

**Fiscal Sustainability and Monetary versus Fiscal Dominance:
Evidence from Brazil, 1991-2000**

PRELIMINARY: DO NOT CITE

Evan Tanner (etanner@imf.org; (202) 623-8608)
Alberto M. Ramos (aramos@imf.org; (202) 623-4956) ¹

International Monetary Fund
700 19th Street, N.W.
Washington, DC 20431

Abstract: This paper examines several questions regarding fiscal sustainability and adjustment in Brazil from 1991 to 2000. We find that during most of this period, the operational deficit was stationarity, and hence the debt was not growing boundlessly. However, before the Real plan (July 1994), the regime appears to be 'fiscal dominant' (FD) or non-Ricardian rather than 'monetary dominant' (MD), since the primary surplus did not respond to changes in real government debt. As expected under an FD regime, inflation was an important source of finance with monetary policy subordinated and constrained by fiscal financing requirements. However, the contemporaneous price level did not increase, that is real debt did fall not in anticipation of future primary deficits—contrary to an implication of the recently developed fiscal theory of the price level (FTPL). Then, in the first months of the Real plan, evidence points to a sustainable MD regime, helped by surging tax revenues. As real interest rates fell from 1995 to 1997, the government spent and borrowed more. As a result, the deficit became unsustainable. The recent fiscal adjustments (1999-2000) helped the deficit become sustainable once again, but evidence does point to a MD regime. This finding does not necessarily preclude an independent monetary policy and the credibility of the inflation targeting regime. However, markets must believe that future adjustments to the primary surplus, when required, will in fact occur.

¹ Tanner: IMF Institute.
Ramos: Western Hemisphere Department, IMF.

I. INTRODUCTION

All governments face an intertemporal budget constraint: the current real value of its net liabilities must by definition equal the present discounted value of future primary surpluses (tax revenues minus non-interest expenditures). If this constraint can be satisfied without a change in either policy or the price level, current fiscal policy is said to be *sustainable*. If the government adjusts the primary deficit to limit debt accumulation, the central bank is not forced to inflate away the debt. Such a regime has been called *monetary dominant* (MD) or *Ricardian*. By contrast, under a *fiscal dominant* (FD) or *non-Ricardian* (FD) regime, primary deficits are set independently of real liabilities.¹

Brazil provides a good example of such concepts. Faced with high deficits, inflation, and dramatic policy shifts, Brazil's government met its intertemporal budget constraint in different ways during the post-war period. Adjustments to the primary surplus helped limit the real value of Brazilian debt between the mid-1970s and the mid-1980s. Then, as revenue collection became more testing and nominal expenditure difficult to compress, real government debt was instead reduced by inflation and incomplete indexation.² With the Real Plan of 1994, inflation fell dramatically, reducing the primary deficit (through higher tax collections) while initially rising real interest payments. From 1995 onwards, both the primary deficit and real interest payments rose, causing a buildup of real public debt (see Chart 1). These events helped cause the collapse of Brazil's fixed-crawl exchange rate regime in early 1999. In response, taxes were raised, expenditures cut, and the primary surplus increased. By mid-2000 key fiscal targets were met under a 3-year (1999-2001) International Monetary Fund (IMF) sponsored program.

This paper examines three questions related to intertemporal solvency and fiscal adjustment in Brazil between 1991–2000, using monthly fiscal data. First, has recent fiscal policy in Brazil been sustainable? In light of policy shifts, has the deficit appeared to be sustainable during some periods but not others? Empirically, sustainable fiscal policy means that the real operational deficit (ODEF) fluctuates about some mean rather than drifting

¹ The distinction between FD and MD regimes is due to Sargent and Wallace (1981). Recently several authors have suggested that under an FD regime price changes will instead force the real value of liabilities to satisfy the intertemporal constraint. This idea is known as the *fiscal theory of the price level* (Leeper (1991), Sims (1994, 1998), Woodford (1995, 1995), Cochrane (1998), Canzoneri, Cumby, and Diba (1998), and others). A similar message is found in Sargent and Wallace (1985). However, as Woodford (1995) notes, if the fiscal theory of the price level holds, the price level adjusts through a wealth effect: private agents sell their (excess) government assets in return for goods, and goods prices hence rise.

² On this issue see Tanner (1994, 1995).

boundlessly upward. Thus, ODEF is tested for stationarity.³ Since ODEF equals the real primary deficit (PDEF) plus real interest payments (RIP), sustainability also means that, in the long-run, PDEF and RIP (see Chart 2) offset one another one-to-one.⁴

Second, how would we in practice distinguish between a 'monetary dominant' (MD) regime and a 'fiscal dominant' (FD) regime? Is the recent fiscal regime in Brazil better characterized as MD or FD? As other authors have suggested, under an MD regime, the primary deficit (PDEF) should respond to indebtedness (or real interest payments RIP). Does PDEF adjust to RIP, and if so, how? To limit debt accumulation, does the authority adjust the primary deficit in response to interest payments? Looking *backward*, does the government cut its primary deficit when interest payments rise? If so, there should be a short-run negative relationship between PDEF and RIP.⁵ Or, looking *forward*, do current reductions in PDEF help pay down the debt and hence reduce RIP in the future? If so, there should be a positive relationship between shocks to PDEF today and RIP in the future.⁶

Third, by extension, if PDEF does adjust to RIP, do such adjustments occur mainly on the expenditure or revenue sides? This analysis must focus on the central government, owing to data limitations. The analysis distinguishes between discretionary and non-discretionary expenditures, the latter including public sector wages, social security entitlements, and certain constitutionally mandated intragovernmental transfers.

This paper is relevant to current policy debates in Brazil. Do the recent fiscal measures taken in the wake of the 1997 Asian crisis, the Russian moratorium of August 1998, and the January 1999 floatation of the Real represent a short-term adjustment effort? Or, do they represent a deeper and structural change in fiscal policy, as the term 'regime' implies? Will such adjustments be sufficient to support the newly implemented inflation targeting regime for the conduction of monetary policy?

This paper is also relevant to recent discussions regarding price level determination and fiscal policy. According to the *fiscal theory of the price level* (FTPL), the price level adjusts instantaneously in order to preserve long run public sector solvency (see Cochrane

³ Such tests are found in Trehan and Walsh (1991) and Tanner (1994, 1995). Similar tests are also found in Bohn (1991), Hakkio and Rush (1991) and Tanner and Liu (1994).

⁴ If both PDEF and RIP are non-stationary, they must cointegrate one-to-one.

⁵ This is a backward looking test since today's real interest payments apply to *yesterday's* outstanding debt stock. This hypothesis is tested with a regression equation, similar to Bohn (1996).

⁶ This hypothesis is tested with a vector autoregression (VAR) framework, in the spirit of Canzoneri, Cumby, and Diba (1998).

(1998)). Unfortunately, it is difficult to directly test the FTPL. However, several authors, including Canzoneri, Cumby and Diba (1998, hereafter referred to as CCD) note that, a necessary condition for the FTPL to hold is that the regime must be FD.

As mentioned earlier, this paper attempts to empirically distinguish between FD and MD regimes. However, the empirical framework mentioned above is also well-suited to examine some hypotheses related to the FTPL. For example, according to the FTPL, when private agents anticipate a gap between current government debt and the present value of *future* primary surpluses in an FD regime, their attempts to trade bonds for goods should increase price level and reduce the real value of government obligations *today*.

Empirically most of the literature about the FTPL has focused on the U.S., not developing countries. But most evidence suggests that the U.S. is MD rather than FD. By contrast, Brazil is a country that witnessed high deficits, inflation, and dramatic policy shifts. As such, it will more likely have a FD regime and thus should provide an excellent alternative laboratory to examine such issues.

The paper is organized as follows. Section II presents an overview of fiscal developments in Brazil during the 1990s. Section III reviews some basic identities and tests related to intertemporal solvency and fiscal sustainability and presents results of stationarity tests for Brazil's real operational deficit, using monthly data for the consolidated public sector, from 1991 to early 2000. Section IV presents estimates of the relationship between the consolidated primary deficit and real interest payments. Section V extends the analysis by separating certain revenues and expenditures. Section VI presents a summary and some conclusions.

Several conclusions emerge. Regarding the sustainability of fiscal policy, results for both the entire period from January 1991 to February 2000 and several subperiods indicate that the deficit is stationary and hence fiscal policy is sustainable. Somewhat differently, estimates from *rolling* two-year samples suggest that, between (approximately) late 1995 and early 1999 (when the Real was allowed to freely float), the null hypothesis of non-stationarity was not rejected and therefore the deficit was growing boundlessly. Afterwards, the deficit again appears to be stationary.

Regarding the adjustment between PDEF and RIP, both backward- and forward-looking tests reveal some temporal relationships between these variables during certain periods (primarily the post-Real plan) but little relationship for the 1991–2000 period as a whole. Backward looking tests reveal that, for several months after the Real plan, Δ PDEF decreased in response to Δ RIP, helping to restrain the debt. This finding may however reflect the surge in tax revenues that occurred in the early months of the Real plan.

During this same period, according to forward-looking tests, innovations to Δ PDEF were *negatively* associated with future values of Δ RIP. Indeed, between 1995 and 1997, both the primary surplus and the implicit real interest rates on domestic debt fell. As mentioned

above, this finding might reflect a rational intertemporal choice by the government to borrow more today under the expectation of lower future interest rates. More likely, it might reflect an implicit choice by the government: lower real interest rates allowed the government to delay fiscal and structural reforms and provided more room for borrowing than otherwise. Also, such a strategy may also be unduly risky, especially if not followed symmetrically.

A related analysis breaks down PDF into three components, namely discretionary federal government expenditure G^D , federal taxes T^F and other elements of the primary deficit PDO. This analysis presents a more complete picture. Only after the real-Plan, current innovations in T^F are negatively related to future real interest payments. This result thus suggests that the Real plan represented a break in fiscal regime, since the authorities attempted to limit indebtedness by raising taxes only after the Real plan. However, the analysis reveals no relationship between current innovations to G^D and future RIP. And, current innovations to PDO are negatively related to future RIP, perhaps reflecting the intertemporal strategy mentioned above.

II. AN OVERVIEW OF FISCAL DEVELOPMENTS IN BRAZIL DURING THE 1990S.

This section provides a prelude to the econometric analysis. First, section II.a presents several issues regarding the measurement of Brazil's public deficit. In section II.b., fiscal impacts of the Real Plan of July 1994 are discussed. In section II.c, the fiscal implications of external pressures in 1997 and 1998 are examined. Section II.d analyses the fiscal adjustment under the IMF plan of 1998. Finally, section II.d presents a discussion of the Real crisis of early 1999 and further adjustment under the IMF program.

A. Some Measurement Issues

Brazil's consolidated public sector includes the central government (the federal government, central bank, and social security system for private sector workers; INSS), state and municipal governments, and public enterprises at all 3 levels of government.⁷ Net public liabilities, presented in Table 1, include debt (B) and the monetary base (M).⁸ From 1996

⁷ As mentioned above, this paper examines fiscal data of the consolidated public sector in Brazil between 1991 and 1999. Other papers, including Tanner (1994,1995), Rocha (1997), and Rossi (1997) examine the *gross* internal debt of the Brazilian federal government. While such data cover a longer period, they are not comparable with the data examined here, which are available only from 1991 onward.

