the government is running a Ponzi scheme against the public is raised, that is, whether the government is borrowing from the public, meeting interest payments on its debt by borrowing more, and, therefore, simply rolling over its debt indefinitely (McCallum, 1984).

The concept of debt sustainability pertains to the question of whether the government is heading towards excessive debt accumulation, which can ultimately threaten price stability. A debt is considered "excessive" and, therefore, unsustainable, when the government does not satisfy an intertemporal budget constraint and, as a result, its debt cannot be offset by expected future primary surpluses of equal present-value.

Having a sustainable fiscal policy does not mean that governments cannot run primary deficits occasionally. It means that the government cannot run permanent interest-exclusive deficits. The reason is that optimizing individuals will not keep buying financial claims from a government that does not intend to pay its debt. An unsustainable domestic debt may threaten price stability in an institutional setting where the monetary authorities do not act independently from the fiscal authority and set its monetary targets in accordance with the fiscal budget (Sargent & Wallace, 1981).

The seminal work by Hamilton and Flavin (1986) has prompted a series of sustainability tests in the last decade (Wilcox, 1989; Kremmers, 1989; Trehan & Walsh, 1991; Bohn, 1991; Hakkio & Rush, 1991; Tanner & Liu, 1994; Ahmed & Rogers, 1995; Pastore, 1995; Uctum & Wickens, 1996; Isller & Lima, 1997; among others). In this paper, the sustainability of Brazilian fiscal policy is tested through the mean-zero stationarity of the discounted debt/GDP ratio in the context of an infinite-horizon framework.

This paper departs from previous studies in three important ways. First, it develops an analytical framework which provides the microfoundations for the analysis of sustainability. Second, in the empirical tests, the introduction of a discounting factor developed by Wilcox (1989) allows for the usage of interest and growth rates actually observed in the Brazilian sample, instead of their averages. Finally, complementing standard unit root tests, sustainability is tested using the Wald form of the OLS  $F$ -test suggested by Dickey and Fuller (1981), and the procedure developed by Kwiatkowski, Phillips, Schmidt and Shin (1992). The motivation for this procedure is that classical hypothesis testing is designed to accept the null hypothesis of a unit root (non-stationarity) unless there is strong evidence against it. As a result, standard tests fail to reject the null of a unit root (non-stationarity) in several economic series. This new procedure allows us to directly test the null hypothesis of stationarity.

## 2. Sustainability of Fiscal Policy: Analytical Framework

The first concept of a sustainable fiscal policy is due the works of Domar (1944) and Harrod (1948). In the absence of monetary financing, if enough taxes are levied to pay the interest accrued to the government debt, but not enough to pay for other government expenditures, the debt will growth and

the tax rate will have to be raised without limit, unless the after-tax interest rate on government securities does not exceed the growth rate of the economy.

In the absence of monetary financing, let the government's budget constraint expressed in real terms and as a ratio to income be:

$$b_t - b_{t-1} = g_t - t_t + (r_{t-1} - \eta_{t-1})b_{t-1}$$

where:

$b$  is the par value of the stock of government debt;

$g$  and  $t$  are government expenditures (exclusive of interest payments on the debt) and tax revenue, respectively;

$r$  is the *ex post* after-tax real rate of interest;

$\eta$  is the rate of income growth.

According to the budget constraint expressed above, the evolution of the debt/income ratio depends on two factors: the primary deficit ( $g_t - t_t$ ), and the product of the accumulated debt/income ratio ( $b_{t-1}$ ) and the difference between the real rate of interest and the income growth rate ( $r_{t-1} - \eta_{t-1}$ ). If the difference is positive, a primary surplus is needed to maintain a constant debt/income ratio. If the difference is negative, it is possible to run a certain level of primary deficit and maintain a constant debt/income ratio. That is, when the after-tax real rate of interest is greater than the economy's growth rate, a positive deficit will induce a growing stock of government debt and, therefore, growing interest payments that will have to be met by an ever increasing tax rate.

In the context of comparing the real rate of interest with the growth rate of income, a primary deficit is considered sustainable if the resulting debt/income ratio is constant, given a specific rate of income growth and a constant real rate of interest. According to the budget constraint expressed above, the debt/income ratio will be constant when  $b_t = b_{t-1}$ , which implies that  $-(g_t - t_t) = (r_{t-1} - \eta_{t-1})b_{t-1}$ . Clearly, when the real rate of interest exceeds the growth rate of the economy, the government will have to run a primary surplus in order to keep the debt/income ratio constant over time.

Harrod and Domar's concept of a financially government debt rests on the assumption that the government will always be able to finance its interest-bearing liabilities as long as the net-of-taxes real interest rate paid on its securities does not exceed the growth rate of the economy. Lenders, however, impose two restrictions on government debt issuing. First, the demand for bonds sets an upper limit on the real stock of government debt relative to the size of economy; second and most important, lenders affect the interest rate the government must pay on its bonds in order to finance them. Although the comparison between the real rate of interest paid on securities and the growth rate of the economy can guide the government and help keeping the debt/GDP ratio from rising, it does not define the behavior of the market towards that particular ratio or enable the government to assess the financiality of its debt in the future. Moreover, depending on the debt/GDP ratio, the market can be quicker at influencing the real interest paid on the debt, than the government at promoting changes in its fiscal budget. The role played by the market (lenders) should, therefore, be taken into account to determine the financiality of the government's debt.

