The behavior of the Brazilian federal domestic debt

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RESUMO

Este artigo analisa a sustentabilidade da política fiscal do governo federal brasileiro examinando as respostas dos superávits fiscais do governo a alterações na razão dívida-PIB previamente observada. A abordagem para acessar a sustentabilidade, proposta por Bohn (1998), contorna os problemas apresentados pelos testes tradicionais de sustentabilidade baseados em raiz unitária e cointegração. Em particular, as regressões propostas não requerem pressupostos restritivos a respeito da taxa real de juros, da estrutura do endividamento governamental ou do comportamento dos agentes em relação ao risco. Utilizando dados anuais de 1966 a 2000, os resultados indicam que os superávits fiscais não têm respondido, de forma sistemática, a variações da relação dívida-PIB, e que esta não apresenta tendência de reversão à média, mesmo quando variações cíclicas no nível de renda e de gastos governamentais são levadas em consideração. Ambos os resultados apontam para a não sustentabilidade da política fiscal brasileira no período analisado.

Palavras-chave: dívida mobiliária federal, consolidação fiscal, Brasil.

ABSTRACT

This paper analyses the sustainability of the Brazilian federal fiscal policy by examining the responses of the government budget surplus to variations of the debt-GDP ratio. The approach to assess sustainability, proposed by Bohn (1998), circumvents the problems present in traditional sustainability tests, such as unit roots and cointegration. In particular, the regressions proposed do not require restrictive assumptions about real interest rates, the structure of the government debt or the agents' behavior towards risk. Using annual data from 1966 to 2000, the results have indicated that the government surplus has not systematically responded to changes in the debt-income level previously observed, indicating that the fiscal policy cannot be considered sustainable during the period analyzed. Moreover, it is shown that the debt-GDP ratio does not exhibit a mean-reverting tendency even when one controls for cyclical variations in income and government expenditures, further indicating a non-sustainable path for the fiscal policy.

Key words: federal domestic debt, fiscal consolidation, Brazil.

JEL classification: H63.

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Recebido em janeiro de 2001. Aceito em outubro de 2002.

expenditure and therefore a sustainable fiscal policy, but still have a debt/income ratio that is too high from the standpoint of debt management.

The purpose of this paper is to further investigate the sustainability of the Brazilian federal domestic debt by examining the responses of the government surplus to variations of the debt-income ratio. This approach, originally proposed by Bohn (1998), circumvents the problems present in tests based on the statistical properties of the debt, such as unit roots and cointegration. In particular, the regressions proposed do not require restrictive assumptions about the real interest rates, the structure of the government debt or the agents' behavior towards risk.

The article is organized as follows. Section 2 discusses the role of the transversality condition for sustainability tests and why traditional tests fail to take into account uncertainty and agents behavior towards risk. Section 3 presents the new approach to sustainability proposed by Bohn (1998). The results of the applications of the new approach to the Brazilian data is presented in section 4. Section 5 concludes the article.

2 Intertemporal balance and transversality conditions

The sustainability of government debts is usually defined in the literature as a fiscal policy whose temporal path is consistent with an intertemporal budget constraint. The government budget constraint in real terms is given by:

$$b_t - b_{t-1} = -s_t + rb_{t-1} \tag{1}$$

where s is the non-interest surplus, b is the stock of government debt and r is the interest rate.

The intertemporal budget constraint is obtained by applying recursive forward substitution to (1):

$$B_t = B_{t+N} + \sum_{j=1}^{N} S_{t+j}\,, \text{ where } B_{t+N} \equiv \frac{1}{(1+r)^N} b_{t+N} \text{ and } S_{t+j} \equiv \frac{1}{(1+r)^j} s_{t+j}$$

Taking expectations as of time t and applying the limit as N tends to infinite gives an expression to analyze what the creditors expect to happen to the government debt as time goes by:

1 Introduction

In the last few years, empirical work on the Brazilian federal domestic debt has focused on whether or not the government's behavior may be considered consistent with an intertemporal budget constraint, and therefore, sustainable in the long-run. A fiscal policy which implies an explosive debt/income ratio with the debt growing over time at a faster rate than the economy is obviously not sustainable. Hence, the emphasis of the empirical work has mostly been on assessing the statistical properties of the debt through either univariate analysis on the debt series (Hamilton and Flavin, 1986; Wilcox, 1989, Kremers, 1989; Uctum and Wickens, 1996) or the cointegration properties of government revenue and expenditure. (Trehan and Walsh, 1988, 1991, Hakkio and Rush, 1991; Haug, 1991; Bohn, 1991; Tanner and Liu, 1994; Ahmed and Rogers, 1995) The univariate analysis usually implies verifying whether or not the debt series as a ratio to income has a unit root, which means that the series does not tend to return to its mean after a shock. The cointegration analysis is a counterpart of the univariate one and implies verifying whether government revenues and expenditures have been historically moving together. If that is the case, the debt/income ratio will tend to be stable.