⁸ In Brazil, while most debt is exchanged in the market (securitized), some debt is not marketable (contractual).

onward, official government debt figures reflect two important factors. First, the direct positive impact of the proceeds obtained from the privatization of public assets (used mainly to reduce debt), and the indirect effect of the transfer of the liabilities of some of the privatized enterprises to private hands. Second, the debt increasing effects of certain past arrears and other previously unsecuritized debts that were explicitly recognized—other discrete adjustments, such as the recapitalization to federal banks also impacted negatively public debt levels. Thus, an unadjusted end-period measure of liabilities in current *Reais* ($B_t + M_t$) equals the previous period's liabilities plus the (flow) current deficit (the primary deficit plus interest payments) minus debt operations associated with privatization ($PRIV_t$) plus, explicit recognition of arrears and other discrete adjustments to the debt stock (ARR_t), henceforth called simply arrears, while an *adjusted* measure of liabilities exclude these latter effects.⁹

Data are also presented in constant (deflated) *Reais* $(B_t + M_t)/P_t = LIAB_t$ and as a percent of GDP $((B_t + M_t)/GDP_t)$.¹⁰ Both Table 1 and Chart 1 show that total net public sector debt falls between 1991 and 1994, but rises thereafter, both in constant *Reais* and as a percent of GDP. During this period federal debt as a percent of the total continually rises.

Table 2 presents *yearly* deficit flows in constant *Reais*, constructed from these (real) stock data, both with and without the effects of net privatization proceeds. Part A presents the operational deficit ($ODEF_t = LIAB_t - LIAB_{t-1}$). This flow includes the effects of privatization revenues $PRIV_t$ and arrears recognition ARR_t . The operational deficit equals the sum of the real primary deficit $PDEF_t$ (also including $PRIV_t$ and ARR_t). Part B shows the primary deficit ($PDEF_t = G_t - T_t + PRIV_t + ARR_t$). Part C presents real interest payments ($RIP_t = ODEF_t - PDEF_t$). Part D shows adjustments for privatization ($PRIV_t$) and recognition of arrears (ARR_t).¹¹ Monthly counterparts of these data are shown in Chart 2. Table 3 presents these

⁹ Unless otherwise noted, all econometric analysis in this paper uses the adjusted measure. If such an adjustment for privatization is not made, the net asset position of the government debt may be understated since the reduction in gross assets is not recorded. Similarly, to include explicitly recognized arrears may introduce a bias since those obligations had previously existed.

¹⁰ The deflator is the centered general price index (*IGP-DI centrado*), base June 1995 = 100. The deflator is adjusted to reflect prices at end-of-month. GDP data use end-year (December) prices. To calculate *annual flows* as a percent of GDP, real monthly flows from January to December are summed; this sum is then multiplied by the *December* price level and then divided by the above GDP figure based on *December* prices. This procedure may yield annual flows in percent of GDP different from other published figures.

¹¹ For example, in 1998, the expanded operational operational deficit $ODEF_t$, 2.2 percent of GDP, reflects *reductions* of public sector debt due both to privatization ($PRIV_t = -1.9$ percent of GDP) and arrears recognition (-.1 percent of GDP). Accordingly, the adjusted (or restricted) operational deficit is $ODEF(\text{adjusted})_t$ approaches 4 percent of GDP.

balances in percent of GDP and the implicit real interest rate (real interest payments divided by debt) in annual percentage terms.

B. Impact of the Real Plan (July 1994)

For Brazil, the *Real* Plan of July 1994 represented dramatic changes. Prior to the *Real* Plan stagflation prevailed; annual inflation exceeded 2,500 percent while real GDP growth was low. With the inception of the *Real* Plan, inflation fell to single digits and growth rebounded. Reforms begun previously under Presidents Collor de Mello and Franco, including trade liberalization and limitations on bank credit to the public sector. After the *Real* plan, both the current and capital accounts were further liberalized, inward foreign investment was promoted, the privatization program accelerated and extended to new sectors, several key areas in the private sector were deregulated, and the financial system (especially state-owned banks) was strengthened.

The Real plan had important implications for Brazil's fiscal position. Prior to the Real plan, relatively good tax indexation and the debasement of many expenditure items raised the primary surplus to about 2 ½ percent of GDP, while inflation helped reduce ex-post real interest payments and hence real government debt. The *Real* Plan immediately slashed inflation and boosted output. In 1994, tax collections grew dramatically, further increasing the primary surplus to almost 5 percent of GDP.¹² However, expenditures soon began to grow. Real interest payments rose, as lower inflation meant led to higher ex-post (implicit) real interest rates, but this hike was temporary. Moreover, in early 1995, in the wake of the Mexican crisis of December 1994, the central bank further raised interest rates to shore up the Real against external pressures. Subsequently, real interest rates fell from about 20 percent in 1995 to under 11 percent in 1997 (Table 3, Part D, memorandum).

Between 1994 and 1996, real interest payments (RIP) averaged 5.3 percent of GDP (Table 3). Pressures mounted on non-interest expenditures as well, discretionary and entitlements alike (the latter including social security and transfers to states and municipalities.)¹³ Also in 1996, early privatizations reduced public sector debt about 0.1 percent of GDP, while recognition of "arrears" and other discrete debt adjustments (including the recapitalization of *Banco do Brasil*) raised public debt by about 1.9 percent of GDP.

¹² Tax collection in Brazil is closely indexed to inflation, but not perfectly so.

¹³ Pension benefits increases substantially in real terms during this period, following the sharp real increase of the official minimum wage.

C. External Pressures, Growing Deficits, and Adjustment, 1997 - 98

Events in Asia that began in mid-1997 affected Brazil. Earlier that year, real interest rates were falling, and RIP had declined to 1 percent of GDP. Privatization proceeds for 1997 totaled about 1.9 percent of GDP. Nonetheless, pressures on non-interest expenditures continued, boosting the primary deficit. Both fiscal and external deficits made Brazil vulnerable to foreign shocks. At end-October 1997, as the Asian crisis worsened, contagion threatened the stability of the *Real*. To calm markets, the central bank doubled the overnight reference (SELIC) rate and announced a comprehensive fiscal adjustment package involving tax increases and spending cuts. The net yield of the package for 1998 (so-called Pacote 51, since it entailed 51 measures) was estimated at around 2½ percent of GDP (R\$20.6 billion). Concurrently, the government intensified discussions about social security and administrative reforms. As a result, stock prices rallied, US dollar interest spreads fell and international reserves recovered somewhat. Domestic interest rates gradually fell to pre-crisis levels by the third quarter of the year.

BRAZIL: November 1997 Fiscal Package (R\$ billion)	
	1998 Yield
Federal Government	12.9
Revenue measures	7.5
Expenditure measures	5.4
Cuts in personnel spending	2.1
Cuts in other current and capital expenditures	2.2
Cuts in investment spending	0.5
Social security savings	0.6
States and Municipalities	
Reduction of bank financing limits	2.0
Federal Public Enterprises	5.7
Increase in tariffs	2.7
Cuts in current spending	0.9
Cuts in investment spending	2.1
Total yield of package	20.6
(% of GDP)	2.5%

Source: Fund staff estimates

However, the fiscal measures were less successful. Some of the planned spending cuts were not made. Instead, the fiscal stance loosened further in early 1998. For the first 3 quarters of 1998, real federal primary spending was 12 ½ percent above that of the same

period of 1997. Privatization proceeds for 1998 totaled around 1.4 percent of GDP, but arrears recognition boosted public obligations by about 2 percent of GDP to public debt. Also, the deficit of the private sector workers' social security system (INSS) more than doubled from the previous year, to around R\$7.3 billion (0.8% of GDP), due to increased minimum benefits and delays in previously planned reforms¹⁴.

D. Fiscal Adjustment Under the IMF Package, 1998

As 1998 progressed, Brazil remained vulnerable to contagion. Following the Russian moratorium of August 1998, as during the Asian crisis, the authorities raised domestic interest rates. By itself, tight money could not defend the *Real*. In October 1998, the government announced a 'mini-package' approaching percent of GDP during the last quarter of 1998. Federal non-interest expenditures were cut by 10 percent, other appropriation limits were imposed, spending by public enterprises was cut by R\$1 billion, and bank and foreign financing for states and municipalities was cut.

Next, a medium-term program was announced, supported by a US\$42 billion funding package with international organizations, including US\$18 billion from the International Monetary Fund (IMF).¹⁵ The program aimed to slow debt accumulation over the medium term, with the debt-to-GDP ratio falling through 2001.¹⁶ The primary surplus was programmed to rise to 2.6 percent of GDP in 1999 including 1.3 percent from the central government, then to 2.8 and 3.0 in 2000 and 2001. To do so, tax measures of roughly 2 percent of GDP in both 1999 and 2000 were implemented. These included rate increases on the financial transactions (CPMF) and social security contributions (COFINS) taxes and base broadening of the value added (IPI) and income (*renda*) taxes.¹⁷ Spending measures included, among other things, nominal caps on public sector wages.¹⁸

¹⁴ Benefit claims in the social security system surged as recipients anticipated a future reform.

¹⁵ The remainder came from other multilateral organizations, including the World and Interamerican Development Banks, Japan, and several BIS member countries. Ultimately, Brazil did not entirely use these funds.

¹⁶ For further details, see the Letter of Intent (LOI, 13 November 1998) and the Technical Memorandum of Understanding (TMU, 8 December 1998), on the IMF website (www.imf.org).

¹⁷ The CPMF was to rise from 0.2 percent to 0.3 percent, with a temporary surcharge of .08 percent for 1999, while the COFINS was to rise from 2 to 3 percent.

¹⁸ Cyclically adjusted, these measures were estimated to yield an improvement in the fiscal balance of about 3 1/2 percent of GDP.

In this context, the crawling-peg exchange rate regime (with a slowly widening band) was to be maintained, monetary policy was to remain tight, and further broad structural reforms, including privatization, were to continue. Also, the government began at this time to try to shift the maturity composition of government debt and to extend average maturities. To reduce rollover risk, the government lengthened the maturity of its debt.¹⁹ However, the market demanded floating-rate instruments rather than fixed-rate (as before), seeking protection from unanticipated market fluctuations, namely further interest rate hikes.

E. The Real Crisis and Further Fiscal Adjustment, 1999

In early 1999, the program faced several challenges. First, there was legislative and judicial resistance to both revenue and expenditure measures. Critically, an increase in the CPMF was delayed. Second, high interest rates and tight money, required to support the *Real*, were opposed by the industrial sector. Third, in January, Minas Gerais state governor and ex-president Itamar Franco threatened to default on the state's obligations. As a result, the currency peg was abandoned on January 15 and the *Real* / Dollar exchange rate rose immediately from 1.52 to 1.91, reaching over 2.0 the following by the end of the month. The exchange rate overshooting peak took place during the first days of March.

The *Real's* rapid depreciation had important fiscal implications. About 40 percent of public sector debt was linked to the US dollar (including about 20 percent in foreign debt). Accordingly, the debt-to-GDP ratio rose about 11 percentage points, to over 53 percent of GDP. In response, the targeted primary surpluses were increased to 3.1 percent in 1999, 3.25 percent in 2000 and 3.35 percent in 2001.

This additional primary adjustment was obtained through both revenue (including efforts to collect back taxes) and spending measures. The crawling-peg exchange rate regime was replaced with a managed float. To provide a nominal anchor, an inflation targeting program was introduced.²⁰ By year's end, the macroeconomic adjustment effort undertaken in 1999 was overwhelmingly regarded as successful, despite the slower-than-expected turnaround of the trade balance. Fiscal targets were met and, despite the sizeable depreciation of the currency, inflation remained below 9 percent at year's end, and real GDP grew, beating the most optimistic expectations, actually grew by 1.1 percent.

¹⁹ Longer maturity debt may also be seen as a measure to boost credibility, as Calvo and Guidotti (1992) note.

²⁰ For further details on Brazil's inflation targeting program, Fraga (2000) and Bogdanski, Tombini, and Werlang (2000).

III. THE SUSTAINABILITY OF FISCAL POLICY IN BRAZIL

In recent years, a sizeable literature devoted to assessing the sustainability of a country's fiscal policy has emerged. Several techniques from this literature are applied to Brazil. In Section III.a, some preliminary identities and tests are presented. Section III.b presents empirical results.