## 2.1 The economy

Suppose an economy with a large number of similar households, where a representative agent seeks at time  $t$  to maximize the following utility function:

$$u_t = E_t \left[ \sum_{t=1}^{\infty} \beta^{t-1} u(c_t, m_t) \right] \quad (1)$$

where:

$c_t$  denotes consumption in period  $t$  and  $m_t \equiv \frac{M_t}{P_t}$  stands for the household's real money stock at the start of period  $t$ ;

$P_t$  indicates the price of the consumption good in  $t$ ;

the utility function is assumed to be strictly concave so that unique, positive values are chosen for  $c_t$  and  $m_t \equiv \frac{M_t}{P_t}$ ;<sup>1</sup>

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<sup>1</sup> If a function is strictly concave and is maximized s.t. a linear constraint, any local maximum is also a global maximum.

$\beta = 1/(1 + \delta)$  is the discount factor with the time-preference parameter positive.

Lets further assume that the household has access to a production function  $f(k)$  which is homogeneous of degree 1 in its inputs, capital and labor.<sup>2</sup> Labor is assumed to be inelastically supplied and  $f(\cdot)$  is assumed to be strictly concave and to satisfy the Inada conditions.<sup>3</sup> Thus a unique, positive value will also be chosen for  $k_t$  in each period.

The household's budget constraint in nominal terms at  $t$  is:

$$P_t f(k_t) - P_t T_t + B_{t-1}(1 + i_{t-1}) + M_{t-1} = P_t C_t + B_t + M_t + P_t(k_t - k_{t-1}), \quad (2)$$

where:

$P_t f(k_t)$  is the household's total production or total income;

$P_t T_t$  are lump sum taxes;

$B_t$  is the dollar amount of government bonds holdings;

$i_t$  is the *ex post* nominal rate of interest paid on government bonds.  $B_{t-1} i_{t-1}$  are, therefore, interest receipts on holdings of government bonds;

$M_t$  are holdings of money (cash balances);

$P_t(k_t - k_{t-1})$  is the change of unconsumed output, which can be interpreted as the household's "investment";

$P_t C_t$  is consumption at time  $t$ ;

$P_t$  is the price of the (single) consumption good.

The left-hand side of the budget constraint can be described as the household's "sources of funds" at the current period: net production or net income (total income less taxes paid), interest receipts from the holdings of government bonds, and the holdings of government bonds and cash balances from the last period. The right-hand side can be described as the household's "uses

<sup>2</sup> A linearly homogeneous (of degree 1) production function exhibits constant return to scale.

<sup>3</sup>  $f(0)=0$ ,  $f'(0)=\infty$  and  $f'(\infty)=0$ .

of funds”: consumption, holdings of government bonds and cash balances, and “investment”.

Dividing the household budget constraint by the price level  $P_t$ , we obtain the budget constraint in real terms:

$$f(k_t) + b_{t-1}(1 + r_{t-1}) + (1 + \pi_{t-1})^{-1}m_{t-1} - t_t = c_t + b_t + m_t + k_t - k_{t-1} \quad (3)$$

where  $\pi_{t-1} = \frac{P_t - P_{t-1}}{P_{t-1}}$  is the inflation rate between periods  $t - 1$  and  $t$ .

The household’s problem is to maximize  $u_t\{c_t, m_t, k_t, b_t\} = E_t [\sum_{t=1}^{\infty} \beta^{t-1} u(c_t, m_t)]$  subject to its budget constraint (3).

The first-order Euler equations for  $c_t$ ,  $m_t$ , and  $k_t$  for all  $t$ , describing the necessary conditions that must be satisfied on any optimal path, are:<sup>4</sup>

$$u_1(c_t, m_t) - \lambda_t = 0 \quad (4)$$

$$u_2(c_t, m_t) - \lambda_t + \beta E_t \lambda_{t+1} (1 + \pi_t)^{-1} = 0 \quad (5)$$

$$[f'(k_{t+1}) - 1] \lambda_t + E_t \beta \lambda_{t+1} = 0 \quad (6)$$

The Euler condition for  $b_t$  is written in two parts:

$$-\lambda_t + \beta E_t \lambda_{t+1} (1 + r_t) \leq 0 \quad (7a)$$

and

$$E_t b_t [-\lambda_t + \beta \lambda_{t+1} (1 + r_t)] = 0 \quad (7b)$$

if any bonds are demanded so that  $b_t > 0$ .<sup>5</sup>

The infinite-horizon transversality conditions are:

$$\lim_{t \rightarrow \infty} E_t m_t \beta^t \lambda_{t+1} (1 + \pi_t)^{-1} = 0 \quad (8)$$

$$\lim_{t \rightarrow \infty} E_t k_t \beta^t \lambda_{t+1} = 0 \quad (9)$$

$$\lim_{t \rightarrow \infty} E_t b_t \beta^t \lambda_{t+1} (1 + r_t) = 0 \quad (10)$$

Conditions (3)–(10) are jointly sufficient for optimality. Given initial asset stocks and the time path for prices, the household’s choice for  $c_t$ ,  $m_t$ ,  $b_t$  and  $k_t$  will be described by (3)–(7).

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<sup>4</sup> Given the assumptions on  $u(\cdot)$  and  $f(\cdot)$ , which assure positive values for  $c_t$ ,  $m_{t+1}$ , and  $k_{t+1}$ , the Euler conditions can be written as equalities.