Although the seminal work on sustainability concerned the American case, the tests presented have been extensively applied to several other countries, including Brazil. Issler and Lima (1997) test the cointegration of expenditure and revenue and conclude that the Brazilian debt has been sustainable. Pastore (1995) uses univariate analysis and considers the domestic debt sustainable, but not as a result of fiscal discipline. Instead, the author argues that intertemporal consistency is obtained through the usage of monetary expansions and seignorage collection. Tanner (1995) argues that sustainability is only attained because the Brazilian government has under-corrected indexation clauses on its debt, impinging real reductions in its debt value. Based on univariate analysis of the debt series, Luporini (2000) tests the implications of the intertemporal budget constraint through the methodology developed by Kwiatkowski and others (1992) and finds that the debt has assumed an unsustainable path during the 1980s. Rocha (1995) also tests for sustainability.

Sustainability tests based on the statistical properties of the debt are not without critics, however. The debt series might present a high degree of persistence and take a long period to return to its mean-value, leading to a non-sustainable result. The comparison between fiscal surpluses and the stock of debt, both measured in present-value terms, depends crucially on the interest rate used in the discount factor. The discount factor itself depends, in turn, on the structure of the debt, particularly on the risks associated with each type of security. The analysis based on cointegration requires assumptions about the real interest rate and about the stochastic processes driving the deficit. A country may have a cointegrated revenue and

$$B_t = \lim_{N\to\infty} E_t B_{t+N} + \sum_{j=1}^{N} E_t S_{t+j} \qquad (2)$$

The theory of government finance states that the budget will be intertemporally balanced when the government's debt is backed by expected primary surpluses of equal present-value and, in this sense, the government debt is sustainable. According to equation (2), this is the case when the transversality condition $\lim_{N\to\infty} E_t B_{t+N} = 0$ applies.

Traditionally, sustainability tests have been based on estimating a cointegrating relationship between revenues and expenditures or, equivalently, estimating the transversality condition. The use of the transversality condition to test for sustainability implies choosing the appropriate discount rate. Empirically, it is common practice to use the real return on government bonds as the discount rate. According to Bohn (1995), this procedure is appropriate only under certainty conditions.

The reason is that in a stochastic environment, the intertemporal budget constraint becomes $B_t = \lim_{N\to\infty} E_t\left(u_{t,N} B_{t+N}\right) + \sum_{j=1}^{N} E_t\left(u_{t,j} S_{t+j}\right)$ and the transversality condition now involves the term $u_{t,N}$ and $E(\ )$, which denote respectively, the marginal rate of substitution between consumption in period t and $t+N$ and the expectation conditional on some state of nature.[1]

In general, the rate of return on a financial asset in period $t+1$ when the state of nature S_{t+1} is realized, given the history of the economy up to time t, will satisfy the Euler equation:

$$E_t\left[u_{t+1}(1+R_{t+1})\right] = 1$$

In a stochastic environment, however, the expression $u_{t,1}\left(1+R_{t+1}\right)$ does not have to equal unity in every state of nature. As a result, the marginal rate of substitution between consumption in period t and $t+N$ may not be measured by the discount rate on government debt based on the observed real rate of interest as it is usually assumed by the applied literature on sustainability. Instead, the discount rate will depend on how the overall level of government debt is distributed across states of nature. As a result, the sustainability tests of the Brazilian

1 See Bohn (1995) for a thorough demonstration of this development.

debt currently present in the literature do not adequately deal with the implications of uncertainty and risk, and a new approach is needed.

3 A new approach to sustainability

The applied literature on sustainability is usually based on the direct estimation of the intertemporal budget constraint under certainty. There are some difficulties in deciding whether or not a policy has been sustainable based on these estimations in a stochastic environment.

To illustrate the problem, suppose two different policies. In the first one, the government sets its primary surpluses equal zero; in the second, the government runs budget surpluses when the debt-income ratio exceeds some exogenously given upper target, but does not make any interest payments if the debt-income ratio remains bellow the target. The policy that keeps the primary surplus equal to zero implies that the government is simply rolling over its debt forever as it does not run positive primary surpluses to face interest payments on its debt. That is, because the primary surplus is zero, the government is not making any provisions to face interest payments on its debt, financing them with newly issued securities.

The second policy implies an upper bound on the debt-income ratio, but as long as the debt-income ratio remains bellow the target, it will behave as a random-walk. (Bohn, 1994)

The first policy is clearly unsustainable because it represents a Ponzi scheme; the second policy might be sustainable under some states of nature.

In this example, accessing sustainability of the government debt becomes difficult because the behavior of the debt series under the two policies will be undistinguishable from an econometric point of view. That is, if there is a positive probability that the economy's growth rate might exceed the rate of return on the debt, the debt series under the two policies will have unit roots. As a result, the two policies are undistinguishable to an econometrician observing this economy, even though the second policy is sustainable while the first one is not.

The new approach proposed by Bohn (1998) represents a much more general test of sustainability because even if the government runs primary deficits on average and in most states of nature, persistent primary deficits will lead to excessive debt accumulation at least in some unfavorable states of nature, which will eventually require a corrective measure in terms of surplus. The approach looks at both the fiscal policy and the behavior of the debt-income ratio and does not depend on the behavior of the real interest rate, growth rates, debt management

policies, uncertainty or degrees of risk aversion.