A. Preliminary Identities and Tests

In any period, the government's budget constraint is:

$$(1) \quad G_t + (1 + i_t) B_{t-1}/P_t - T_t + M_{t-1}/P_t = [B_t + M_t]/P_t$$

where G_t and T_t are *real* government expenditures and revenues, i_t is the nominal interest rate, P_t is the price level, B_t is interest bearing debt held by public, and M_t is the monetary base (government debt held by the central bank). Shifting subscripts, equation (1) can also be written:

$$(1') \quad [B_t + M_t]/P_t = [T_{t+1} + S_{t+1} - G_{t+1} + (M_{t+1} + B_{t+1})/P_{t+1}]/(1 + r_{t+1})$$

where $S_{t+1} = i_{t+1}M_t/P_{t+1}$ is the foregone interest payments on the public's money holdings that accrue to the government (a measure of seignorage) and r is the real interest rate ($r = (1 + i)P_{t-1}/P_t$).²¹ Substituting equation (1') forward from the current period (period 1) to infinity ((1''), (using the identities $LIAB_t = (M_t + B_t)/P_t$ and $PDEF_t = [G_t - T_t - S_t]$) yields the intertemporal budget constraint:

$$(2) \quad LIAB_0 = -\sum_{t=1}^{\infty} PDEF_t/\Pi_t(1+r_t) + \lim_{t \rightarrow \infty} LIAB_t/\Pi_t(1+r_t)$$

²¹ Note (1') is often written as $B_t/P_t = [T_{t+1} + (M_{t+1} - M_t)/P_{t+1} - G_{t+1} + B_{t+1}/P_{t+1}]/(1 + r_{t+1})$. Here, seignorage is measured more traditionally as $(M_{t+1} - M_t)/P_{t+1}$. However, the two measures of seignorage are equal when the growth rate of *real* money demand equals the real interest rate r .

The transversality condition is:

$$(3) \quad \lim_{t \rightarrow \infty} \frac{\text{LIAB}_t}{\prod_{i=2}^t (1+r_i)} = 0$$

Equations (2) and (3) summarize the notion of governmental intertemporal budget balance (GIBB). These expressions hold by definition and hence as identities are *not* testable. However, it is possible to test whether the *observed* behavior of G, T, M, B, and P over time are *sustainable* (and hence consistent with GIBB). By contrast, if fiscal policy is not sustainable, an adjustment to one or more fiscal variables will be required at some future date.

Several tests of fiscal sustainability have been developed in the literature, including Hamilton and Flavin (1986), Wilcox (1991), Trehan and Walsh (1991), Bohn (1991), Hakkio and Rush (1991), and others. Trehan and Walsh (1991) test whether real operational deficit $\text{ODEF}_t = \text{LIAB}_t - \text{LIAB}_{t-1}$ is *stationary* about a constant. Their test is the empirical counterpart to McCallum's (1984) demonstration that, over an infinite horizon, constant interest inclusive deficit is consistent with GIBB.²²

Trehan and Walsh's test is similar to that of Hakkio and Rush (1991) (see also Tanner and Liu (1994)), namely a test for the one-to-one cointegration of interest-inclusive government expenditures $\text{GG}_t = G_t + \text{RIP}_t$ and T_t^* , where $\text{RIP}_t = r_t * \text{LIAB}_{t-1}$ and $T_t^* = T_t + S_t$. Note that both tests permit a variable real interest rate.²³ However, the Hakkio-Rush test requires that both GG_t and T_t^* be non stationary. By contrast, the Trehan-Walsh does not require these assumptions. For this test, the Augmented Dickey Fuller (ADF) equation is:

$$(5) \quad \Delta \text{ODEF}_t = a_0 + a_1 \text{ODEF}_{t-1} + \sum_{j=2}^J a_j \Delta \text{ODEF}_{t-j+1} + \text{error}_t$$

²² To see this, suppose that the government runs a constant deficit of k dollars each period. With a constant real interest rate, the right hand side of equation (3) is written as:

$$\lim_{t \rightarrow \infty} = [\text{LIAB}_0 + tk]/(1+r)^t$$

which converges to zero.

²³ By contrast, a similar test proposed by Bohn (1991), for the cointegration of G, T^* , LIAB with a vector of coefficients [1, -1, r] requires a constant real interest rate.

The null hypothesis of non-stationarity implies that $a_1 = 0$. The related Z_t and Z_α tests, due to Phillips (1987) and Phillips and Perron (1988) are also presented.

B. Empirical Results.

In this section, tests for the stationarity of ODEF are presented. During the period under study, there have been dramatic changes in policy, and parameters may vary over time. Accordingly, estimates are presented for both the entire 1991:1 – 2000:2 period and selected sub-samples, namely the pre-Real period (1991:1 – 1994:6), the post-Real period (1994:7 – 1999:4), and the post-Tequila period (1995:4 – 1999:3). However, since these subperiods are to some degree arbitrary, estimates for *rolling* two year periods, beginning with the period 1991:1 – 1993:1 and ending with the period 1998:2 – 2000:2, are also presented.

Table 4 presents the stationarity tests mentioned above: ADF, Z_t and Z_α . For the entire sample, as well as all three sub-periods, most results suggest that ODEF is stationary: with the exception of the ADF statistics for the pre-Real period, for all three statistics and all periods, the null hypothesis of the non-stationarity of ODEF is rejected at the 90 percent level or better.

However, ADF statistics from rolling 2-year samples (Chart 3) reveal a somewhat different story. The finding of stationarity for the pre-Real period is weakened somewhat: for several periods, from the beginning of the sample through 1992:8 - 1994:8, it is not possible to reject the null hypothesis of non-stationarity. Then, for most of 1994 through 1996, ADF statistics indicate rejection of the null of non-stationarity at the 95 percent level. Importantly, for 24-months rolling windows starting in early 1995 through early 1997 (that is, ending in early 1999), the ADF statistic is (absolutely) less than 2.75, once again suggesting a non-stationary process for the operational deficit. Finally, rolling windows starting from 1997:3 onward, we observe something akin to a regime shift, since the null hypothesis of non-stationarity is rejected at the 90 percent level or better.

IV. THE ADJUSTMENT MECHANISM: FISCAL VERSUS MONETARY DOMINANCE

Closely related to fiscal sustainability is the issue of *adjustment*: what mechanism limits government indebtedness according to equations (2) and (3)? Potentially, the primary deficit ($PDEF = G - T^*$), through changes in G , T^* , or both, may respond to changes in the real value of liabilities, thus balancing the government's intertemporal budget, according to equations (2) and (3). In this case, monetary policy is not determined by fiscal considerations. For this reason, such a regime has been called 'monetary dominant (MD)' (see Canzoneri, Cumby, and Diba (1998)). Alternatively, if there is no such response, the primary deficit is set independently of either liabilities or real interest payments. In this case, monetary policy

is determined by fiscal needs, under a 'fiscal dominant' (FD) regime. And, an MD regime is required for monetary policy to be conducted independently.²⁴

A related notion that has also recently received attention is the *fiscal theory of the price level* (FTPL) (see Woodford (1995, 1996), Cochrane (1998), Canzoneri, Cumby, and Diba (1998)): continual adjustments in the price level, rather than the primary deficit, force equation (3) (intertemporal balance) to hold at any point in time (since *real* liabilities $LIAB_t$ equal nominal liabilities deflated by the price level $(M_t+B_t)/P_t$).²⁵ The FTPL cannot hold under an MD regime. Rather, for the FTPL to hold, an FD regime is necessary (but not sufficient).

Conceptually, these notions are familiar to most macroeconomists. However, as discussed below, it is difficult to distinguish between these regimes and even harder to test for the FTPL. This section represents an attempt to examine the adjustment mechanism in Brazil. To begin, section IV.a develops a definition of a MD regime as one in which the primary deficit consistently responds to real interest payments to limit the present value of the debt. Then, two empirical tests are presented. First, in section IV.b, a one-equation test, similar to work by Bohn (1996), is presented. Looking *backward*, does the government cut its primary deficit when real interest payments rise? If so, there should be a short-run negative relationship between PDEF and RIP. While there are severe shortcomings to this test (also discussed), its appeal lies in its simplicity, and it is thus presented as a 'first pass'. Then, in section IV.c, to remedy these shortcomings, a more complex framework is presented. This test, similar to one developed by Canzoneri, Cumby, and Diba (1998), uses a vector autoregression system (VAR) whose elements include the primary deficit and government debt. The framework permits a *forward-looking* examination of fiscal policy that can test for a broad range of fiscal adjustment patterns. Do current reductions in the primary deficit help pay down the debt? Do current borrowing decisions reflect future interest payments? Or, is today's primary deficit independent of future indebtedness?

A. Distinguishing between MD and FD regimes: Some issues

To empirically distinguish between two MD and FD regimes, it is first necessary to define an MD regime. For the tests in this paper, under a MD regime, the government adjusts

²⁴ A good example is the recently implemented inflation targeting regime in Brazil.

²⁵ Such a price level adjustment need not be the result of current monetization. Rather, as Woodford (1995) notes, the price level can adjust through a wealth effect: private agents sell their (excess) government assets in return for goods, and goods prices hence rise.

the primary surplus on a regular basis to limit the level of real indebtedness according to (2). Equivalently, to satisfy (2) under a MD regime, movements in PDEF should be proportional to those of RIP. For example, assuming for simplicity a constant interest rate r , the constant primary deficit required to satisfy (2) is $PDEF^* = -r/(1+r) LIAB_0 = -RIP/(1+r)$. More generally, if the primary deficit follows a stationary autoregressive process $PDEF_t = \lambda_0 + \lambda_1 PDEF_{t-1} + v_t$, with $\lambda_1 < 1$, where v_t contains both an error term and one-time adjustments, the expected present value of current and future primary deficits is:

$$(6) \quad E \sum_{t=0}^{\infty} PDEF_t / (1+r)^t = \lambda_0(1+r)/r \left\{ \sum_{t=0}^{\infty} (1+r)^{t+1} \lambda^t \right\} + PDEF_t (1+r)/(1+r-\lambda_1)$$

Accordingly, under an MD regime, the primary surplus that satisfies (2) $PDEF_t^*$ equals a factor proportional to real interest payments plus a constant term:

$$(7) \quad PDEF_t^* = -RIP_t/(1+r) + \lambda_0 \sum_{j=0}^{\infty} \lambda_1^j (1+r)^{j+1}$$

Note that if $\lambda_1(1+r) < 1$, the rightmost term converges to $\lambda_0(1+r)/[1-\lambda_1(1+r)]$. Thus (7) is a reaction function: it captures systematic responses of the current primary deficit to either primary deficits, change in interest rates (including changes in the exchange rate for dollar denominated debt), or both.

It may be more fruitful to analyze fiscal adjustment in a *forward-looking* manner. To illustrate, consider several examples. First, under a MD regime (as defined above) *current* reductions in PDEF help pay down the debt and hence reduce RIP in the future. If so, we should observe a *positive* relationship between *current* innovations to PDEF today and *future* RIP.

Second, under a FD regime (as defined above) when private agents perceive a gap between the value of government debt today and the present value of primary surpluses in the future, they attempt to sell bonds. This raises the price level and thus reduces the real value of government debt today. According to the FTPL, we would observe a *negative* relationship between *current* innovations to RIP and *future* PDEF. Such an interpretation is plausible if inflation is high. However, as an alternative interpretation, such a relationship may simply reflect *backward-looking* adjustments of PDEF to RIP like those discussed above. Such an interpretation is more plausible if inflation is low. Note also that the FTPL interpretation ignores the possibility of a risk premium: when private agents perceive a gap between the value of government debt today and the present value of primary surpluses in the future, they may require higher interest rates to hold government debt.

Third, policy makers may incorporate future real interest rates when deciding today's current primary deficit. For example, they may spend more and borrow more if they anticipate

lower interest rates in the future. If so, there should be a *negative* relationship between current innovations to PDEF today and RIP in the future.