<sup>5</sup> The Euler condition for bonds must be written this way because bonds are not part of the utility function and an equilibrium where no bonds are held is not ruled out by the assumptions on  $u(\cdot)$ .

## 2.2 The government

Consider the following budget constraint for the government, expressed in *per capita* nominal terms at time  $t$ :

$$B_t - B_{t-1} + M_t - M_{t-1} = P_t G_t - P_t T_t + i_{t-1} B_{t-1} \quad (11)$$

where:

$B_t - B_{t-1}$  is the dollar amount of the net interest-bearing government debt held by the public at period  $t$ ;

$M_t - M_{t-1}$  is the change in the money stock;

$i$  is the *ex post* nominal interest rate, interpreted as the holding-period return on the stock of debt outstanding;<sup>6</sup>

$G$  and  $T$  are respectively government expenditures and tax revenue.<sup>7</sup>

In the absence of inflationary finance, the government budget constraint is:

$$B_t - B_{t-1} = -S_t + i_{t-1} B_{t-1} \quad (12)$$

where  $S$  denotes the non-interest surplus ( $-S$  denotes the primary deficit, that is, the difference between government expenditures exclusive of interest payments on the debt and tax revenues).

The real government deficit can be defined as the change, in real terms, of the government debt over time. The government budget constraint must be adjusted for inflation so that changes in its components do not reflect price variations. Moreover, it is important to adjust the budget constraint for real changes in the income level or economic growth.

The government's budget constraint in real terms and as a ratio to income can be written as:

$$b_t - b_{t-1} = -s_t + (r_{t-1} - g_{t-1})b_{t-1} \quad (13)$$

where  $r \equiv i - \pi$  stands for the real rate of interest and  $g$  denotes the rate of income growth.

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<sup>6</sup> Note that it is not necessary to assume that the government issues only one-period bonds.

<sup>7</sup> Adding the household and the government's budget constraints yields the national income identity  $f(k_t) = c_t + k_t - k_{t-1} + G_t$ .



Just for simplicity, let's assume that the real rate of interest is constant ( $R$ ) and that the growth rate of income is zero, so that equation (13) becomes simply:<sup>8</sup>

$$b_t = -s_t + (1 + R)b_{t-1} \quad (14)$$

Applying recursive forward substitution to (14) and letting  $B_{t+N} \equiv \frac{1}{(1+R)^N} b_{t+N}$  and  $S_{t+j} \equiv \frac{1}{(1+R)^j} s_{t+j}$ , we obtain the government intertemporal budget constraint:

$$B_t = B_{t+N} + \sum_{j=1}^N S_{t+j} \quad (15)$$

The relevant question is what creditors expect to happen to  $B_{t+N}$  as  $N$  gets large.

Taking expectations as of time  $t$  of equation (15) and applying the limit as  $N$  goes to infinite, gives:

$$B_t = \lim_{N \rightarrow \infty} E_t B_{t+N} + \sum_{j=1}^{\infty} E_t S_{t+j} \quad (16)$$

The government's budget is balanced in expected present-value terms when its debt can be offset by the sum of expected future discounted primary surpluses. According to equation (16), this is the case when  $\lim_{N \rightarrow \infty} B_{t+N} = 0$ . If  $\lim_{N \rightarrow \infty} B_{t+N} < 0$ , the expected discounted future primary surpluses exceeds the present value of the government's debt by an amount that does not converge to zero. The government is accumulating tax revenues which could be translated into higher disposable income for households and, therefore, increased consumption level at all periods.<sup>9</sup>

In the opposite case,  $\lim_{N \rightarrow \infty} B_{t+N} > 0$ , the present-value of the government's debt exceeds expected primary surpluses. This implies that the government is continually borrowing to meet interest payments on its debt, which will grow, *ceteris paribus*, at the rate of interest. But such a Ponzi scheme

<sup>8</sup>In the empirical tests carried out in the next section, the real rate of interest and growth rates are allowed to vary and the rates actually experienced by the economy are used.

<sup>9</sup>Alternatively, the government could improve social welfare by increasing spending in public goods. Given that public goods were not included in the household's maximization problem, this alternative is not contemplated here.

violates the household's optimality condition (equation 10), since it amounts to providing the government with "free" resources. When  $\lim_{N \rightarrow \infty} B_{t+N} = 0$  the government is asymptotically using the resources allowed by its budget constraint, no more and no less.

## 2.3 The role of seignorage

Seignorage represents real revenue which the government acquires by using newly issued money to buy goods and nonmoney assets.

In the theoretical models where seignorage is analyzed, the government is treated as one single entity. So, which branch of the government actually collects seignorage revenue and benefits from the acquisition of goods and nonmoney assets, or how it gets transferred between government branches, is immaterial. In practice, the government institution responsible for the issuing of new money is separate from the one which actually uses the proceeds of seignorage to acquire goods and services.

When there are separate branches of the government responsible by the monetary policy and by the fiscal policy of the country, it is necessary to consolidate their balance sheets in order to understand how seignorage is collected and how the fiscal authority makes use of it.

Suppose that the fiscal authority issues debt to finance its purchases of goods and services. The debt is bought by the public and the proceeds of it are used to finance purchases. If the central bank in question is independent from the fiscal authority, the monetary authorities might choose to issue new money to buy the fiscal authority's debt from the public. In doing so, the central bank is monetizing the debt by printing money and buying it back from the public.