The approach to asses sustainability consists of searching for evidence of corrective actions by the government in response to changes in its debt by looking directly at the relationship between primary surpluses and the debt-income ratio. A positive response in terms of surplus indicates, for instance, that either expenditures are being reduced or revenues are being raised in order to counteract a previous increase in the debt-income ratio.

The author shows in the technical appendix to the article that when one writes the surplus-income ratio as a function of the debt-income ratio observed at the beginning of the period and other determinants, a strictly positive and at least linear response of the surplus to increases in the debt-income ratio will suffice to ensure compliance to an intertemporal budget constraint:

$$s_t = \rho b_t + \mu_t \qquad (3)$$

where μ_t is bounded and represents other determinants of the surplus, namely temporary government spending and a business cycle indicator.

This condition, a positive coefficient on b_t, implies that any negative shock resulting in an increase of the debt-income ratio will eventually lead to an increase in the primary surplus as well, regardless of the nature of the shock.

4 Fiscal policy and The Brazilian federal domestic debt

As explained earlier, the approach to asses sustainability consists of searching for corrective measures by the government in response to increases in the debt/income ratio.

In the case of Brazil, debt issuing only became an important instrument for government finance after the financial reform of 1964-66, when the first indexed government security was created. From 1966 to 1980, the federal domestic debt was relatively stable averaging 6.6 percent of the country's GDP. The ambitious development programs launched by the government during this period was primarily financed through external borrowing and, at least until the first oil shock of 1973, the government relied on the low cost funds of the Eurocurrency market. After that, external credit conditions started to deteriorate with a reduction in international trade volume and an increase in interest rates. Despite the tightening in external credit, the Brazilian government avoided macroeconomic adjustments and decided to continue its investment programs. Although the strategy succeeded in sustaining high growth

rates (averaging 7% between 1973 and 1979), there was a rapid increase in the country external debt, from US$13.9 billions in 1973 to US$ 53.9 billions in 1979. (Cavalcanti, 1988) The pattern of the federal domestic debt closely followed the country's external debt at least until 1974, as in order to convert the incoming dollars into local currency and avoid increasing the money supply, the government sold securities. After 1974, the domestic debt assumed a pattern of its own, as securities were sold to finance the previously acquired debt and the government's primary deficits. (Tavares, 1978)

Shaken by the Mexican moratorium on interest payments of its external debt in 1982, commercial banks' loans to Brazil were significantly reduced and, after 1985, external resources literally dried out. The borrowing requirements of the federal government increased from 4.8% of GDP in 1983 to 7.9% in 1984 and 12.5% in 1985 (*Relatório Anual do Banco Central*), and the financing of the federal government was primarily through expansions of the domestic debt. Concerns about accelerating inflation rates precluded the government from relying on expansions of the monetary base to finance itself and during the 1980s, the federal domestic debt as a ratio to income increased steadily. The fiscal stance of the federal government deteriorated in the late 1980s with increases in transfer payments to local governments (states and municipalities), increments in earmarked expenditures, both established by new legislation, and increasing costs with the social security system.

In the early 1990s, the combination of a one-time increase in tax revenues attained by the financial siege of the so-called Collor Plan, expenditure cuts (mainly the reduction in transfer payments to state-owned enterprises) and economic growth helped improving the fiscal stance of the public sector, with government revenues increasing from 23 7% of GDP in 1989 to 27.9% in 1994. (Giambiagi e Além, 1999)

In the early months of 1994, Congress approved an emergency fund (**Fundo de Estabilização Fiscal**) that reduced earmarked transfer payments for a period of two years. According to the government, the fund would allow for the fiscal improvement necessary for the success of the stabilization program being implemented. Indeed, by the end of the fiscal year, the borrowing requirements of the central government (Treasury and Central Bank) represented a primary surplus of 3.25% of GDP (see Table I). From 1995 to 1998, government expenditures increased, however, due to three main reasons: transfer payments to local governments, the so-called **other expenses** item of the government accounts ("**Outras despesas de custeio e capital - OCC**"), and social security expenses.

Table I
Borrowing Requirements of the Public Sector -Primary Deficits (% of GDP)*

	1994	1995	1996	1997	1998	1999	2000	2001
Total	-5.21	-0.27	0.09	0.98	-0.01	-3.24	-3.54	-3.67
Central Government	-3.25	-0.52	-0.37	0.32	-0.58	-3.03	-2.84	-1.85
Social Security	-0.16	0.00	0.08	0.32	0.79	--	0.93	1.08
Local Governments	-0.77	0.18	0.54	0.73	0.21	-0.21	-0.70	-0.88
Public Enterprises	-1.19	0.07	-0.08	-0.07	0.36	-0.64	-1.07	--

Source: Boletim do Banco Central, series *Necessidades Financeiras do Setor Público.*

* Negative values indicate a primary surplus.