B. Single-equation test: The response of Δ PDEF to Δ RIP

Even if (2) holds through adjustments in PDEF, it may be unrealistic to expect that the PDEF and $RIP/(1+r)$ move (minus) one-to-one over the short run. Instead, consider the testable reaction function:²⁶

$$(8) \quad \Delta PDEF_t = b_0 + b_1 \Delta RIP_t + error_t$$

This is a backward looking test since today's real interest payments apply to *yesterday's* outstanding debt stock. Also, since equation (8) is specified in first differences, b_1 reflects a *short-term* relationship between PDEF and RIP, not a cointegrating relationship.²⁷

Unfortunately, while equation (8) can in some cases rule out a MD regime, it cannot distinguish between MD and FD regimes. For example, under a MD regime, the primary deficit responds to changes in real interest payments. By contrast, under a FD regime, if the FTPL also holds, the price level jumps and real interest payments fall in anticipation of future primary deficits. In either case, b_1 would be negative. However, even if price level doesn't jump in anticipation of future primary deficits, b_1 will be zero or positive under a FD regime. Therefore, if b_1 is either not different from zero or significantly positive, a MD regime is ruled out.

Table 5 presents estimates of equation (8) for both the entire 1991:1 – 2000:2 period and the same subsamples presented above. In all cases, there appears to be no statistically significant reaction of Δ PDEF to Δ RIP. Instead, the null hypothesis of $b_1 = 0$ is never rejected. These results do not favor a MD regime: for neither the entire period nor the subperiods was debt limited by regular adjustments to the primary deficit.

²⁶ This test modifies Bohn (1996) who examines the relationship between PDEF and LIAB for the US. For Brazil, it is more appropriate to use RIP, owing to substantial fluctuations in the real interest rate.

²⁷ Note also that $ODEF_{t-1}$ could be included in (6), making it an error-correction model. Such a specification, whose results are available from the authors, yielded results very similar to those reported here.

Estimates of b_1 from rolling two-year samples (see Chart 4) modify the story somewhat. For most of the sample period, b_1 is not significantly from zero. However, from 1995:4 – 1997:4 to 1995:11 – 1997:11, a period that includes the start of the Real Plan (July 1994), b_1 is negative and statistically different from zero. Thus, an MD regime cannot be ruled out during this period. However, for subsequent periods, estimates of b_1 are not different from zero, once again ruling out an MD regime. Note also that, during this most recent period, the deficit is stationary. As noted in Section II, there were fiscal adjustments during the later part of this period. However, these adjustments may have not been statistically perceived as sufficiently permanent (possibly due to lack of enough observations) and hence not statistically related to real interest payments.

C. Vector Autoregression Analysis

Equation (8) is simple and intuitive. However, a one-equation framework may be insufficient to address questions like those posed here. As discussed above, such a framework cannot distinguish between *ex-post* adjustments of PDEF to RIP (consistent with an MD regime) and *ex-ante* adjustments of RIP to PDEF (consistent with an FD regime and the FTPL). Canzoneri, Cumby, and Diba (1998, hereafter referred to as CCD) propose a vector autoregression (VAR) framework that permits a richer analysis of fiscal adjustment, including several of the issues discussed above. A modification of CCD's VAR is:

$$(9) \quad \Delta \mathbf{X}_t = \mathbf{a}_0 + \mathbf{a}_1 \Delta \mathbf{X}_{t-1} + \mathbf{a}_2 \Delta \mathbf{X}_{t-2} + \dots + \mathbf{v}_t$$

where $\mathbf{X} = [\text{RIP}, \text{PDEF}]$ is the real value of outstanding liabilities, \mathbf{a}_i is a vector of coefficients, and $\mathbf{v}_t = (v_{\text{PDEF}}, v_{\text{RIP}})$ is a vector of error terms.²⁸ In standard fashion, assume that each element of the error vector \mathbf{v}_t is in turn composed of "own" error terms $\mathbf{w}_t = (w_{\text{PDEF}_t}, w_{\text{RIP}_t})$ and contemporaneous correlations with "other" errors:

$$(10) \quad \mathbf{v}_t = \mathbf{B} \mathbf{w}_t$$

²⁸ If \mathbf{X} is a cointegrating vector, an error-correction term $\theta_k \mathbf{X}_{t-k}$ should also be included. In the analysis, it is assumed that RIP and PDEF move together one-to-one (i.e. that ODEF is stationary). Thus, the error correction term is ODEF. However, results were largely insensitive to the inclusion or omission of such a term.

where \mathbf{B} is a 3 x 3 matrix whose diagonal elements ("own correlations") equal one and whose nonzero off-diagonal elements reflect contemporaneous correlations among the error terms. Also, (10) yields impulse response functions (IRF's) that summarize the effects of current innovations w_t on values of \mathbf{X} .

Like any VAR framework, system (9) estimates relationships of time-series causality or 'precedence' between variables (see Maddala (1992, p. 357)) that run in both directions. These time-series relationships have economic interpretations that depend on the direction and the sign, as summarized in Table 6.

Table 6
Summary of interpretation, system (9), $\mathbf{X} = [\text{RIP}, \text{PDEF}]$

Current primary deficit (ΔPDEF_t) * \rightarrow future real interest payments (ΔRIP_{t+i})	
Positive	Government pays down future debt, consistent with MD regime.
Zero	Primary deficit exogenous, consistent with FD regime.
Negative	Government anticipates future interest bill, consistent with MD regime.
Current real interest payments (ΔRIP_t) \rightarrow future primary deficit (ΔPDEF_{t+i})	
Positive	Unstable policy, consistent with FD regime; or interest rates anticipate future primary deficits.
Zero	Primary deficit exogenous, consistent with FD regime.
Negative	Government pays down past debt, consistent with MD regime; or price level anticipates future primary deficits, consistent with FD regime and FTPL.

* Innovations.

Consider first temporal relationships running *from* current real interest payments (ΔRIP_t) to future primary deficits (ΔPDEF_{t+i}). Like equation (6) a *negative* relationship may either indicate that primary deficits compensate for changes in real interest payments to help limit debt accumulation (consistent with an MD regime) or that the price level (and hence real interest payments) anticipate future primary deficits (consistent with an FD regime and the FTPL). By contrast, a *positive* relationship indicates that primary deficits respond to real interest payments in an unstable fashion (consistent with an FD regime) or that current interest rates (and hence interest payments) respond positively to anticipated future primary

deficits (reflecting higher risk).²⁹ The absence of a relationship suggests that the primary deficit is exogenous, consistent with an FD regime.

Consider next relationships in system (9) that run *from* the current primary deficit ($\Delta PDEF_t$) *to* future real interest payments (ΔRIP_{t+i}). Under an MD regime current *innovations* to the primary deficit w_{PDEF_t} should be related to future government debt and hence interest payments. For example, when the government reduces the primary deficit, it pays down the debt and hence reduces future interest payments (either through the stock of liabilities, the interest rate, or both). But, a negative relationship between w_{PDEF_t} and future RIP is also consistent with an MD regime as it indicates that government responds to lower (higher) expected future interest payments by borrowing more (less) and hence running higher (lower) primary deficits today. By contrast, under an FD regime, w_{PDEF_t} would be uncorrelated with future RIP.³⁰

In Table 7, exclusion (Granger causality) tests and impulse response functions (IRF's) are summarized for system (9), estimated with 2 and 4 lags, for both the entire 1991:1 – 2000:2 period and the selected subsamples.³¹ Like the estimates of equation (8), there is little evidence for either the entire sample or the selected subsamples that current ΔRIP helps explain future $\Delta PDEF$. Rather, the null hypothesis that current ΔRIP does not explain future $\Delta PDEF$ is never rejected. Moreover, all of the corresponding IRF's are insignificant. However, there is evidence that current $\Delta PDEF$ helps explain future ΔRIP . For the 4-lag model, for both the entire sample and the post-Real period (1994:7-2000:2), the null hypothesis that current $\Delta PDEF$ does not explain future ΔRIP , can be rejected at the 90 percent level or better, and the corresponding IRF's are significant. Note also that the IRF's indicate a *negative* relationship: positive (negative) current values of w_{PDEF} imply future decreases (increases) in RIP.

Rolling samples are also applied separately to both equations in the VAR system (9). Rolling F-statistics for the exclusion of past ΔRIP on current $\Delta PDEF$ and past $\Delta PDEF$ on current ΔRIP are presented in Charts 5 and 6, respectively. These charts suggest that during certain periods, there were statistically significant relationships ΔRIP and $\Delta PDEF$ in both directions. Chart 5 confirms the results of the single equation analysis of the previous section: there was a significant negative relationship (and especially so for the two-lag model) between current ΔRIP on future $\Delta PDEF$ during the first years of the Real plan, from (approximately) the third quarter of 1994 through early 1996.

²⁹ Obviously, such a relationship may be directly tested using fiscal variables and interest rates.

³⁰ An exception, as CCD note, occurs if w_{PDEF} is negatively correlated with future PDEF. In this case, w_{PDEF_t} may be positively related with future RIP even under an FD regime.

³¹ Several other lag lengths were estimated, but qualitative results were similar to those presented here.

As suggested above, there are two ways to interpret this finding. On the one hand, according to a forward-looking interpretation, this finding might represent adjustments of the price level in anticipation of future primary deficits (consistent with the FTPL). However, since this is the low inflation period, and such a finding was not evident during the high inflation period, this interpretation is not plausible. It is somewhat more plausible to put a backward-looking interpretation on this finding: during the initial months of the Real plan, government debt was kept under control by reductions in the primary deficit.

Likewise, Chart 6 suggests a significant negative relationship between past $\Delta PDEF$ on current ΔRIP was also concentrated in the first months of the Real plan, but mainly during 1995. This finding may represent an *implicit* (rather than explicit) intertemporal decision by the government: with the implicit real interest rate on public debt falling between 1995 and 1997, the government was not as compelled as it might have otherwise been to either reduce the primary deficit or to quickly implement needed reforms.

V. ADJUSTMENT OF DISCRETIONARY EXPENDITURES AND REVENUES.

Evidence presented above suggests that, apart from the initial months of the Real plan, Brazil's fiscal regime more closely resembled FD than MD, in the sense that primary deficit appeared not to adjust to interest payments. A question closely related to the above analysis is whether adjustments of PDEF to RIP occur through changes in expenditures, revenues, or both.³² As in many countries, Brazilian authorities are limited in their ability to make such adjustments. On the expenditure side, wages, certain social entitlements such as pension benefits, and constitutional transfers to the sub-national governments are legally predetermined. For this reason, discretionary elements of the budget include basically other current and capital expenditure. On the tax side, room for discretion lies mainly in federal taxes (set by the central authority) rather than state or local taxes. Thus, to analyze how the discretionary elements of the federal budget adjust, consider the following expression for the real operational deficit:

$$(11) \quad ODR_t = G_t^D - T_t^F + PDO_t + RIP_t$$

³² A related issue, not addressed in this paper, is whether the increase in tax revenues was a result of the dramatic fall of inflation in 1994 (a 'reverse Tanzi' effect).

where G^D is discretionary federal spending G^D , T^F is federal tax revenue T^F and PDO contains all other elements of the consolidated primary deficit. Accordingly, a modified VAR system (11) uses the vector $\mathbf{X} = [\text{RIP}, \text{PDO}, G^D, T^F]$,

The logic developed in the previous section can be easily extended, as summarized in Table 8. Under either an MD regime (looking backward) or an FD regime in which the price level anticipates future government liabilities (FTPL, looking forward), current RIP_t will be *negatively* related to future G^D_{t+i} and PDO_{t+i} but *positively* related to T^F_{t+i} . By contrast, a positive (negative) relationship between current values of either RIP_t or PDO_t and future G^D_{t+i} (T^F_{t+i}) may indicate an unstable response by the government. Also, a positive (negative) relationship between current RIP_t and future G^D_{t+i} or PDO_{t+i} (T^F_{t+i}) may indicate that current interest rates (and hence interest payments) respond positively to anticipated future primary deficits (reflecting higher risk).