The issue of debt enters as a liability in the fiscal authority's balance sheet. The acquisition of debt by the central bank enters as an asset on the monetary authority's balance sheet. The newly issued money is a liability to the monetary authority while the goods purchased are assets on the fiscal authority's balance sheet. When the two accounts are consolidated, the transfer of debt from the fiscal to the monetary authority has no effect in the balance sheet (they cancel each other, since it is an asset in one account and a liability in the other). The net result is the issue of new money to finance expenditures. In other words, according to the consolidated accounts, the government is

financing itself by simply printing new money. It is the use of its power over money issuing that characterizes the seignorage collection by the consolidated government; it is the consolidated government's ability to finance expenditures through newly printed money. The newly issued money, in the context of the consolidated government, constitutes seignorage collection.

Because the relationship between the Treasury and the Brazilian Central Bank is characterized by a low degree of independence, it is reasonable, for the present purpose, to treat the government as a single entity and include seignorage collection in its budget constraint.

With money finance, the government's budget constraint in real terms and as a ratio to income can be written as:

$$b_t - b_{t-1} + m_{t-1} = -s_t + (r_{t-1} - g_{t-1})b_{t-1} - (\pi_{t-1} + g_{t-1})m_{t-1} \quad (17)$$

Rewrite (17) to obtain:

$$b_t - b_{t-1} = -\bar{s}_t + (r_{t-1} - g_{t-1})b_{t-1} \quad (17a)$$

where  $-\bar{s}_t = -s_t - (m_t - m_{t-1}) - (\pi_{t-1} - g_{t-1})m_{t-1}$ .

Now the government surplus must be interpreted as the primary surplus inclusive of the actually collected seignorage.<sup>10</sup>

Given the newly defined government surplus and assuming for the moment that the real rate of interest on government securities is constant ( $R$ ) and that the rate of income growth is zero, the government's intertemporal budget constraint can be written as:

$$B_t = B_{t+N} + \sum_{j=1}^N \bar{S}_{t+j} \quad (18)$$

Taking expectations as of time  $t$  of equation (18) and applying the limit as  $N$  goes to infinite yields equation (19):

$$B_t = \lim_{N \rightarrow \infty} E_t B_{t+N} + E_t \sum_{j=1}^N \bar{S}_{t+j} \quad (19)$$

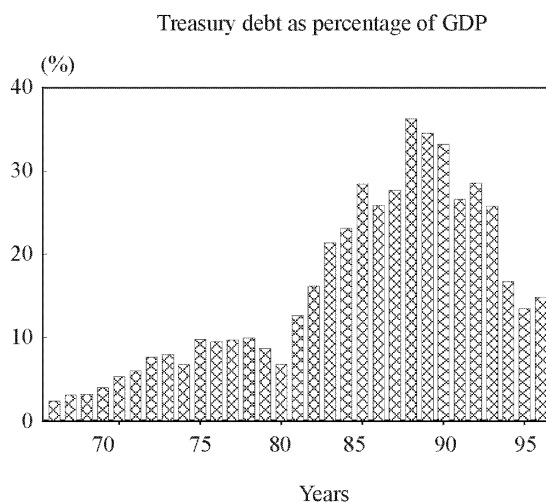
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<sup>10</sup> *Inflation tax is the total capital loss that inflation inflicts on holders of real money balances  $(\pi_t \cdot \frac{M_t}{P_t})$ . Seignorage equals inflation tax proceeds plus the change in the economy's real money holdings, that is  $(\pi_t \cdot \frac{M_t}{P_t}) + (\frac{M_t}{P_t} - \frac{M_{t-1}}{P_{t-1}})$ .*

This version of equation (16), which includes seignorage collection in the government surplus, is the basis for the empirical tests presented in the following section. It is assumed that the amount of seignorage collected by the government is consistent with a non-accelerating rate of inflation, that is, seignorage collection is bounded by its maximum, given the public's demand for real cash balances.<sup>11</sup>

### 3. Sustainability of the Brazilian Fiscal Policy: Econometric Tests and Results

The Brazilian federal government ran budget deficits during several years since the financial reform of 1964-66. The pattern of fiscal deficits, along with the expanding financial needs of the federal government to meet interest payments on its previously issued debt, resulted in increases in the debt/GDP ratio observed during the period 1966-96 (see graph).<sup>12</sup>



Is the government's fiscal policy leading the country towards excessive debt accumulation, which could ultimately jeopardize the price stability achieved since 1994? In other words, is the debt sustainable?

<sup>11</sup> For a discussion of the dynamics of inflation and debt under alternative ways of financing the government deficit, see Blanchard & Fischer (1989:513-6).

<sup>12</sup> For a discussion of the evolution of the federal government's debt during this period, see Luporini (1998, ch. 1).

The government's budget is balanced in expected present-value terms when its debt can be offset by the sum of expected future discounted primary surpluses. According to equation (19), this is the case when  $\lim_{N \rightarrow \infty} B_{t+N} = 0$ .

### 3.1 The data set

The data set was obtained from the Brazilian Central Bank and consists of annual observations over the period 1966-96.

Government debt at par value is the series *dívida mobiliária interna federal fora do Banco Central* or federal government debt held by the public. The market value of the debt/GDP ratio is defined as the debt/GDP at par divided by  $(1 + r)$ , where  $r$  is the annualized *overnight* real rate of interest.