Transfer payments to local governments had a relative increase of over 40% in the early 1990s. (Giambiagi e Além, 1999) After 1994, local governments found themselves in financial trouble with a fall in sales tax (ICMS), the major source of local government revenue (0.6 points of GDP between 1994 and 1998) and a contemporary increase in expenditures (public employees and social security expenses). In 1997, the federal government renegotiated local government's debt at favorable terms, exchanging federal issued bonds for local governments ones, relieving local governments from having to roll over theirs securities at increasing interest rates.

The second main reason for increasing government expenditures, the so-called **OCC** item of the federal government accounts represents expenses that are not under payroll (wages and salaries to public employees), social security expenses, earmarked transfer payments, or interest payments on the public debt. That is, it represents **other expenses**, and as such, are not subjected to the same institutional constraints as the other items of the government accounts. In periods of high inflation, it was a common practice to let the budget "adjust itself".by simply delaying payments owed on the **OCC** account. After price stabilization was achieved in 1994, the federal government expenditures under the **OCC** item, measured at prices of 1998, increased from R$ 17 billions in 1994 to R$ 31 billions in 1998.

It is worth noting that after 1994, the so-called hidden liabilities (**esqueletos**) began to be computed as part of the government's liabilities. These hidden liabilities are the result of previously acquired debts that were not properly included in the government accounts. Although

not directly related to the current fiscal stance of the government, the recognition of these liabilities do increase the public sector overall net debt. Also during this period, resources from the privatization of public enterprises began being accounted for, resulting in a reduction of the overall public debt. These adjustments are presented as **Ajustes Patrimoniais** in the government accounts. For instance, in 1998, these adjustments represented 0.9% of GDP. Although hidden liabilities increase the government debt when recognized, improvements in legislation, such as the law of fiscal responsibility **(Lei de Responsabilidade Fiscal)** tend to improve the control of the public accounts, reducing the possibilities of hidden liabilities.

Finally, regarding expenses with the social security system, the combination of an aging population, increases in the informal sector of the economy, which does not contribute to social security, and increments in the number of retirements at a relatively young age (mainly public employees who feared losing benefits with the on-going reform of the social security system) led to a steady increase in the financial requirements of the public sector. Financial requirements with social security turned from a surplus of 0.16 % of GDP in 1994 to a deficit of 1.08% of GDP in the year 2001.

From the revenue side, the government has also been able to find new sources of resources. Besides the aforementioned fiscal emergency fund (**Fundo de Estabilização Fiscal**), which has rendered the government about 0.3% of GDP in revenues, the federal government started charging a temporary tax over financial transactions (**Contribuição Provisória sobre Movimentação Financeira, CPMF**). Although first implemented in 1994, the **CPMF** has been in effect only since 1997 Generating an average of 0.9% of GDP, the financial tax has proved to be a very important source of revenue for the government

In the end of 1997, the federal government was able to approve a change in the income tax code, which led to an increase in the tax rate inciding on financial gains from 15 to 20%. The tax rate applies to financial gains whether or not they have been realized in the market. The increase in the tax rate implied a once-and-for-all revenue of 0.5% of GDP in 1998. After that, the revenue (net of transfers to local governments) has been of around 0.3% of GDP. Finally, in 1997, the government began receiving revenues from the privatization of public enterprises (notadably the telecommunications company **Telebrás**) and other services such as cellular phones (**Banda B**), which rendered revenues of about 1.0% of GDP.

As a result of the fiscal consolidation by local governments, coupled with the improved revenue side of the government accounts, the Brazilian public sector as a whole has been able to generate fiscal primary surpluses of at least 3.0% of GDP since 1999 (see **Table I**). From this point of view, there has been a significant change in the fiscal stance of the government after 1999. But given the relative rigidities of government expenditures and the fact the

historically high revenue-income ratio has been, at least in part, the result of temporary increments in revenue, it is too early to assume a change in fiscal regime after 1999 Also because, despite the fiscal efforts, the management of the Brazilian public debt has proved increasingly difficult.

The price stabilization program implemented in 1994 relied on a fixed exchange rate regime. Until 1998, the maintenance of the fixed exchange rate regime depended greatly on foreign capital inflows to support an overvalued domestic currency. The fixed exchange rate was kept afloat at the expense of high domestic rates of interest. The result was increments in the Brazilian public debt of around 38.8% between 1994 and 1998. The public debt represented 31.2% of GDP in 1994 and reached 43.3% of GDP in 1998 (see **Table II**).

Table II
Brazilian Public Debt (% of GDP)

	1995	1996	1997	1998	1999	2000	2001
Total	31.2	34.4	34.5	43.3	49.7	49.5	53.3
Domestic	25.5	29.6	30.2	36.9	39.2	39.7	42.7
External	5.7	4.1	4.3	6.4	10.5	12.6	13.3
Federal Domestic Debt: Securities in the market*	16.0	21.0	28.2	24.0	33.1	35.0	38.5

Source: Boletim do Banco Central, series *Dívida Líquida do Setor Público.*

* Series *Dívida Mobiliária Federal.*

Although the liberalization of the exchange rate in January 1999 eased the way to reductions of the interest rate, fears of upward pressures on domestic prices have led the Central Bank to postpone cuts in the basic rate. The public debt continued to rise as a ratio to income and the issuance of federal securities increased from 24.0% of GDP in 1998 to 38.5% in 2001.