Consider next temporal relationships in system (7) that run *from* either current tax receipts (ΔT^F_t) or discretionary expenditures (ΔG^D_t) to future real interest payments (ΔRIP_{t+i}) and/or other elements of the primary deficit (ΔPDO_{t+i}). Under an MD regime, current *innovations* to either current tax receipts (ΔT^F_t) or discretionary expenditures (ΔG^D_t) should be related to future government obligations, either interest (RIP_{t+i}) or otherwise (PDO_{t+i}). The government may 'pay down' future obligations (RIP_{t+i} and/or PDO_{t+i}) by either raising current taxes T^F_t or reducing current discretionary expenditures G^D_t . In this case, innovations in taxes w^T_t should be positively related to future RIP_{t+i} and/or PDO_{t+i} , while innovations in discretionary expenditures w^G_t should be negatively related to future RIP_{t+i} and/or PDO_{t+i} . Alternatively, the government may anticipate changes in future obligations and compensate accordingly. In this case, innovations in taxes w^T_t should be *negatively* related to future RIP_{t+i} and/or PDO_{t+i} , while innovations in discretionary expenditures w^G_t should be *positively* related to future RIP_{t+i} and/or PDO_{t+i} .³³

In Table 9, exclusion (Granger causality) tests and impulse response functions (IRF's) are summarized for modified system (11), estimated with 2 and 4 lags, for both the entire 1991:1 – 2000:2 period and the selected subsamples.³⁴ Evidence indicates that past ΔRIP helps explain some current elements of ΔPDEF , for both the entire sample and the selected subsamples. However, this evidence is not strong and results are sensitive to the number of lags included. For example, ΔRIP helps explain ΔPDO in the two-lag but not the four-lag

³³ There are, of course, also interrelationships among the elements of the primary deficit, PDO , T^F and G^D . For example, higher taxes today may permit more future spending. If so, w^T should be positively related to future G^D . Also, higher spending today may force the government to raise more taxes. If so, w^G should be positively related to future T^F .

³⁴ As before, several other lag lengths were estimated, but qualitative results were similar to those presented here.

model, and the significant relationship is concentrated primarily in the post-Tequila period. By contrast, ΔRIP helps explain ΔG in the four-lag but not the two-lag model.

Relationships between lagged elements of ΔPDEF and current ΔRIP are stronger. This is especially true for the 4-lag model: for the entire sample, null hypotheses that past ΔPDO , ΔG and ΔT do not explain current ΔRIP can each be rejected at the 90 percent level or better, and corresponding IRF's are significant. Note, however, that significant relationships are concentrated mainly in the immediate post-Real period. For the pre-Real period, the null hypotheses are never rejected, while for the post-Real period, they are always rejected at the 90 percent level or better. For the post -Tequila period, in no case can the null hypotheses that lagged ΔPDO , ΔG or ΔT do not explain current ΔRIP be rejected, while for the post-Real period, these hypotheses are always rejected at the 90 percent level or better.

Was there a change in patterns of fiscal responses after the Real plan? In the post-Real period, federal taxes T^{F} and discretionary expenditures G^{D} appear to cause real interest payments RIP . As before, F-statistics for rolling samples applied to each equation separately, plotted in Charts 7 to 12 help reveal exactly *when* statistically significant relationships between ΔRIP and elements of ΔPDEF took place. These results, in large part consistent with those presented previously. However, Chart 11 shows an important exception: statistically significant relationships from lagged $\Delta\text{G}^{\text{D}}$ to current ΔRIP occur only if the devaluation of early 1999 is included. An outlier analysis further indicates that this significant relationship depends entirely on one extremely high value for $\Delta\text{G}^{\text{D}}$ in early 1997.

According to IRF's shown in Charts 13 and 14, in the post-Real plan period, current innovations to $\Delta\text{T}^{\text{F}}$ and to a lesser degree in ΔPDO have statistically significant effects on future ΔRIP (these estimates use the four-lag model, but other lag lengths yielded similar results). In the case of federal taxes T^{F} , the overall response is negative; a positive and significant response occurs at lag 5, while a more-than-offsetting negative response occurs at lag 6. This result suggests that, during this period, tax increases helped limit indebtedness.³⁵ However, in the opposite direction, innovations to other elements of the primary deficit PDO appear to be negatively related to real interest payments: a positive and significant response occurs at lag 9, while a more-than-offsetting negative response occurs at lag 10. Thus, in anticipation of lower interest payments, the government increased the portion of the primary deficit that contains wages and entitlements.

³⁵ Also, lagged $\Delta\text{G}^{\text{D}}$ appears to be positively related to current ΔRIP . However, as mentioned above, this observation reflects some extreme outliers.

VI. SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

This paper examines several questions related to intertemporal solvency and fiscal adjustment in Brazil between 1991–2000, using monthly fiscal data. First, has recent fiscal policy in Brazil been sustainable? In light of dramatic policy shifts, has fiscal policy been sustainable at some times but not at others? Results for both the entire period from January 1991 to February 2000 and several subperiods indicate that the deficit is stationary and hence fiscal policy is sustainable. Somewhat differently, estimates from *rolling* two-year samples suggest that, between (approximately) late 1995 and early 1999 (when Real depreciated), the null hypothesis of non-stationarity was not rejected, indicating that the fiscal deficit was growing boundlessly. Afterwards, the deficit appears again to be stationary.

Second, is the recent fiscal regime in Brazil better characterized as 'fiscal dominant' or 'monetary dominant'? Does the primary deficit adjust to real interest payments, and if so, how? To limit debt accumulation, does the authority adjust the primary deficit in response to interest payments? In this aspect, the results were weak. While both backward- and forward-looking tests reveal some relationship between these variables during certain periods (primarily the post-Real plan), there was little relationship for the 1991 – 2000 period as a whole.

Backward looking tests indicated the primary deficit decreased in response to real interest payments, in a stabilizing fashion, immediately after the Real plan. However, during this same period, current innovations to the primary deficit were *negatively* associated with future real interest payments, reflecting a deterioration of the primary balance and lower implicit real interest rates on public debt between 1995 and 1997. Such a pattern might reflect a rational intertemporal choice by the government to borrow more today in anticipation of lower interest rates. More likely, this result reflected an implicit calculus by the government. In any event, such a strategy may also involve undue risks and should be pursued symmetrically.

Third, did the adjustments of the primary deficit occur in expenditures, revenues, or both? This analysis suggests that, after the real-Plan (but not before), current innovations in federal taxes are negatively related to future real interest payments, suggesting a break in fiscal regime. After the Real plan, debt was restrained with higher tax revenues. However, there does not appear to be a significant relationship between current innovations to discretionary expenditures and future interest payments. And, current innovations to other elements of the primary deficit are negatively related to future real interest payments, perhaps reflecting once again the implicit intertemporal choice mentioned above.

The results in this paper are relevant to recent developments in Brazil, regarding both fiscal adjustment and the recently announced inflation targeting regime. Substantial fiscal adjustment took place at the end of 1998, and especially during 1999 and 2000 (following the collapse of the Real). During this period, Brazil's fiscal policy was sustainable in the sense

that its operational deficit appears to be stationary. But an MD regime *as defined* --- a statistically significant relationship between PDEF and RIP --- is found to be absent.

In June of 1999, the central bank announced the adoption of an inflation targeting regime as the main anchor for inflation expectations. It is well known that such a program requires that the monetary authority not be dominated by financing fiscal requirements. Nonetheless, it should be stressed that to empirically find that an MD regime is absent does not necessarily mean that the monetary authority will be unable to pursue an independent policy like inflation targeting. For example, the recent fiscal adjustments, until further consolidated, may represent transitory adjustments, not closely tied to debt accumulation, rather than the regular adjustment of PDEF to RIP implied by (7). However, an independent monetary policy requires *credibility*: markets must believe that future adjustments to the primary deficit, if required, will in fact occur. And, the qualitative nature of the adjustment has welfare implications: continual adjustments may be better for the economy than discrete ones, as they imply smaller, smoother changes in either expenditures or taxes, or both.

Finally, results in this paper are relevant to an implication of the recently developed fiscal theory of the price level (FTPL). If the market perceives a gap between current government debt and the present value of future primary surpluses in an FD regime, current innovations in RIP should be negatively related to future PDEF, reflecting a jump in the price level and hence a fall in the real value of government obligations *today*. Such a relationship would have been most likely during the pre-Real period, when high inflation was required to balance the budget. The absence of such a relationship favors more traditional monetary theories of inflation over the FTPL.

REFERENCES

Bogdanski, Joel, A. Antonio Tombini, and Sérgio Werlang (2000) "Implementing Inflation Targeting in Brazil," paper presented at High Level Seminar on Inflation Targeting, International Monetary Fund, Washington DC, March 20 - 20, <http://www.imf.org/external/pubs/ft/seminar/2000/targets/index.htm>

Bohn, Henning (1991) "Budget Balance through Revenue or Spending Adjustments? Some Historical Evidence for the United States," *Journal of Monetary Economics*; v27 n3 (June), pp. 333-59.

------(1996) "The Behavior of U.S. Public Debt and Deficits," *Quarterly Journal of Economics*; v113 n3 August, pp. 949-63.

Calvo, G. and P. Guidotti (1992) "Optimal maturity of nominal government debt: an Infinite-horizon model," *International Economic Review*, 33 (November): 895-919

Canzoneri, Matthew, Robert Cumby, and Behzad Diba (1998) "Is the Price Level Determined by the Needs of Fiscal Solvency?" National Bureau of Economic Research Working Paper: 6471, 1998

Cochrane, John H. (1998) "A Frictionless View of U.S. Inflation," *NBER Macroeconomics Annual* (Cambridge: National Bureau of Economic Research).

Fuller, W. A. (1976) *Introduction to Statistical Time Series* (New York: Wiley)

Fraga, A. (2000) "Monetary Policy During the Transition to a Floating Exchange Rate," *Finance and Development*, 37, 1 (March).

Hakkio, Craig and Mark Rush (1991) "Is the Budget Deficit 'Too Large?'" *Economic Inquiry*; v29 n3 July 1991, pp. 429-45.

Hamilton, James D. and Marjorie A. Flavin (1986) "On the Limitations of Government Borrowing: A Framework for Empirical Testing," *American Economic Review*; v76 n4 September, pp. 808-19.

Leeper, Eric (1991) "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies ," *Journal of Monetary Economics*;27(1), February 1991, pages 129-47.

Maddala, G.S. (1992), *Introduction to Econometrics*, New York: McMillan

McCallum, Bennet T. (1984) "Are Bond-Financed Deficits Inflationary? A Ricardian Analysis," *Journal of Political Economy* 92 (February), 123-35.

Phillips, Peter C.B. (1987) 'Time Series Regressions with a Unit Root,' *Econometrica*, 55: 277-301

_____ and Pierre Perron (1988) 'Testing for a Unit Root in Time-Series Regressions,' *Biometrika*, 75: 335-46.

Rocha, Fabiana (1997) "Long-Run Limits on the Brazilian Government Debt," *Revista Brasileira de Economia*, 51 (4), October/December; pp. 447 – 470.

Rossi, Jose (1997) "A Solvência da dívida: Testes para o Brasil " Working Paper, IPEA, Rio de Janeiro (July)

Sims, Christopher A. (1994) "A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy," *Economic Theory*;4(3), 1994, pages 381-99.

_____ (1998) "Econometric Implications of the Government Budget Constraint," *Journal of Econometrics*," 83(1-2), March-April, pages 9-19.

Tanner, Evan (1994) "Balancing The Budget With Implicit Domestic Default: the Case of Brazil in the 1980's" *World Development*, January

----- (1995) "Domestic Intertemporal Budget Balance and Indexed Debt in Brazil: Evidence from 1976 - 1991" *Journal of International Money and Finance*, August

----- and Peter Liu (1994) "Is the Budget Deficit 'Too Large'? : Some Further Evidence," *Economic Inquiry*; v32 n3 July, pp. 511-18.