Table 1  
Public sector borrowing requirements:  
federal government and Central Bank<sup>1</sup> and Inflation<sup>2</sup>

Year	Nominal <sup>3</sup>	Primary <sup>4</sup>	Operational <sup>5</sup>	Inflation
1986	6.2	0.0	1.6	142.3
1987	17.8	1.7	3.1	224.8
1988	26.6	0.9	3.3	684.5
1989	49.3	1.1	3.7	1,320.0
1990	10.4	-3.0	-2.4	2,739.7
1991	6.5	-0.9	-1.4	414.7
1992	14.9	-1.3	0.8	991.4
1993	20.5	-1.4	0.0	2,103.7
1994	17.4	-3.1	-1.6	1,093.8
1995	2.3	-0.6	1.7	14.8
1996	2.6	-0.4	1.7	9.34

Source: Brazilian Central Bank (s.d.).

<sup>1</sup>Percentage of GDP.

<sup>2</sup>Percentage variation of general price index (internal supply).

<sup>3</sup>Deficit as usually defined.

<sup>4</sup>Deficit exclusive of interest payments.

<sup>5</sup>Deficit exclusive of monetary correction.

Nominal variables (except interest and inflation rates) were converted into millions of cruzeiros reais and divided by the *general price index* (IGP), internal supply (1989=100). The real interest rate was calculated as  $r = \frac{(1+i)}{(1+\pi)} - 1$ , which is equivalent to the standard  $r = i - \pi$  when the inflation rate is low.

Ideally, the cost to the government of servicing its debt should be assessed by using the net-of-taxes real rate of interest, given that the taxable part of interest payments actually flows back to the government. Obtaining data on net-of-tax yield on government securities proved, however, to be a rather difficult task: tax rates vary whether the security holder is an individual, a financial institution or a large firm; some tax rates are applied to nominal returns, while others to real returns; the tax code for government securities has been changed several times. In 1996, for example, the government waved taxes on holdings of its securities (Carvalho, 1992). Given the limited information on the identity of government securities' holders and the frequent changes in the tax code, there is no straightforward way to calculate the real interest rate net-of-taxes on government securities. We opted therefore to use the real interest rate gross-of-taxes.

### 3.2 Econometric tests

In order to implement the sustainability tests to be developed in this section using the real rate of interest and growth rates actually experienced by the economy during the period of this analysis, we used a discounting technique presented by Wilcox (1989).

Let  $\alpha_t \equiv (r_t - g_t)$  and rewrite equation (17a) to obtain:

$$b_t = -\bar{s}_t + (1 + \alpha_{t-1})b_{t-1} \quad (20)$$

Define  $Q_t = \prod_{j=0}^{t-1} (1 + \alpha_j)^{-1}$ ;  $Q_0 = 1$ . Multiplying equation (20) through by  $Q_t$  gives:

$$Q_t b_t = Q_{t-1} b_{t-1} - Q_t \bar{s}_t \quad (20a)$$

Rewrite (20a) and obtain a version of equation (20) discounted back to period zero:

$$B_t = B_{t-1} - \bar{S}_t \quad (21)$$

The budget constraint now involves the market value of the government debt which is expressed at its present value of the initial date. Equation (21) means that the change in the discounted value of the debt equals the discounted value of the non-interest deficit inclusive of seignorage revenue. Note that no assumptions about the interest rates are necessary.

A sustainable fiscal policy can be defined as a policy such that the government debt as a ratio to GDP is backed by future primary surpluses of equal present value,  $B_t = E_t \sum_{j=1}^N \bar{S}_{t+j}$ . Alternatively, according to equation (19), the  $\lim_{N \rightarrow \infty} B_{t+N}$  must be zero. Uctum and Wickens (1996) show that the condition  $\lim_{N \rightarrow \infty} B_{t+N} = 0$  is equivalent to the proposition that  $B_t$  is a zero-mean stationary series.

Testing for the unconditional-mean stationarity of the discounted debt series does not exclude the case where the government is accumulating primary surpluses causing the debt to fall. Although this case would not pose a problem for the payment of the government debt *per se*, it is clearly non-optimal. The government would be accumulating excess tax revenues, which could be translated into higher disposable income and consumption levels.

The test for zero-mean stationarity of  $B_t$  involves the following procedure:

- a) calculate the series mean;
- b) subtract the mean from each observation;
- c) test for stationarity of the resulting series.

Dickey and Fuller (1979) suggested that the following equation be estimated by OLS to test for the presence of a unit root in the  $y_t$  series:

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

The augmented Dickey-Fuller (ADF) test for unit root consists of testing whether the coefficient on  $y_{t-1}$  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  $y_t$  contains a unit root and, therefore, is nonstationary. Under the alternative  $H_1 : \beta_1 < 0$ , the series is stationary.

Table 2 presents the results of the unit root tests for the (mean reduced) discounted debt. The first column gives the results for the case where only one lagged change in the variable is included in the regression equation, the second column presents the results for two lagged changes, and, finally, the third column gives the results for four lagged changes in the regression equation. The Akaike criterion places a penalty on extra coefficients and it selects only one lag for the regression equation.