Besides the sharp increase in the issuance of federal securities, the quality of the debt has deteriorated as the market became more reluctant in accepting nominal government securities. In 1996, 61 % of the federal securities were comprised of nominal debt (sold at a discount); in 1998, this percentage had fallen to 3.5%, and although the Central Bank has succeeded in selling securities at a discount, their relative participation have not returned to the level reached in 1996. Moreover, the relative participation of securities indexed to the interest rate (floating debt) has nearly doubled between 1997 and 1998 (see **Table III**).

Table III
Federal Securities - Relative Participation by Correction Clause (%)

	Exchange Rate	Price Level	Interest Rate	TR	INDEXED	Nominal	Others	TOTAL
1996	9.4	1.8	18.6	7.9	37.7	61.0	1.3	100.0
1997	15.4	0.3	34.8	8.0	58.5	40.9	0.6	100.0
1998	21.0	0.4	69.1	5.4	95.9	3.5	0.6	100.0
1999	24.2	2.4	61.1	3.0	90.7	9.2	0.1	100.0
2000	22.3	6.0	52.2	4.7	85.2	14.8	0.0	100.0
2001	28.6	7.0	52.8	3.8	92.2	7.8	0.0	100.0

Source: Boletim do Banco Central, series *Títulos Públicos Federais-Participação por Indexador.*

It is worth noting, however, that the exchange rate liberalization has not significantly increased the relative participation of dollar-indexed securities, which increased from 21% in 1998 to 24.2% in 1999, returning to 22.3% in the year 2000. Only in 2001, due to an increased volatility in the exchange rate market, has the Central Bank placed relatively more dollar-indexed securities, increasing its relative participation to 28.6%. Instead, floating rate securities have made a strong come back. Only during a period of eight months, between December 2000 and July 2001, has the government experienced a modest success in increasing the relative participation of nominal securities that reached its peak at 14.8% in January 2001.

For most of the period, over 80% of the Brazilian federal securities have been indexed, to the price level, the exchange rate or, to a larger extent, to the interest rate. This means that every real movement in these variables (particularly the interest rate) has a direct effect on the public debt, not only on the price commanded by new securities being placed in the market, but also on the stock of the debt already in the hands of the public. The management of the federal debt becomes even more difficult, if not costly, if one considers that it is comprised mostly of short-term securities.

The discussion on the management of government securities concerns strategies for achieving the optimal composition of the debt, and are well beyond the scope of this article. From the point of view of compliance to an intertemporal budget constraint, the crucial question is to see whether or not the Brazilian Treasury has systematically adjusted it primary surplus to previous changes in the stock of its debt.[2]

2 See Goldfajn and Paula (2000) for a discussion of the Brazilian case.

5 Empirical results

In order to search for a systematic relationship between the primary surplus and the debt-income ratio, and assess sustainability, Bohn (1998) proposes estimating the following regressions:

$$s_t = \alpha + \rho b_t + \beta_1 GVAR + \beta_2 YVAR + \varepsilon_t \qquad \text{(A)}$$

and

$$\Delta b_{t+1} = \alpha + \gamma \quad b_t + \beta_1 GVAR + \beta_2 YVAR + \varepsilon_t \qquad \text{(B)}$$

According to equation (3), the surplus-income ratio is a function of the beginning of the period debt-income ratio and other determinants of the surplus, namely the level of temporary government spending and a business cycle indicator, *GVAR* and *YVAR*, respectively. A possible rationale for this specification is the neoclassical theory of tax-smoothing (Barro, 1979) with further elaborations to allow for counter cyclical variations of the federal budget and temporary changes in government spending. (Barro, 1986). As Barro uses American data, he gives special attention to temporary changes in government expenditures due to war years. For the Brazilian case, the variable *GVAR* is intended to capture temporary changes in government spending, or deviations from a long run trend.

A sustainable policy implies a strictly positive coefficient on the debt-income ratio in the first regression, as previously discussed. In the second regression, sustainability implies a negative coefficient on the lagged debt-income ratio because, in this case, there is evidence of mean-reversion in the debt series.

The possible counter cyclical effect of the budget surplus is captured by the business cycle variable *YVAR*. Following Barro (1986), *YVAR* is defined as $(1 - y/y^*)$, where y^* stands for trend output. As such, *YVAR* represents the output gap or a measure of unemployment. The coefficient on *YVAR* is expected to be negative, as an increase in the output gap is accompanied by an increase in the budget deficit (or a decrease in the surplus). For the same reason, the coefficient on temporary government spending *GVAR* is also expected to be negative. *GVAR* is defined as g^*/g, with g^* standing for the normal (or trend) amount of government expenditure.

In the second regression, sustainability implies a negative coefficient on the lagged debt-income ratio because, in this case, there is evidence of mean-reversion in the debt series. The coefficients on *YVAR* and *GVAR* are now expected to be positive since both a temporary increase in government spending and a counter cyclical motive for the deficit will imply an increase in the debt-income ratio.