Trehan, Bharat and Carl Walsh (1991) "Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits," *Journal of Money, Credit, and Banking*; v23 n2 May 1991, pp. 206-23.

Woodford, Michael (1995) "Price Level Determinacy Without Control of a Monetary Aggregate," *National Bureau of Economic Research Working Paper*: 5204, August

_____ (1996) "Control of the Public Debt: A Requirement for Price Stability?" *National Bureau of Economic Research Working Paper*: 5684, 1996

Table 1
Brazil: Net Public Sector Liabilities
A. Millions of Current Reais (B_t+M_t)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	56	678	17,715	153,163	208,460	269,193	308,426	385,870	516,579
Central Government	19	222	5,194	65,836	90,406	128,413	167,742	231,268	316,222
State and Local	11	169	5,001	51,091	72,476	93,338	115,892	130,905	170,786
Enterprises	27	288	7,520	36,236	45,578	47,442	24,793	23,697	29,571
Accumulated Adjustments						14,481	-2,049	3,211	-1,809
Privatizations (APRIV)	-	-	-	-	-	-1,144	-17,790	-30,650	-39,623
Arrears Rec. (AARR)	-	-	-	-	-	15,625	15,741	33,862	37,814
Public Sector (restricted)	56	678	17,715	153,163	208,460	254,712	310,475	382,658	518,388

B. Millions of Constant Reais LIAB_t = (B_t+M_t)/P_t

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	193,984	185,025	162,492	167,369	198,050	234,167	250,484	307,684	342,375
Central Government	64,984	60,504	47,645	71,943	85,892	111,705	136,229	184,408	209,583
State and Local	36,729	45,976	45,872	55,830	68,857	81,193	94,120	104,381	113,192
Enterprises	92,272	78,545	68,975	39,597	43,301	41,269	20,135	18,895	19,599
Accumulated Adjustments						12,597	-1,664	2,561	-1,199
Privatizations (APRIV)	-	-	-	-	-	-995	-14,448	-24,440	-26,261
Arrears Rec. (AARR)	-	-	-	-	-	13,592	12,784	27,001	25,062
Public Sector (restricted)	193,984	185,025	162,492	167,369	198,050	221,570	252,148	305,123	343,574
Deflator (May - Jun 95=100)	0.03	0.4	10.9	91.5	105.3	115.0	123.1	125.4	150.9

C. In percent of GDP (B_t+M_t)/GDP_t

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	37.9	37.2	33.0	29.2	30.5	33.3	34.6	42.4	47.0
Central Government	12.7	12.2	9.7	12.5	13.2	15.9	18.8	25.4	28.7
State and Local	7.2	9.2	9.3	9.7	10.6	11.5	13.0	14.4	15.5
Enterprises	18.0	15.8	14.0	6.9	6.7	5.9	2.8	2.6	2.7
Accumulated Adjustments						1.8	-0.2	0.4	-0.2
Privatizations (APRIV)	-	-	-	-	-	-0.1	-2.0	-3.4	-3.6
Arrears Rec. (AARR)	-	-	-	-	-	1.9	1.8	3.7	3.4
Public Sector (restricted)	37.9	37.2	33.0	29.2	30.5	31.5	34.8	42.0	47.1
GDP	148	1,824	53,617	525,027	683,401	809,332	891,801	910,595	1,100,212

D. Composition (Percent of Total)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Central Government	33.5	32.7	29.3	43.0	43.4	47.7	54.4	59.9	61.2
State and Local	18.9	24.8	28.2	33.4	34.8	34.7	37.6	33.9	33.1
Enterprises	47.6	42.5	42.4	23.7	21.9	17.6	8.0	6.1	5.7
Foreign Debt	63.4	50.3	43.8	29.0	18.3	11.7	12.5	14.8	21.1

Source for all data: Central Bank of Brazil.

1 / Deflator is general price index (IGPDI)

2 / GDP calculated with end year prices.

Table 2
Public Sector Deficits, Brazil
Millions of Constant *Reais*
(Minus sign (-) indicates surplus)

A. Operational Deficit ($ODEF_t = LIAB_t - LIAB_{t-1}$)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-65,373	-8,959	-22,532	4,876	30,681	36,117	16,316	57,201	34,691
Federal / BC	-30,926	-4,479	-12,859	24,297	13,949	25,813	24,524	48,179	25,176
State and Local	-12,234	9,247	-104	9,958	13,028	12,336	12,926	10,261	8,812
Enterprises	-22,213	-13,727	-9,570	-29,378	3,705	-2,032	-21,134	-1,240	703
Adjustments	-	-	-	-	-	12597	-14261	4225	-3760
Privatizations (PRIV)	-	-	-	-	-	-995	-13,453	-9,992	-1,821
Arrears Rec. (ARR)	-	-	-	-	-	13592	-808	14,217	-1,938
Public Sector (restricted)		-8959	-22,532	4,876	30,681	23,520	30,578	52,976	38,450

B. Primary Deficit ($PDEF_t = G_t - T_t$)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-14,662	-11,329	-13,260	-28,127	-2,315	622	7,088	-98	-22890
Federal / BC	-4,286	-6,413	-7,190	-16,936	-3,760	-2,694	2,335	-4,057	-16743
State and Local	-6,834	-1,733	-2,762	-4,597	1,102	3,885	5,263	1,410	-1616
Enterprises	-3,542	-3,183	-3,307	-6,595	343	-568	-510	2,549	-4531

C. Real Interest Payments ($RIP_t = ODEF_t - PDEF_t$)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-50,712	2,370	-9,273	33,004	32,996	35,495	9,229	57,298	57,581
Federal / BC	-26,640	1,934	-5,669	41,233	17,709	28,507	22,189	52,236	41,918
State and Local	-5,400	10,980	2,659	14,554	11,926	8,451	7,663	8,852	10,428
Enterprises	-18,672	-10,544	-6,262	-22,783	3,361	-1,464	-20,624	-3,789	5,234
Public Sector (adjusted)		2,370	-9,273	33,004	32,996	22,897	23,490	53,074	61,340

D. Adjustments

Privatization						-995	-13,453	-9,992	-1,821
Arrears Recognition						13,592	-808	14,217	-1,938

Memo: Implicit Real Interest Rate (Percent per year) -5.0 20.3 19.7 11.6 10.6 21.0 20.1

Source: See Table 1.

Table 3
Public Sector Deficits, Brazil
In Percent of GDP
(Minus sign (-) indicates surplus)
A. Operational Deficit

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-12.8	-1.8	-4.6	0.8	4.7	5.1	2.3	7.9	4.8
Federal / BC	-6.0	-0.9	-2.6	4.2	2.1	3.7	3.4	6.6	3.5
State and Local	-2.4	1.9	0.0	1.7	2.0	1.8	1.8	1.4	1.2
Enterprises	-4.3	-2.8	-1.9	-5.1	0.6	-0.3	-2.9	-0.2	0.1
Adjustments	-	-	-	-	-	1.8	-2.0	0.6	-0.5
Privatizations (PRIV)	-	-	-	-	-	-0.1	-1.9	-1.4	-0.2
Arrears Rec. (ARR)	-	-	-	-	-	1.9	-0.1	2.0	-0.3
Public Sector (restricted)		-1.8	-4.6	0.8	4.7	3.3	4.2	7.3	5.3

B. Primary Deficit

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-2.9	-2.3	-2.7	-4.9	-0.4	0.1	1.0	0.0	-3.1
Federal / BC	-0.8	-1.3	-1.5	-3.0	-0.6	-0.4	0.3	-0.6	-2.3
State and Local	-1.3	-0.3	-0.6	-0.8	0.2	0.6	0.7	0.2	-0.2
Enterprises	-0.7	-0.6	-0.7	-1.1	0.1	-0.1	-0.1	0.4	-0.6

C. Real Interest Payments

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Public Sector	-9.9	0.5	-1.9	5.8	5.1	5.0	1.3	7.9	7.9
Federal / BC	-5.2	0.4	-1.2	7.2	2.7	4.0	3.1	7.2	5.7
State and Local	-1.1	2.2	0.5	2.5	1.8	1.2	1.1	1.2	1.4
Enterprises	-3.6	-2.1	-1.3	-4.0	0.5	-0.2	-2.8	-0.5	0.7
Public Sector (adjusted)	-9.9	0.5	-1.9	5.8	5.1	3.3	3.2	7.3	8.4

D. Adjustments

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Privatization						-0.1	-1.9	-1.4	-0.2
Arrears Recognition						1.9	-0.1	2.0	-0.3

Source: See Table 1.

Note: To calculate *annual flows* as a percent of GDP, real monthly flows from January to December are summed; this sum is then multiplied by the *December* price level and then divided by the above GDP figure based on *December* prices. This procedure may yield annual flows in percent of GDP different from other published figures.

Brazil: Real Net Public Debt

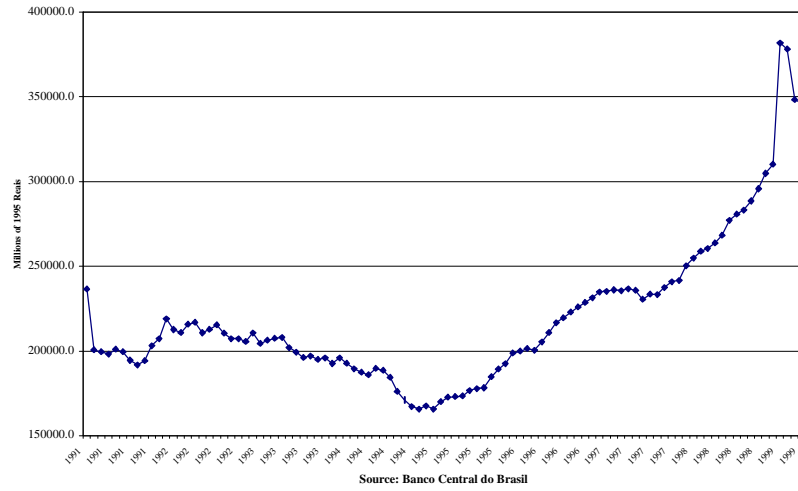


Chart 1: Real Net Public Sector Debt, Brazil, 1991-1999 (Millions of 1995 Reais).

Brazil: Real Primary Deficit and Interest Payments

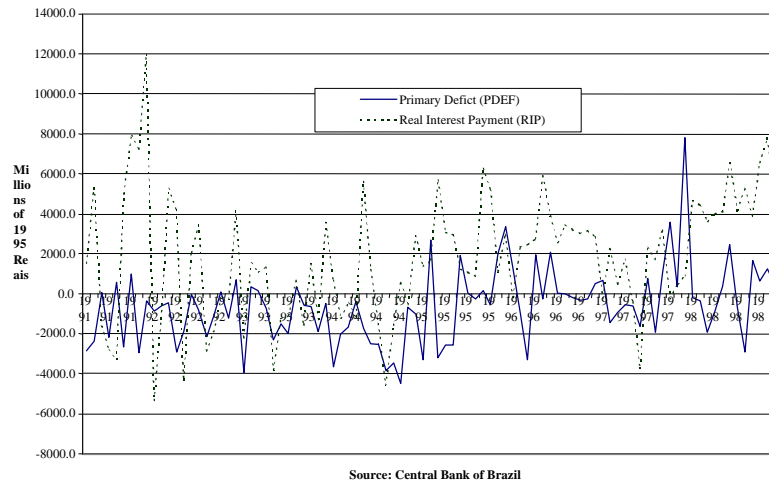


Chart 2: Brazil: Real Primary Deficit (PDEF) and interest payments (RIP).