Table 2  
Stationarity of discounted debt

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$$\Delta B_t = \gamma_0 B_{t-1} + \sum_{j=1}^4 \gamma_j \Delta B_{t-j} + \varepsilon_t$$


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	(1)	(2)	(3)
$B_{t-1}$	-0.279 (0.121)	-0.222 (0.131)	-0.274 (0.159)
$\Delta B_{t-1}$	0.218 (0.184)	0.213 (0.183)	0.319 (0.219)
$\Delta B_{t-2}$		-0.307 (0.200)	-0.294 (0.244)
$\Delta B_{t-3}$			0.226 (0.224)
$\Delta B_{t-4}$			0.020 (0.229)
ADF Stat	-2.30	-1.70	-1.72
PP Stat	-2.24	-1.89	-2.08

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Standard errors in parenthesis. Critical values of -2.65, -1.95, and -1.62 for 1, 5, and 10% confidence intervals respectively.<sup>13</sup>

The ADF test statistics for the discounted debt in the first regression is -2.30, which compared with the critical values -1.95 (at 5% level) and -1.62 (at 10% level), suggests the rejection of the null hypothesis of a unit root. That is, at the 5% and 10% confidence interval, the ADF statistic indicates that the mean-adjusted  $B_t$  does not have a unit root and is, therefore, mean-zero stationary.

The inclusion of higher-order autoregressive terms in the regression controls for serial correlation of the disturbance term, but not for heteroskedastic error terms. As a result, the Phillips-Perron test (PP), which corrects the statistics both for serial correlation and heteroskedasticity of the error terms, was also performed. Once more, the null of a unit root cannot be accepted at the 5 or 10% levels.

Dickey and Fuller (1981) used Monte Carlo experiments to calculate the distribution of the Wald form of the OLS  $F$  test of the joint null hypothesis

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<sup>13</sup>MacKinnon (1991) implemented a larger set of replications and estimated response surface regressions which permit the calculation of critical values for any sample size. The ADF tests were carried based on his critical values.



that  $\alpha = 0$  and  $\rho = 1$  in the regression  $y_t = \alpha + \rho y_{t-1} + \eta_t$ . Since the mean of the adjusted  $B_t$  series is zero by construction, yet another form of testing the mean-zero stationarity of the discounted debt is rejecting the joint hypothesis as proposed by D&F's Wald test. The results are presented in table 3.

Table 3  
Dickey-Fuller Wald test

$B_t = \alpha + \rho\beta_{t-1} + \eta_t$	
$\alpha$	-0.002 (2.124)
$B_{t-1}$	0.744 (0.178)
Wald test:	$H_0 : \alpha = 0$ and $\rho = 1$
$F$ -Stat	1.02

Standard errors in parenthesis. Critical values of 5.18 ( $T=25$ ) and 4.12 for 1% and 5% confidence intervals respectively (Hamilton, 1994, ap. B).

The coefficients of the regression show that the constant term is highly insignificant, as expected. The F-statistic for the joint hypothesis is smaller than the critical value  $F(2,25)$  of 5.18, and the null is accepted at the 5% level.<sup>14</sup> According to this test, the mean-adjusted discounted debt series is, therefore, not stationary and the policy is not sustainable.

**Subsamples.** After the oil shock of 1979, the government implemented a series of currency devaluations in an attempt to promote exports and finance large current account deficits. In order to alleviate their inflationary impact, the Brazilian government increased direct subsidies to key consumer goods and agriculture, which caused an increase in the primary deficit. Until 1980, the federal domestic debt presented a steady increase. The international real interest rate had been relatively low during the early 70's, even reaching negative values, and borrowings from the international markets were the main source of government finance. After 1980, foreign loans to Brazil were dramatically reduced and the federal government turned to the domestic market. The federal domestic debt assumes thereafter an unprecedented upward trend

<sup>14</sup>The critical values for the sample size  $T=30$  has not been reported by Dickey and Fuller (1981). Although the appropriate critical value could be calculated by interpolation, the calculated F-statistic guarantees the acceptance of the null hypothesis even for  $T=50$  (4.86).

(see graph on section 3.1). Based on this information, we divided the sample in two parts, prior and after 1980, to test for the debt sustainability on the two subsamples. The results are presented in table 4.

Table 4  
Subsamples: stationarity of the discounted debt

$$\Delta B_t = \gamma_0 B_{t-1} + \sum_{j=1}^2 \gamma_j \Delta B_{t-j} + \varepsilon_t$$

	(1)	(2)
Sample 1966-80		
$B_{t-1}$	-0.151 (0.091)	-0.190 (0.108)
$\Delta B_{t-1}$	0.241 (0.269)	0.227 (0.290)
$\Delta B_{t-2}$		0.123 (0.339)
ADF Stat	-1.65	-1.76
PP Stat	-1.72	-1.72
Sample 1981-96		
$B_{t-1}$	-0.319 (0.188)	-0.222 (0.203)
$\Delta B_{t-1}$	0.241 (0.260)	0.210 (0.258)
$\Delta B_{t-2}$		-0.329 (0.282)
ADF Stat	-1.70	-1.09
PP Stat	-1.70	-1.44

Standard errors in parenthesis. Critical values are: sample 1966-80 – -2.78 (1%), -1.97 (5%), and -1.63 (10%); sample 1981-96 – -2.72 (1%), -1.96 (5%), and -1.63 (10%).

In the first sample, both the ADF and the PP test statistics for the mean-reduced discounted debt indicate a rejection of the unit root hypothesis at the 10% level in both specifications; that is, the discounted debt series is stationary during the first sample period and the government's budget was balanced in present-value terms during 1966-80.