The data set

The data set was obtained from the Brazilian Central Bank and consists of annual observations ranging from 1966 to 2000, the first year of federal securities issuing and the most recently available data on government expenditures and revenue. Revenues is the series **Receita Total do Tesouro Nacional** and government expenditures is **Despesa Total do Tesouro Nacional**, which includes interest payments on the government debt.

Data for government expenditures net of interest payment is, unfortunately, only available after January 1986 and not all the values obtained from the Central Bank are in accordance with those from **Secretaria do Tesouro Nacional**.

s = government surplus/GDP as of time t

b = debt/GDP as of time $t-1$

gvar = temporary government spending defined as g^*/g, with g^* standing for the normal (or trend) amount of government expenditure

yvar = business cycle variable defined as $(1 - y/y^*)$, where y^* stands for trend output

intr = real rate of interest defined as $(1 + r) = (1 + i) / (1 + \text{inf})$, where i stands for the nominal rate of interest and *inf* stands for the inflation rate.

The two regressions proposed, (A) and (B), can be estimated by Ordinary Least Squares (OLS) as long as the variables involved are stationary. *GVAR* and *YVAR* are stationary by construction. Augmented Dickey-Fuller (ADF) and the heteroskedastic-consistent Phillips-Perron unit root test were performed at the appropriate specification and the null-hypothesis of a unit root was rejected at the 5 percent confidence interval (see **Table IV**). The regressions are then estimated by *OLS*.

Table IV
Unit Root Tests

Variable	ADF (lag 1)	PP (lag 3)	Statistic at 5% confidence interval	Specification
s	-2.77	-3.11	-1.95	no trend or intercept
b	-5.18	-14.80	-3.56	trend and intercept
gvar	-2.44	-2.54	-1.95	no trend or intercept
yvar	-2.72	-2.01	-1.95	no trend or intercept
intr	-5.03		-3.55	trend and intercept

* Null hypothesis of a unit root.

Estimates of regression (A) are reported in **Table V** When the surplus-income ratio is regressed against the previous level of debt-income ratio, the coefficient is negative suggesting a non-sustainable fiscal policy, but it is not statistically significant. Ideally, one should look for responses of the **primary** budget surplus to variations in the previously observed debt-income ratio, not total surplus. As reliable data for interest payments on the debt is only available after 1986, the negative coefficient might have resulted from movements in the real interest rate. Regression 2 controls for the real interest rate. As expected, the effect of the real interest rate on the surplus-income ratio is negative and highly significant, but not sufficient to revert the sign of the debt-income ratio coefficient. It remains negative and now becomes significant at 5%.

Bohn (1998) argues that a systematic government response to changes in the previous debt-income level might be obscured in a univariate analysis of the debt-income ratio by cyclical variations in output and temporary government spending. Regression 3 considers these effects. The results show that the coefficient on debt-income ratio remains negative and significant, although smaller in absolute value. As expected, temporary government spending has a negative impact on the surplus-income ratio. Cyclical variations in output are statistically significant, but do not have the expected negative sign. A possible non-linear effect of the debt-income ratio on the surplus is considered by adding a quadratic term to Regression 3. A positive coefficient on the quadratic term would suggest that the marginal response of the surplus ratio to changes in the debt-income ratio previously observed increases in the debt-income level, with the government responding more to deficits when the debt is high. The results show that the quadratic term is statistically insignificant and so are higher order terms (not reported). Moreover, the inclusion of a quadratic term worsens the fit of the regression, decreasing the precision of the estimates.

Table V

Dependent Variable: Federal Budget Surplus as a Ratio to GDP

	Const.	b_t	r_t	*GVAR*	*YVAR*	$(b_t - \bar{b})^2$	$\bar{R}^2$	*DW*
(1)	-.00252	-.03243					0.05	1.38
	(-0.63)	(-1.66)						
	[-0.95]	[-1.47]						
(2)	-.00012	-.03853*	-.00029*				0.38	1.49
	(-0.03)	(-2.43)	(-4.20)					
	[-0.05]	[-2.42]	[-2.33]					
(3)	-.00258	-.02287**	-.00025*	-.30439*	.03522**		0.63	1.18
	(-1.00)	(-1.82)	(-4.63)	(-4.86)	(1.71)			
	[-1.33]	[-1.52]	[-3.29]	[-3.05]	[1.87]			
(4)	-.00258	-.02275	-.00025*	-.30383*	.03518	-.00095	0.62	1.18
	(-0.98)	(-1.33)	(-3.34)	(-3.64)	(1.64)	(-0.01)		
	[-1.33]	[-1.33]	[-2.81]	[-2.42]	[1.70]	[-0.01]		

OLS estimations with annual data; ordinary *t*-statistic in parenthesis; Newey-West heteroskedastic and autocorrelation consistent *t*-statistic in brackets (lag window size 1). Annual observations, 1966-2000.

(*) 5% confidence interval; (**) 10% confidence interval.

Estimates of regression (B) are reported in **Table VI**. The coefficient on lagged debt-income level is positive and significant in all regressions, indicating absence of a mean-reverting process in the series and therefore a non-sustainable fiscal policy. The result is not altered when one controls for business cycles. In fact, both the temporary government spending and the output gap have positive signs as expected, but are not statistically significant.

