Artigos

Present value tests of the Brazilian current account*

Fabiana Rocha§
Siegfried Bender§

ABSTRACT

During the 90s, and in particular after the adoption of the Real Plan in 1994, a clear deterioration in the Brazilian current account has been observed. This fact attracted immediate attention to the question of whether or not the economy is obeying its external present value constraint, i.e., whether the current account deficit is on a sustainable path.The purpose of this paper is to investigate the "long run tendency" of the Brazilian current account. The procedure used is to estimate cointegrating regressions between exports and imports plus interest rate payments. Initial evidence from the regressions suggests that from 1947 to 1997 the long-run Brazilian current account was not zero. As we use a long span of data we also examine if there are any structural breaks in the cointegrating vectors in the face of regime changes. Since 1982 there has been an apparent structural shift in the relationship between trade flows. With the break, however, the results do not change. Conditions for intertemporal budget balance are still not satisfied.

Key words: current account, sustainability, structural breaks, Brazil.

RESUMO

Durante os anos 90, em particular depois da adoção do Plano Real em 1994, observou-se uma clara deterioração da conta corrente brasileira. Este fato chamou imediatamente atenção para a questão do País estar ou não obedecendo sua restrição externa, ou seja, se os déficits em conta corrente estão numa trajetória sustentável. O objetivo deste artigo é investigar a tendência de longo prazo da conta corrente no Brasil. O procedimento usado é a estimação de regressões de cointegração entre exportações e importações mais pagamento de juros. A evidência inicial das regressões sugere que de 1947 a 1997 os déficits externos brasileiros não eram sustentáveis. Como uma amostra longa é usada, também procura-se examinar se existem quebras estruturais nos vetores de cointegração diante de mudanças de regime. Uma mudança estrutural parece ter ocorrido em 1982. Com a quebra, contudo, os resultados não mudam. As condições para o equilíbrio orçamentário intertemporal ainda não são satisfeitas.

Palavras-chave: conta corrente, sustentabilidade, quebras estruturais, Brasil.

JEL classification: F10.

---

* Os autores agradecem a Afonso Bevilaqua, Marcelo Portugal e demais participantes do I Encontro USP-EPGE de Macroeconomia pelos valiosos comentários. As sugestões de dois pareceristas anônimos foram fundamentais para melhorar a qualidade do trabalho. Quaisquer erros remanescentes são de responsabilidade dos autores.

§ Departamento de Economia, Universidade de São Paulo.

Recebido em janeiro de 2000. Aceito em abril de 2000.

Introduction

In the 90s the Brazilian economy has experienced growing deficits in the current account of the balance of payments. This trend became absolutely transparent as of 1993 and gathered impetus with the implementation of the Real Plan in 1994. This situation, however, did not present itself as a symptom indicative of changes that needed to be introduced in the exchange policy, the anchor of the stabilization plan in course. We were living in a time of vast flows of private capital to emerging countries, which permitted sustaining the growing external imbalances for a long time and accumulating considerable levels of reserves. However, the greatest evidence that something was profoundly wrong with the Brazilian economic policy was the fact that as of 1995 the trade balance also began to register growing deficits. From the mid 80s through 1994, in contrast, this account had registered surpluses in excess of US$ 10 billion.

In the midst of this rapid deterioration of the external imbalance, the Brazilian economy had to face the crisis in the international capital market, hurt by the Asian collapse in 1997. The result was an intense loss of reserves with the reversal of the flows of private capital, leading to the establishment of a "**stand by**" agreement with the IMF at the end of 1998 and, in the beginning of 1999, to the abandonment of the exchange rate regime.

Despite the intense adjustments observed in the international financial market since the middle of 1997, the economic policy of the Real Plan was sustained for more than a year, from mid-1997 to November of 1998. It was only after the Russian crisis that the Brazilian position began to be seen by the market as unsustainable. This fact is remarkable because it shows that, for a reasonable period during the crisis, the international financial market made an acquiescent assessment of the dynamics of the Brazilian foreign indebtedness. In other terms, the international financial system understood that there were no problems of solvency of the foreign debt or of sustainability of the Brazilian exchange arrangement.

After mid-1998, though, Brazil suffered a strong speculative attack on its currency. Could it be that the economic conditions were altered so suddenly as to justify the intense loss of reserves that has occurred since then?