Table 4
Stationarity Tests, Real Operational Deficit (ODEF)

(5)
$$\Delta ODEF_t = a_0 + a_1 ODEF_{t-1} + \sum_{j=2}^J \Delta ODEF_{t-j+1} + \text{error}_t$$

	ADF(1)	ADF(2)	Zt(1)	Zt(1)	Za(1)	Za(1)
Whole Period (1991:1-2000:2)	-8.55**	-5.81**	-9.69**	-9.68**	-97.67**	-90.49**
Pre-Real (1991:1-1994:6)	-2.39	-1.72	-3.93**	-3.91**	-32.28**	-31.95**
Post-Real (1994:7-2000:2)	-7.14**	-4.66**	-7.58**	-7.55**	-62.15**	-56.19**
Post-Tequila (1995:7-2000:2)	-6.71**	-4.25**	-7.09**	-7.09**	-52.89**	-47.50**

Notes: Null hypothesis is $a_1=0$. ADF(x), Zt(x) and Za(x) are the Augmented Dickey Fuller (Equation (5)) test, Phillip's Zt and Za tests (See Phillips (1987) and Phillips and Perron (1988), respectively, where x is the number of augmented terms included in the test. The 95 and 99 percent critical values for the ADF(x) and Zt tests are -3.00 and -3.75, respectively. The 90 and 95 percent critical values for the Za test are -8.0 and -13.6, respectively. *, ** represents rejection of the null hypothesis of non-stationary process at 90,95 percent levels. Critical values are from Fuller (1976, pp.371-73).

Brazil: Estimates of ADF (2) Statistic, ODEF

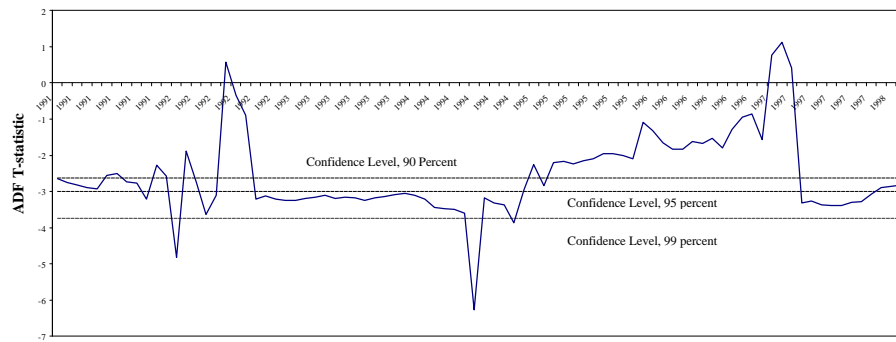


Chart 3: ADF Statistic, 2-year rolling samples (start period 1991:1 –1993:1, end period 1998:2 - 2000:2).

Table 5
Equation (8)
Response of $\Delta PDEF$ to ΔRIP (b_1)
(Standard Errors in Parentheses)

(8) $\Delta PDEF_t = b_0 + b_1 \Delta RIP_t + error_t$

	b_0	b_1	R^2 (Adj.)
Whole Period (1991:1-1999:4)	-18.04 (233.75)	0.00 (0.02)	-0.01
Pre-Real (1991:1-1994:6)	-10.29 (334.31)	-0.08 (0.08)	0.00
Post-Real (1994:7-1999:4)	-0.11 (316.49)	0.00 (0.02)	-0.01
Post-Tequila (1995:7-1999:4)	-79.92 (332.44)	0.00 (0.03)	-0.02

Brazil: Rolling Estimate, Response of $\Delta PDEF$ to ΔRIP (b_1)

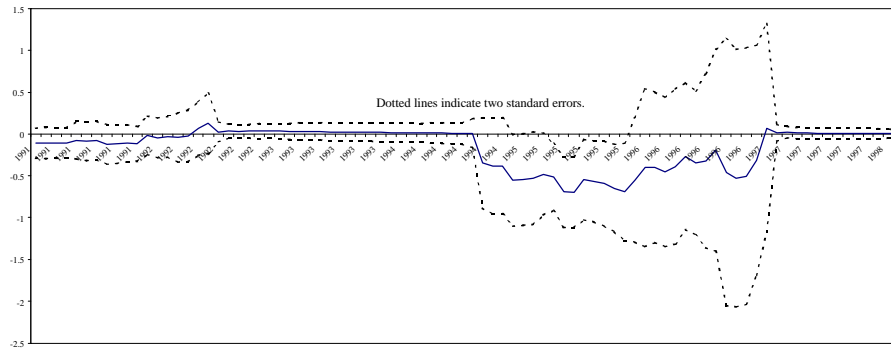


Chart 4: Response of $\Delta PDEF$ to ΔRIP (b_1 , equation (8)) 2 year rolling samples (dotted lines indicate 2 standard errors).

Table 6
Summary of interpretation, system (9), $\mathbf{X} = [\text{RIP}, \text{PDEF}]$

Current primary deficit (ΔPDEF_t) * \rightarrow future real interest payments (ΔRIP_{t+i})	
Positive	Government pays down future debt, consistent with MD regime.
Zero	Primary deficit exogenous, consistent with FD regime.
Negative	Government anticipates future interest bill, consistent with MD regime.
Current real interest payments (ΔRIP_t) \rightarrow future primary deficit (ΔPDEF_{t+i})	
Positive	Unstable policy, consistent with FD regime; or interest rates anticipate future primary deficits.
Zero	Primary deficit exogenous, consistent with FD regime.
Negative	Government pays down past debt, consistent with MD regime; or price level anticipates future primary deficits, consistent with FD regime and FTPL.

* Innovations.

Table 7
Summary of results, system (9)

$$(9) \quad \Delta\mathbf{X}_t = \mathbf{a}_0 + \mathbf{a}_1 \Delta\mathbf{X}_{t-1} + \mathbf{a}_2 \Delta\mathbf{X}_{t-2} + \dots + \mathbf{v}_t$$

$$\mathbf{X} = [\text{RIP}, \text{PDEF}]$$

	<i>2 Lag Model</i>				<i>4 Lag Model</i>			
	$\text{PDEF}_t \rightarrow \text{RIP}_{t+i}$		$\text{RIP}_t \rightarrow \text{PDEF}_{t+i}$		$\text{PDEF}_t \rightarrow \text{RIP}_{t+i}$		$\text{RIP}_t \rightarrow \text{PDEF}_{t+i}$	
	F-Stat	IRF	F-Stat	IRF	F-Stat	IRF	F-Stat	IRF
Whole Period (1991:1-2000:2)	0.82	NS	1.51	NS	3.36**	Neg.	0.61	NS
Pre-Real (1991:1-2000:2)	0.43	NS	1.13	NS	0.95	NS	1.26	NS
Post-Real (1994:7-2000:2)	0.57	NS	0.90	NS	2.40*	Neg.	0.32	NS
Post-Tequila (1995:7-2000:2)	0.27	NS	0.98	NS	1.83	Neg.	0.43	NS

*** Significant at 99% level

** Significant at 95% level

* Significant at 90% level

F-Stat: Test for hypothesis that lagged variable does not help explain contemporaneous variable in system (7).
IRF: impulse response function. NS: Not significant. Neg: negative and significant.

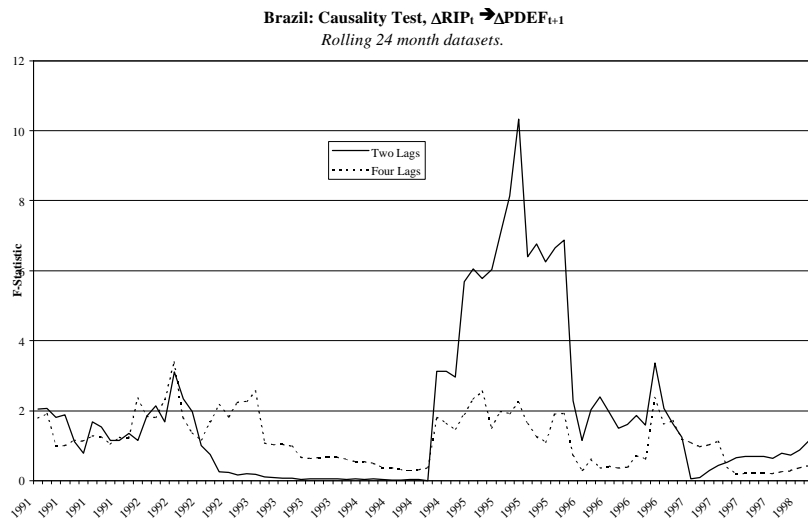
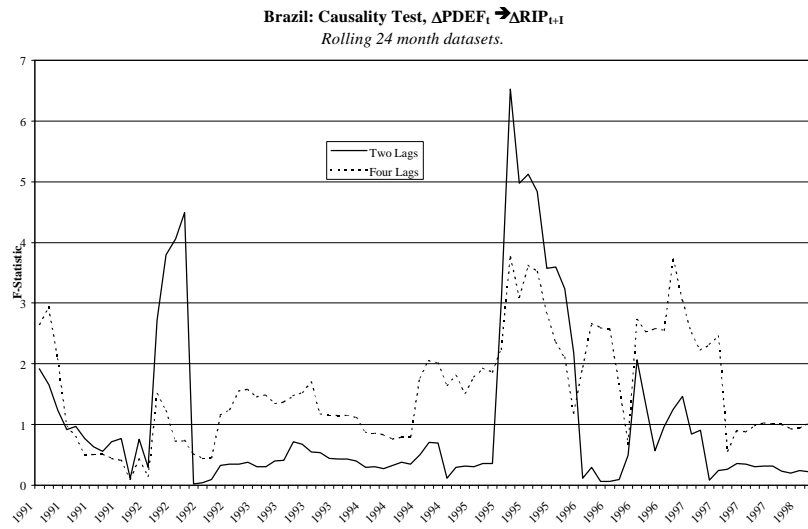


Chart 5 F-statistics for causality tests of ΔRIP_t on $\Delta PDEF_{t+1}$, rolling two-year samples.



*
Chart 6 F-statistics for causality tests of $\Delta PDEF_t$ on ΔRIP_{t+1} , rolling two-year samples.

Table 8
Summary of interpretation, system (11) modified, $\mathbf{X} = [\text{RIP}, \text{PDO}, G^D, T^F]$

Current taxes (ΔT^F_t) or Discretionary expenditures (ΔG^{FD}_t)		→	Future real interest payments (ΔRIP_{t+i})
Positive (T^F) or Negative (G^D)	Government pays down future obligations --- interest and/or entitlements --- consistent with MD regime.		
Zero	Primary deficit exogenous, consistent with FD regime.		
Negative (T^F) or Positive (G^D)	Government anticipates future obligations --- interest and/or entitlements ---- consistent with MD regime.		
Current real interest payments (ΔRIP_t)		→	Future taxes (ΔT^F_{t+i}) or discretionary expenditures (ΔG^{FD}_{t+i})
Negative (T^F) or Positive (G^D)	Unstable policy, consistent with FD regime; or interest rates anticipate future primary deficits.		
Zero	Primary deficit exogenous, consistent with FD regime.		
Positive (T^F) or Negative (G^D)	Government pays down past debt, consistent with MD regime; or price level anticipates future primary deficits, consistent with FD regime and FTPL (applies only to RIP).		