Table VI

Dependent Variable: Change in Debt-GDP Ratio (Δb_{t+1})

	Const.	b_t	*GVAR*	*YVAR*	$\bar{R}^2$	*DW*
(1)	-.05212**	.39156*			0.20	1.96
	(-1.85)	(3.07)				
	[-1.67]	[3.53]				
(2)	-.05179*	.38919**	.04078	.00748	0.15	1.96
	(-1.70)	(-2.73)	(0.05)	(0.03)		
	[-1.77]	[3.62]	[0.06]	[0.05]		

OLS estimations with annual data; ordinary *t*-statistic in parenthesis; Newey-West heteroskedastic and autocorrelation consistent *t*-statistic in brackets (lag window size 1). Annual observations, 1966-2000.

(*) 5% confidence interval; (**) 10% confidence interval.

In order to understand the relationship between the results from **Tables V** and **VI** , it is useful to assume that the government's debt for the period $t+1$ is given by the debt minus the primary surplus in period t, both multiplied by the gross interest factor $(1 + i_{t+1})$. That is, let's say the government's debt evolves according to the expression:

$$B_{t+1} = (B_t - S_t).(1+i_{t+1})$$

Calculated as a ratio to income, the expression above becomes

$$b_{t+1} = (b_t - s_t).q_{t+1} \qquad (4)$$

where $q_{t+1} \equiv (1+i_{t+1}).{}^{Y_t}\!/_{Y_{t+1}} \cong \; 1+r_{t+1}-g_{t+1}$ is the ratio of the gross return on government debt to the gross growth rate of income. (Bohn, 1998, p. 951)

Combining equation (4) with the previously defined equation (3), and letting $\Delta b_{t+1} \equiv b_{t+1} - b_t$, one can establish a relationship between the response of the government surplus to changes in the previous debt-income level and the nature of the mean-reversion process required for sustainability:

$$\Delta b_{t+1} = -\left[1-q_{t+1}(1-\rho)\right]b_t - q_{t+1}\mu_t \qquad (5)$$

According to equation (5), provided that q and u are stationary processes, the debt-income ratio will be a stationary mean-reverting process if $\overline{q}(1-\rho)<1$ In this case, the coefficient on b_t will be negative implying mean-reversion. Note that the crucial factor is the well known relationship between the real interest rate and the income growth rate, on one hand, and the response of the surplus to variations in the debt-income level, ρ, on the other. If the real interest rate is below the economy's growth rate, the debt-income ratio will decline even if the government produces a primary surplus of zero.[3] But if the real interest rate is above the economy's growth rate, then the government must run primary surpluses, on average, in order to keep the debt-income ratio from rising without bound. Moreover, the response of the budget

3 In fact, if the real interest rate is below the economy's growth rate with probability one, the economy will be operating in the dynamically inefficient region and the government intertemporal budget constraint is irrelevant.

surplus to variations in the debt-income ratio will have to be larger the greater is the difference between the real rate of interest and the economy's growth rate:

$$\rho > \left(1 - \frac{1}{\overline{q}}\right)$$

In the case of Brazil, the real interest rate has been, on average, above the economy's growth rate. For the period of time at hand, the real interest rate averaged **4.99%** while the growth rate averaged **4.83%**. These values make an average $\overline{q} = 1.0016$. Given this value of $\overline{q}$, the response of the government surplus to variations in the debt-income ratio would have to be greater than **2.0**, on average, if the mean-reversion condition is to be satisfied. The results from **Table V** show, however, that not only the coefficient on the debt-income ratio is much smaller than **2.0** in absolute value, but it also has the opposite sign. The results suggest, therefore, that although the federal government has been implementing a policy of keeping positive primary surpluses, because the real rate of interest on government securities has been substantially above the economy's growth rate, the fiscal effort has not yet proved itself sufficient for the compliance of the government's intertermporal budget constraint. A $\rho = 2.0$ indicates, for instance, that for each increment of the debt-income ratio, the surplus-income ratio should be incremented twice as much.

The stabilization of the debt-income ratio involves the rate of debt expansion, which depends crucially on the fiscal policy and on the real interest rate, and the rate of GDP growth. The real interest rate is regarded as an important instrument for price stability. The government has faced the trade off between achieving the agreed inflation targets through high real interest rates and allowing a fast growing debt-income ratio despite its fiscal efforts or controlling the ever-growing financial component of its debt. If one adds to the equation the impact of high real interest rates on the growth rate of the economy, the inconsistency of the government's macroeconomic policy becomes readily apparent and demands immediate adjustments. The high concentration of government debt in indexed securities of short maturity periods certainly does not help matters.

5 Final remarks

This paper has analyzed the sustainability of the Brazilian federal fiscal policy by examining the responses of the government budget surplus to variations of the debt-GDP ratio and the

mean-reverting process of debt-income level, using the approach proposed by Bohn (1998). Using annual data from 1966 to 2000, the results have indicated that the government surplus has not systematically responded to changes in the debt-income level previously observed, indicating that the fiscal policy can not be considered sustainable during the period analyzed. It is also shown that the debt-GDP ratio does not exhibit a mean-reverting tendency even when one corrects for cyclical variations in income and government expenditures, further indicating a non-sustainable path for the fiscal policy. The results presented confirm the diagnostic of an unsustainable debt presented in Luporini (2000).