In the second sample, the ADF statistic for the first specification (column 1) is -1.70 and the null of a unit root is accepted at 1 and 5% levels. The inclusion of the second lagged difference reduces the ADF statistics significantly and the null of a unit root is accepted at the 1, 5%, and 10% confidence

intervals. The Phillips-Perron test, furthermore, indicates that the null of a unit root is also accepted at the 10% level for one-lag specification, while it cannot be rejected at all for two lags.

The conclusion is that the mean-reduced discounted debt series is not stationary, indicating that the government's budget is not intertemporally balanced and, therefore, fiscal policy assumes an unsustainable path after 1981. It is important to notice that some series take long to revert to their mean and the diagnostic of an unsustainable fiscal policy after 1980 might be the result of the relatively small size of the samples. The mean-reduced discounted debt does not exhibit, however, a high degree of persistence, which could indicate a longer mean-reversion process.

**Further tests.** Classical hypothesis testing is designed to accept the null unless there is strong evidence against it. As a result, standard unit root tests fail to reject the null hypothesis of a unit root in several economic series. Kwiatkowski, Phillips, Schmidt and Shin (1992), herein KPSS, developed a procedure to test the null of stationarity.

The test for level stationarity is based on the statistic  $\hat{\eta}_\mu = T^{-2} \frac{\sum_{t=1}^T S_t^2}{s^2(1)}$ , where:

$S_t$  is the sum of the residuals from the regression  $y_t = \bar{y} + e_t$ ;

$s^2(1) = T^{-1} \sum_{t=1}^T e_t^2 + eT^{-1} \sum_{s=1}^1 w(s, 1) \sum_{t=s+1}^T e_t e_{t-s}$  is a consistent estimator of the error variance;

$w(s, \ell) = 1 - s/(\ell + 1)$  is a weighting function which guarantees the nonnegativity of  $s^2(\ell)$ ;

$\ell$  is the lag truncation parameter. A zero truncation lag ( $\ell = 0$ ) implies no correction for autocorrelation.

The authors show that for small values of  $\ell$ , the test has good power even for small samples like the one used here.

Table 5 presents the test statistics for the null of stationarity around a level (zero in the case of the mean-reduced discounted debt series) for the lag

truncation parameter  $\ell = 0, 1 \dots 4$ , and also  $\ell = 8$ .<sup>15</sup> The critical values at 5 and 10% levels are 0.463 and 0.347, respectively.

Table 5  
KPSS stationarity test

	$\bar{\eta}_\mu = T^{-2} \frac{\sum_{t=1}^T S_t^2}{s^2(1)}$
l=0	0.032
l=1	0.018
l=2	0.012
l=3	0.006
l=4	0.004
l=8	0.004
$\eta_\mu$ critical values	0.463 (5%) 0.347 (10%)

Upper tail critical values, level stationarity (Kwiatkowski et alii, 1992:156).

The calculated statistics are smaller than the critical values and indicate that the null of stationarity cannot be rejected at the 5 or 10% level for all used values of  $\ell$ . In fact, the test statistics falls as the lag truncation parameter increases suggesting stronger evidence of stationarity (around the level zero) when correction for error correlation is made.

The KPSS test clearly indicates that the discounted debt is mean-zero stationary, and that, therefore, the government's fiscal policy has been sustainable over the whole sample. This result is consistent with those previously obtained (Pastore, 1995; Isller & Lima, 1997).

It would be interesting to test the sustainability of the fiscal policy in the two subsamples previously used. Unfortunately, there are not enough degrees of freedom to run the KPSS test on a subset of the data.

Finally, the government's intervention in the securities' market suggests a possible break in the series in 1990. There are not enough data points after 1990 in the sample used in this paper, however, to justify the inclusion of a dummy variable to test this possibility. Moreover, the government's intervention did not represent a default *per se* in its federal debt, but simply a slight

<sup>15</sup> Kwiatkowski et alii (1992) argue that  $\ell=8$  is a compromise between the test size distortions under the null when  $\ell=4$  and the test low power when  $\ell=12$ .

increase in its average maturity period. One should not expect, therefore, that the dummy be statistically different from zero.

#### 4. Sustainability and Central Bank Independence

The results indicate that the federal domestic debt seems to have become unsustainable after 1981, in the sense that the government has been heading towards excessive debt accumulation, and that the federal government may have an incentive to repudiate its debt, either openly or through monetization. But the Brazilian government was able to continue placing its securities in the market despite the unsustainable path assumed by the federal debt after 1981. How has the Treasury managed to do so? The answer can be found on the low degree of independence that characterizes the relationship between the Treasury and the Brazilian Central Bank.

A central bank is considered independent from the Treasury when it has control (formally and/or informally) over the levers of monetary policy, and it is free to set and pursue monetary goals, such as price stability.

In the multicountry study of central bank independence developed by Cukierman et alii (1992), the aggregate index for legal Central Bank independence during the 1980s ranges from a maximum of 0.69 for the Federal Republic of Germany to a minimum of 0.10 for Poland. Brazil scores at the lower end, along with Taiwan and Pakistan, with an index of 0.21.<sup>16</sup>

Although there are several aspects of the relationship between the Treasury and the Brazilian Central Bank that characterizes its low degree of independence, two in particular stand out as to have helped the Treasury finance itself: the usage of letters of repurchase (*repurchase agreements*) and the issuance of securities by the Central Bank.