Some believed that the existing external imbalances were, in essence, sustainable and that there were adjustments in course that would gradually tend to lessen the most troublesome aspects. The sudden deterioration of expectations resulted from panic, and a contagion effect in international portfolio investments.

On the other hand, others believed that the Brazilian economic policy was badly designed and it was imposing increasingly unsustainable structural external imbalances in the long term. In this sense, the Brazilian economy would experience at some point a crisis of confidence in the national currency, with reversal of the national and international private capital for investments in dollars.

The natural question to be answered in order to evaluate the viability of external imbalances is whether the country is solvent or not. Solvency is understood as a countries' ability to generate sufficient trade surpluses in the future to repay its existing debt. We are also going to define sustainability based on solvency conditions. Therefore, solvency and sustainability will be used interchangeably. The same procedure is adopted in the literature discussing fiscal imbalances but is less consensual in the external imbalances literature.[1] Some authors (for example, Corsetti,Pesenti and Roubini (1998a,1998b) and Milesi-Ferretti and Razin (1996a,1996b) consider a path of current account deficits sustainable if the shift to reverse the trade balance to a position consistent with solvency is expected to occur without drastic changes in current policies and/or an external crisis.[2]

The purpose of this paper is to investigate the "long-run" tendency of the Brazilian current account. Following the vast literature on the feasibility of permanent government budget deficits,[3] some papers that deal with the sustainability of external deficits appeared.

---

1 Milesi-Ferretti and Razin (1996a, 199b) argue that "*the definition of sustainability based on solvency conditions is simpler for fiscal imbalances, given that these can be associated (at least to some degree) with direct policy decisions on taxation and government expenditure. Defining sustainability is more complex in the case of current account imbalances, given that these reflect the interaction between savings and investment decisions of the government and domestic private agents as well as the lending decisions of foreign investors. While government decisions can, to a first approximation, be taken as given, private sector decisions are going to depend on their perceptions regarding future government actions. Furthermore, a key relative price, the exchange rate, is a forward-looking variable that by definition depends on the future evolution of policy variables.*"

2 An external crisis can assume two forms: 1) a currency crisis, that is, a run on the central bank's reserves and/or a sudden depreciation of the exchange rate; 2) a foreing debt crisis, that is, the inability to continue to obtain international financing or to meet repayments or an actual default on the debt.

3 Hamilton and Flavin (1986) show that if the the undiscounted surplus and the undiscounted debt are both stationary the government constraint holds. Wilcox (1989) argues that the present value constraint holds, and so fiscal policy is sustainable, if the forecast trajectory for the discounted debt converges to zero. Wilcox extends Hamilton and Flavin by allowing for a variable real interest rate and stochastic violations of the borrowing constraint. Intertemporal budge balance holds if and only if the discounted debt series is stationary with mean zero. Trehan and Walsh (1991) show that when the expected real rate of interest is constant, a necessary and sufficient condition for budget balance is the stationarity of the inclusive of interest deficit. When the expected real rate of interest is variable, the cointegration test is no longer valid. In this case, intertemporal budget balance is satisfied if the first difference of the debt process is stationary, given a strictly positive expected real rate of interest. Hakkio and Rush (1991) argue that it is important to verify if government expenditures inclusive of interest payments and revenues are cointegrated over subsamples.

Trehan and Walsh (1991) examine this issue by testing if the change in the stock of net domestic assets held by foreigners is stationary. Using data from 1946 to 1987 they are unable to reject non-stationarity. Husted (1992), on the other hand, tests for cointegration between exports and imports plus interest payments abroad. He builds on Hakkio and Rush's (1991) test for the sustainability of the government budget deficits. For the whole sample (1960-1989) he finds no evidence of cointegration. An analysis of subsamples, however, supports cointegration if a structural break in 1983 is allowed. Ahmed and Rogers (1995) test whether exports, imports and net interest payments to foreigners are cointegrated with cointegrating vector (1,-1,-1). They use , as in the other studies, U.S. data and also U.K. data. In both cases they find strong evidence of the external present value constraint being satisfied over the sample period. Sawada (1994) applies Trehan and Walsh's test as well as Hakkio and Rush's test to 13 heavily indebted countries, including Brazil. For the Brazilian case, during the period 1955-1990, insolvency is indicated. Another study for Brazil is Ponta (1996). She tests for cointegration between the stock of the external debt and trade surpluses. Using data from 1970-I to 1992-I she concludes that the external debt growth is unsustainable.