Moreover, given the historically levels of the real rate of interest and the economy's growth rate, the results indicate that for every increment of the debt-income ratio, the government's surplus should be incremented by at least twice as much for compliance to the government intertemporal budget constraint. The higher the difference between the real rate of interest and the growth rate, the greater has to be the government's fiscal efforts. Recently, the government has opted for high real interest rates and has left the debt-income ratio to rise unprecedently. Besides the impact of high interest rate on the ever-growing financial component of the government's debt, the monetary policy has negatively affected income growth, making the control of the debt-income ratio even more difficult. The increasing reliance on indexed securities of rather short maturity periods has added to the difficulties of debt management as any variation in the real exchange rate or the interest rate has an immediate impact, not only on new securities being issued, but also on the indexed stock of the debt.

Because the federal debt is mostly comprised of interest-indexed securities, stabilization of the debt-income ratio would logically require a reduction in interest rates. However, given the inflation targets approved by the Central Bank, high domestic rates are necessary to keep the exchange rate under control. As long as Brazilian exports do not pickup, consistently producing trade surpluses, the scarce dollar will keep the exchange rate under pressure and prevent the necessary reduction in domestic interest rates.

In summary, the diagnostic is of an unsustainable federal domestic debt. The return to a sustainable path will require a systematic reduction in domestic interest rates. The Central Bank only controls the nominal interest rate of the economy, however. A reduction of the Brazilian domestic rate in real terms depends crucially on keeping the exchange rate in check. In order to prevent further increases in the external debt and reduce the country's dependence on short-term influx of foreign capital, a consistent effort to improve Brazilian exports must be made, involving both the government and the private sector.

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Appendix

The data set used in the regressions is:

Obs	*s*	*b*	*gvar*	*yvar*	*intr*
1.	-.009333		.0709576	.1461198	1.093111
2.	-.0147977	.0216761	.0456988	.1864365	5.837079
3.	-.0106537	.0292089	.0346326	.1771584	-3.221392
4.	-.0049934	.0293737	.0207606	.164854	1.588776
5.	-.003798	.0384613	.0181463	.1408072	2.410748
6.	-.0026055	.050871	.017548	.1043855	0.6104648
7	-.001359	.0525792	.0181899	.0575558	0 .0478939
8.	.0005764	.0690921	.0110957	-.0133498	-12.22198
9.	.0052098	.0652868	.0032505	-.0372674	-10.1236
10.	.0000695	.0635763	-.0085251	-.0354615	-2.893593
11.	-.0008476	.0767667	.0038759	-.0864908	-8.038164
12.	.0004184	.0891666	-.0051991	-.0874682	-6.244028
13.	.0013469	.0816553	-.0099399	-.091183	-4.637871
14.	.0003851	.0867375	-.0206088	.1157507	-9.403221
15.	.0001627	.0666367	-.006143	-.1693521	-23.81261
16.	.0001266	.0496426	-.0209575	-.0760537	-5.612338
17.	.0001356	.0903491	-.0262418	-.0443176	9.111305
18.	.0001307	.099956	-.0282226	.0229041	25.85709
19.	.0000615	.0870604	-.0346503	.0060501	13.50121
20.	.0101363	.1525819	-.0356878	-.0358471	6.961412
21.	-.0303035	.1976642	.017557	-.0771398	-32.33632
22.	-.0170882	.1025569	-.0012161	-.0799614	47.93744
23.	-.0617992	.2064645	.0597255	-.0462864	59.03354
24.	-.061178	.3902734	.0521773	-.0473014	78.52764
25.	.0040551	.6037517	-.0129678	.0271418	-55.82547
26.	.0041181	.0696566	-.0446488	.0446689	23.26587
27	-.0022709	.0745317	-.0447303	.0757323	54.28957
28.	-.0225351	.2558261	-.0137328	.0559949	50.75286
29.	.0039262	.3538001	-.0167021	.0266041	-93.31664
30.	-.0061313	.176923	-.0098678	.0110934	-21.75675
31.	-.0117154	.1678845	-.0140144	.009745	5.557611
32.	-.0064841	.2262816	-.0105482	.0018988	31.2132
33.	-.0101199	.2934378	.0077679	.0231403	25.33393
34.	-.0051287	.37628	.0124484	.0379644	14.05025
35.	-.012142	.431803	.0762772	.0175499	7.020125

Obs = yearly data, 1966 to 2000.

s = government surplus/GDP as of time *t*.

b = debt/GDP as of time *t-1*.

gvar = temporary government spending defined as g^*/g, with g^* standing for the normal (or trend) amount of government expenditure.

yvar = business cycle variable defined as $(1 - y/y^*)$ where y^* stands for trend output

intr = real rate of interest defined as $(1 + r) = (1 + i) / (1 + \text{inf})$, where i stands for the nominal rate of interest and *inf* stands for the inflation rate.