The Central Bank is the agent responsible for placing Treasury securities in the primary market. As such, the Central Bank issued letters of repurchase along with the government securities being sold, assuring financial institutions that the Central Bank would repurchase the securities before their maturity

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<sup>16</sup> *The study did not capture, however, the legal changes occurred after 1986, such as the elimination of the so-called "movement account", the unification of the fiscal budget between the Central Bank and the Treasury, and the prohibition of purchase of Treasury securities by the Central Bank in the primary market. The coding most probably underestimates the degree of independence of the Brazilian Central Bank.*

date. The letters of repurchase also helped the government improve its seignorage collection, but this does not seem to have been enough to guarantee the sustainability of the Treasury's debt after 1981. The use of letters of repurchase by the Central Bank favored the Treasury not only through seignorage, but also through rendering the public the choice of the security's maturity date and, therefore, substantially reducing the risks for investors associated with holding federal debt.

As the market became increasingly wary of government securities in the late 80's and the prices that government securities were able to command were falling (with their yields on the rise), the issuance of the repurchase agreements guaranteed a stable demand for government securities at a particular interest rate. Through the repurchase letters, therefore, the Central Bank eased the placement of new securities in the market when needed and helped the Treasury roll over its debt. In other words, the letters of repurchase helped the Treasury mainly through the management of interest rates and risk associated with the federal debt.

The second characteristic of the relationship between the Treasury and the Central Bank was the use of special securities issued by the Central Bank. As part of the Central Bank liabilities and being backed by holdings of Treasury issued securities, the Central Bank securities became important instruments to ease the Treasury's financial constraint by avoiding losses to security holders, facilitating the management of interest rates, and reducing the maturity period of the consolidated government's debt (Treasury and Central Bank).

The first security issued by the Central Bank was the Central Bank Bill (LBC – *Letras do Banco Central*), created in 1986 to enable the Central Bank to increase interest rates without imposing losses to financial institutions holding the price-indexed ORTN (indexed national treasury obligation – *obrigações reajustáveis do Tesouro Nacional*) and the pre-fixed LTN (National Treasury Bill – *Letras do Tesouro Nacional*). By avoiding losses to financial institutions, the Central Bank prevented problems for the placement of Treasury securities later on.

In 1991, after the government implemented a financial siege that resulted in the compulsory increase in the average maturity period of its debt, the Central Bank issued the Central Bank Bond (BBC – *Bônus do Banco Central*). The Treasury securities held by the Central Bank were of longer maturity and not well accepted by the market in a time when inflation was making a strong

come back. According to the Central Bank, in order to facilitate the operation of the monetary policy, the Central Bank issued the BBC, of shorter maturity.

The Central Bank note (NBC – *Notas do Banco Central*) was issued later on in 1991 and was backed by the Treasury-issued National Treasury Note (NTN-D – *Notas do Tesouro Nacional, série D*). Both securities, the one issued by the Treasury and the one issued by the Central Bank, share the same characteristics, except for their maturity periods. Having a maturity period of no longer than a year, the security issued by the Central Bank is more tradable than the longer maturity Treasury security.

Finally, in 1994, the Central Bank issued the Central Bank Special Note (LBCE – *Letra especial do Banco Central*). The costs to local governments (states and municipalities) of financing their debts was higher than the cost to the federal government, as their securities were being traded at a rate 4.4% higher than federal securities. The Central Bank's charter allows only the central government to use credit lines at the bank. In order to circumvent the law and yet be able to finance the local governments, the government authorized the Central Bank to issue securities to be exchanged for ones issued by local governments. The use of repurchase agreements to manage interest rates and the issuance of special securities by the Central Bank has helped the Treasury finance itself in a context of falling credibility, either by avoiding losses to financial institutions holding government's debt or by effectively reducing the maturity period of Treasury securities. In both cases, the Central Bank guaranteed a stable demand for government's securities and, therefore, the Treasury's ability to continue financing itself.

## 5. Concluding Remarks

This paper analyzed the sustainability of the federal government debt in Brazil since 1966. Standard unit root tests (ADF and PP) and the test for the null of stationarity developed by Kwiatkowski, et alii (1992) indicated that the government's budget constraint has been balanced in present-value terms and that, therefore, the fiscal policy in Brazil has been sustainable since 1966.

Sustainability was also tested in two subsamples of the original data, 1966-80 and 1981-96. The results indicated that the government's fiscal policy was sustainable prior to 1980, but it assumed an unsustainable path after that. The federal domestic debt became unsustainable after 1981, in the sense that

the government has been heading towards excessive debt accumulation, and that the federal government may have an incentive to repudiate its debt, either openly or through monetization.

Despite the unsustainable path assumed by the federal debt after 1981, the Brazilian government was able to continue placing its securities in the market, given the low degree of independence that characterizes the relationship between the Treasury and the Brazilian Central Bank. The Central Bank helped the Treasury to finance itself in a context of falling credibility and market pressure for higher yields (or larger discounts) by managing interest rates through the usage of *repurchase agreements* and issues of its own securities. The Central Bank was able to calm investors, guaranteeing a stable market for government securities and enabling the Treasury to continue rolling over its debt.

The diagnostic of an unsustainable fiscal policy after 1980 might be a result of the relatively small size of the subsamples and should, therefore, be interpreted with care. Moreover, the theoretical model used to derive the econometric implications for debt sustainability does not include the agent's behavior towards risk, which seems to have driven the issuance of letters of repurchase and securities by the Brazilian Central Bank. As a result, the development of a more complete model and further tests on the sustainability of the federal debt after 1980 seem promising starting points for future research.

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