The procedure used here is to estimate cointegrating regressions between exports and imports, following Husted (1992) and Sawada (1995). However, we use a longer data span than the other two studies about the sustainability of the Brazilian current account.[4] A long span of data is appropriate in assessing whether the conditions implied by intertermporal budget constraints hold, because these conditions are only required to be observed in the long run. However, when using a longer span of data we should be careful because at some point in time agents may believe that a structural shift has occurred in the long run current account of Brazil. We, then, also examine if there are any structural breaks in the cointegrating vectors in the face of unusual events.

The question of solvency/sustainability is important because, if the recent path of foreign indebtedness allow us to foresee eventual Ponzi financing problems, we can in some extent argue that the recent speculative attacks on the Brazilian currency reflect negative expectations concerning the current account deficits instead of irrationality or pure panic on the part of investors and holders of national and foreign assets.[5] In the "traditional"

4 Sawada uses only 35 years of annual data while Ponta uses only 12 years of quarterly data.

5 We can not forget, however, that they were already extremely sensitized by the effects of the depreciation of asset values that occurred in the recent financial crises in other parts of the world.

empirical literature on currency crises the indicators that have proved to be particularly useful do no include the current account deficits. The indicators that received more support are international reserves, the real exchange rate, domestic credit to the public sector, and domestic inflation.[6] Also, the literature on "early warning" of currency crises does not identify the current account deficit as one of the best indicators. These are composed by exports, deviations of the real exchange rate from trend, the ratio of broad money to gross international reserves, output, and equity prices. In spite of that, some authors such as Corsetti, Pesenti and Roubini (1998a, 1998b, 1998c) stress the relevance of the current account deficits in speculative attacks. They empirically established that "the Asian countries that came under attack in 1997 appear to have been those with large current account deficits throughout the 1990s. Countries with smaller deficits or actual surpluses did not suffer comparable currency attacks or subsequent depreciations on the value of the domestic currency" Thus they concluded that, "*while the correlation between currency depreciation and external imbalances by a group of countries* ("Asian countries") *in the 1990s need not imply causation, prima facie evidence suggests that current account problems may have played a role in the dynamics of the Asian meltdown.*"

In section 2 we present and discuss the empirical evidence on the Brazilian current account imbalances. In section 3 we derive the cointegrating vectors implied by the present value constraints. In section 4 we present the data and the cointegration results. In section 5 we search for a break and test the deficit for stationarity. In section 6 we present the main conclusions, and some suggestions for further research.

2 The Brazilian current account in the 90s

Initially, we try to get some idea of the magnitude of the Brazilian current account deficits. Tables 1 and 2 show two very distinct phases. In the first phase, from 1980 to 1992, we observe a trend of systematic reduction of the current account deficit - in nominal terms and as a proportion of the GDP. These results are the consequence of a slightly

6 See Kaminsky, Lizondo and Reinhart (1998) for an excellent survey. They also point out that the exclusion of the current account deficit "*may be because the behavior of the current account balance to some extent already may have been reflected in the evolution of the real exchange rate. In most of the studies in which the effect of the current account balance was found to be non-significant, the real exchange rate also was included in the test, and had a significant effect.*"

increasing surplus in the trade balance and of a decreasing deficit in the balance of services from 1990-92.On the other hand, in the second phase, from 1993 to 1997/98, we observe the inversion of this trend with a systematic increase in the current account deficit. These results are a consequence of the fact that, as of 1995, we observed deficits in the trade balance for the first time in many years. In addition, the balance of services, whose nominal deficit remained somewhat stable from 1980-1992, as of 1993 began to register deficits that increased year to year - certainly an effect of the significant and growing influx of external capital.