Table 9
Summary of results, modified system (11)

(11)
$$\Delta \mathbf{X}_t = \mathbf{a}_0 + \mathbf{a}_1 \Delta \mathbf{X}_{t-1} + \mathbf{a}_2 \Delta \mathbf{X}_{t-2} + \dots + \mathbf{v}_t$$

$$\mathbf{X} = [\text{RIP}, \text{PDO}, \text{G}^D, \text{T}^F]$$

F-test for exclusion of:	<i>2 Lag Model</i>			
	RIP	PDO	G	T
Whole Period (1991:1-1999:11)				
<i>Dependent Variable: RIP</i>	16.98**	1.95	12.16***	0.94
<i>Dependent Variable: PDO</i>	3.13**	18.95***	1.01	0.46
<i>Dependent Variable: G</i>	1.28	2.30	25.26***	0.96
<i>Dependent Variable: T</i>	2.23	2.82*	0.75	5.45***
Pre-Real (1991:1-1994:6)				
<i>Dependent Variable: RIP</i>	1.44	0.40	0.39	0.05
<i>Dependent Variable: PDO</i>	0.24	20.53	0.25	1.37
<i>Dependent Variable: G</i>	0.11	0.20	5.27**	1.67
<i>Dependent Variable: T</i>	1.11	1.14	0.44	1.55
Post-Real (1994:7- 1999:11)				
<i>Dependent Variable: RIP</i>	12.91***	1.36	11.99***	0.77
<i>Dependent Variable: PDO</i>	2.30	8.51	0.77	0.16
<i>Dependent Variable: G</i>	1.10	1.65	16.57***	0.56
<i>Dependent Variable: T</i>	1.75	2.01	0.50	3.03*
Post-Tequila (1995:7-1999:11)				
<i>Dependent Variable: RIP</i>	9.65***	1.18	12.71***	0.335
<i>Dependent Variable: PDO</i>	2.56*	7.34***	0.78	0.20
<i>Dependent Variable: G</i>	0.76	0.96	12.79***	0.41
<i>Dependent Variable: T</i>	1.68	1.68	0.45	1.79
Post-Real, Pre-Asia (1994:7-1997:9)				
<i>Dependent Variable: RIP</i>	19.24***	2.59*	0.57	4.04
<i>Dependent Variable: PDO</i>	0.02	2.79*	0.37	0.85
<i>Dependent Variable: G</i>	0.21	2.96*	9.15***	0.07
<i>Dependent Variable: T</i>	0.029	3.71***	2.07	4.77***

F-Stat: Test for hypothesis that lagged variable does not help explain contemporaneous variable in system (7).
 '***', '**' and '*' indicate rejection at the 99, 95 and 90 percent level, respectively.

Table 9, Cont'd.
Summary of results, modified system (11)

$$(11) \quad \Delta \mathbf{X}_t = \mathbf{a}_0 + \mathbf{a}_1 \Delta \mathbf{X}_{t-1} + \mathbf{a}_2 \Delta \mathbf{X}_{t-2} + \dots + \mathbf{v}_t$$

$$\mathbf{X} = [\text{RIP}, \text{PDO}, \text{G}^D, \text{T}^F]$$

F-test for exclusion of:	<i>4 Lag Model</i>			
	RIP	PDO	G	T
Whole Period (1991:1-1999:11)				
<i>Dependent Variable: RIP</i>	15.67***	4.55***	2.60**	5.90***
<i>Dependent Variable: PDO</i>	1.26	13.26***	0.59	0.25
<i>Dependent Variable: G</i>	3.62	2.15*	12.48***	5.85***
<i>Dependent Variable: T</i>	1.18	4.60***	0.29	11.43***
Pre-Real (1991:1-1994:6)				
<i>Dependent Variable: RIP</i>	1.76	1.60	0.96	0.67
<i>Dependent Variable: PDO</i>	1.13	10.63***	0.13	1.97
<i>Dependent Variable: G</i>	1.03	0.70	2.72*	0.66
<i>Dependent Variable: T</i>	0.68	1.90	0.37	3.72**
Post-Real (1994:7- 1999:11)				
<i>Dependent Variable: RIP</i>	11.45***	3.28**	2.74**	3.63**
<i>Dependent Variable: PDO</i>	0.61	5.98***	0.50	0.31
<i>Dependent Variable: G</i>	3.27**	1.61	8.50***	5.18***
<i>Dependent Variable: T</i>	0.89	3.79***	0.53	6.86***
Post-Tequila (1995:7-1999:11)				
<i>Dependent Variable: RIP</i>	5.25***	2.46*	2.77**	1.89
<i>Dependent Variable: PDO</i>	1.40	6.38***	0.81	0.71
<i>Dependent Variable: G</i>	2.58*	1.34	6.97***	4.97***
<i>Dependent Variable: T</i>	1.51	3.66**	0.62	4.82***
Post-Real, Pre-Asia (1994:7-1997:9)				
<i>Dependent Variable: RIP</i>	23.64***	3.05**	0.17	3.09**
<i>Dependent Variable: PDO</i>	0.48	2.86**	0.81	0.33
<i>Dependent Variable: G</i>	0.18	2.30**	2.74**	0.47
<i>Dependent Variable: T</i>	0.15	3.51**	1.24	3.44**

F-Stat: Test for hypothesis that lagged variable does not help explain contemporaneous variable in system (7).
***, ** and * indicate rejection at the 99, 95 and 90 percent level, respectively.

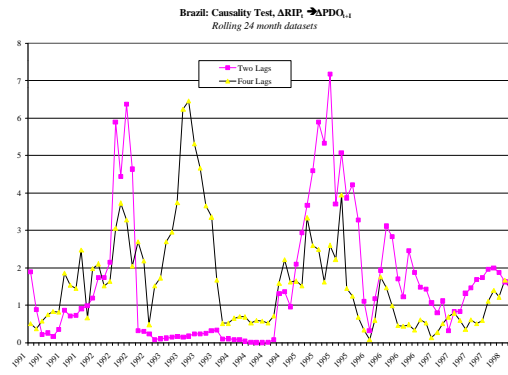


Chart 7 F-statistics for causality tests of ΔRIP_t on ΔPDO_{t+1} , rolling two-year samples.

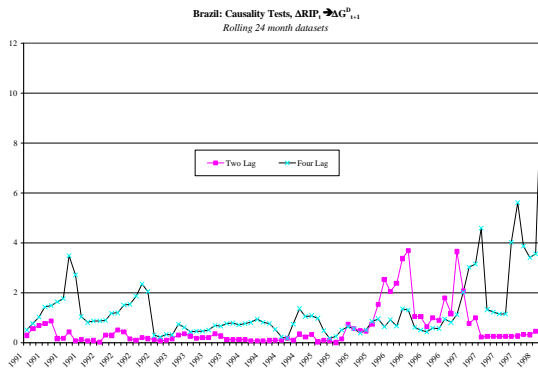


Chart 8 F-statistics for causality tests of ΔRIP_t on ΔG^D_{t+1} , rolling two-year samples.

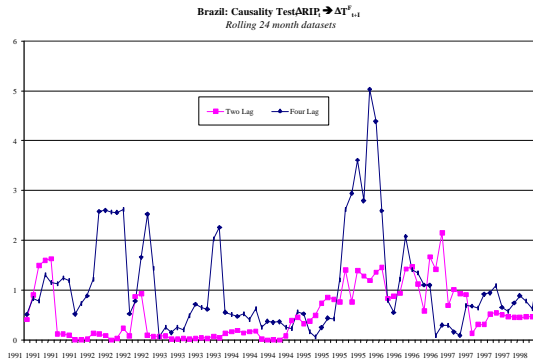


Chart 9 F-statistics for causality tests of ΔRIP_t on ΔT^F_{t+1} , rolling two-year samples.

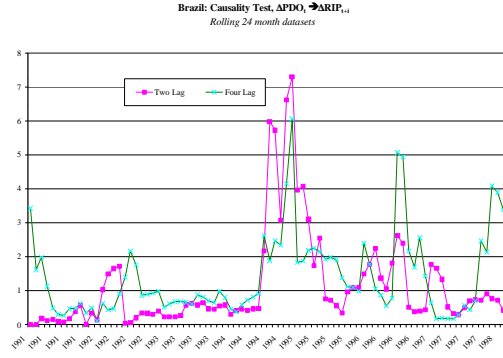


Chart 10 F-statistics for causality tests of ΔPDO_t on ΔRIP_{t+1} , rolling two-year samples.

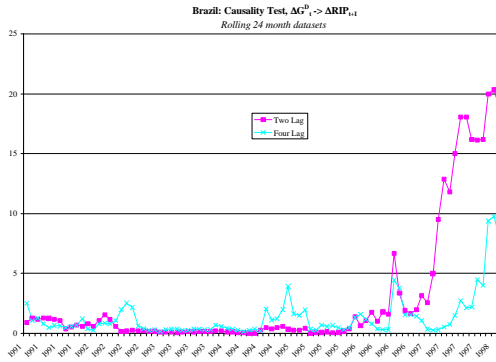


Chart 11 F-statistics for causality tests of ΔG^D_t on ΔRIP_{t+1} , rolling two-year samples.

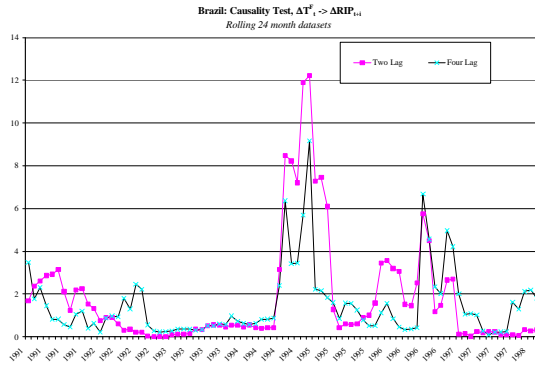


Chart 12 F-statistics for causality tests of ΔT^F_t on ΔRIP_{t+1} , rolling two-year samples.

Brazil: Impulse Response Function, $w_t^T \rightarrow \Delta RIP_{t+1}$
Post-Real Plan Period: 1994:6 - 1999:11

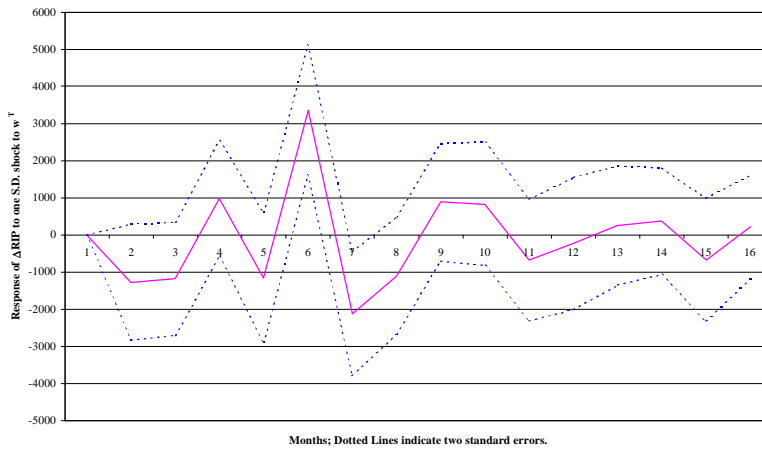


Chart 13 Impulse Response Function: Effects of innovations to ΔT^F on future ΔRIP

Brazil: Impulse Response Function, $w_t^F \rightarrow \Delta RIP_{t+1}$
Post-Real Plan Period: 1994:6 - 1999:11

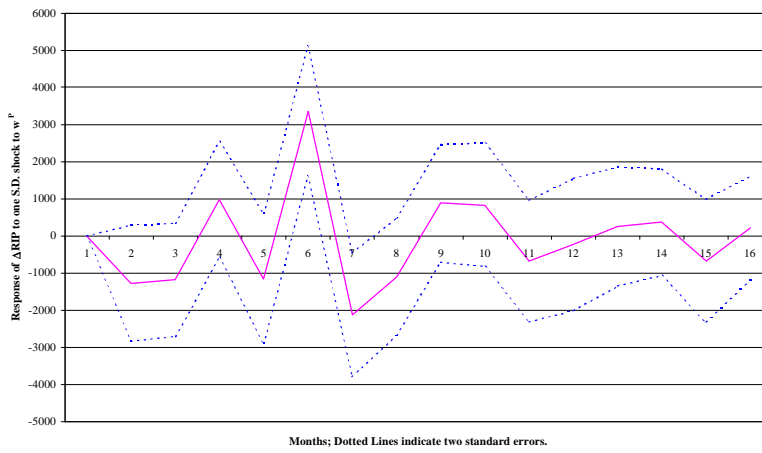


Chart 14 Impulse Response Function: Effects of innovations to ΔPDO on future ΔRIP