Therefore, although the levels of current account imbalance had not reached 5% of GDP, the critical number emphasized by Summers to characterize an unsustainable path, the dynamics registered in the Brazilian external accounts shows a visible and rapid deterioration, mainly after 1995.[7]

Table 1
Balance of Payments of Brazil: Select Items
(in US$ millions)

	1980-1984*	1985-1989*	1990	1991	1992	1993	1994	1995	1996	1997	1998
Trade Balance	3743.6	13453.6	10753	10579	15239	13307	10466	-3352	-5539	-8372	-6430
Balance of Services	-13400	-13936.7	-15369	-13542	-11339	-15585	-14743	-18594	-21707	-27286	-30670
Balance in current Account	-9528.9	-354.7	-3782	-1407	6143	-592	-1689	-17972	-24347	-33439	-35194
Balance in the Capital Account	6531.6	-2084.24	-4718	-4148	25271	10115	14294	29359	34263	26087	16082
Exchange Value Reserves	6501.4	8929	9973	9406	23754	32211	38806	51840	60110	52173	34382

(*) Annual averages of the period.

Source: *Boletim do Banco Central do Brasil* (several issues).

7 Lawrence Summers, the U.S. Deputy Treasury Secretary, wrote in The Economist (Dec. 23 1995-Jan. 5 1996, pp.46-48) that "*close attention should be paid to any current account deficit in excess of 5% of GDP, particularly if it is financed in a way that could lead to rapid reversals*"

Table 2
Balance of Payments of Brazil: Select Items
(in % of GDP)

	1990	1991	1992	1993	1994	1995	1996	1997*
Trade Bal.	2.44	2.75	4.04	3.04	1.85	-0.47	-0.74	-1,07
Bal. Serv.	-3.49	-3.52	3.01	-3.55	-2.61	-2.59	-2.90	-3,50
Curr. Acct.	-0.86	-0.37	1.63	-0.14	-0.30	-2.51	-3.25	-4,29
Cap. Acct.	-1.07	-1.08	6.70	2.31	2.53	4.09	4.58	3,34

(*) With preliminary estimate of the GDP of US$ 780 billion.
Source: *Boletim do Banco Central do Brasil* (several issues) and IBGE.

In addition to Summers's suggestion, a practical criteria to evaluate a country's solvency is a non-increasing ratio of external debt over GDP. In the long run, the fact that this ratio remains stable over time constitutes a sufficient condition for the solvency of the external debt.[8]

From the current account identity in (t+1) we have:

$$B_{t+1} = (1+r)B_t - TB_t$$

where B is the foreign debt, r is the interest rate and TB is the trade balance.

Dividing by Y_t (the nominal GDP), and doing $Y_{t+1} = (1+g)Y_t$ where g is the rate of growth of GDP we have:

$$(1+g)b_{t+1} = (1+r)b_t - tb_t$$

where b=B/Y and tb=TB/Y.

8 Assuming this stability perpetuates itself in time, the condition of solvency $\lim_{T\to\infty}\left(\frac{1+g}{1+r}\right)^T\left(\frac{B}{GDP}\right)_{t+T+1} = 0$ is satisfied, where g = rate of growth of the product and r = interest rate.

Assuming a stable debt/GDP ratio, that is, $b_{t+1} = b$, the identity above becomes:

$$\{(g-r)b_t + tb_t\} = 0$$

The trade surplus that solves the expression above is denominated required trade surplus (Corsetti, Pesenti and Roubini, 1998a). It is the surplus in the trade balance that guarantees a stable debt/GDP ratio over time. The difference between this required trade surplus and the trade surplus which is actually observed makes up the so-called "resource balance gap" Table 3 presents the "resource balance gap"[9] for the Brazilian economy in the 90s:

Table 3
Required Surplus and "Resource Balance Gap"
(in US$ millions and in % of GDP)

	1990	1991	1992	1993	1994	1995	1996	1997	1998**
Req. Surplus									
US$ millions	9748	8621	7253	8280	6338	8158	9840	10390	12100
% of GDP	2.10	2.13	1.81	1.89	1.16	1.15	1.26	1.29	-----
Gap									
US$ millions	-1005	-1958	-7986	-5027	-4128	11510	15379	18762	18530
% of GDP	-0.18	-0.48	-2.00	-1.14	-0.76	1.63	1.98	2.33	-----

(*) No estimate of the GDP available.
Source: *Boletim do Banco Central do Brasil* (several issues).

From 1990-1994 the solvency criterion was satisfied. The "gap" was negative, indicating that the trade surplus was more than enough to keep the given debt/GDP ratio

9 In order to calculate the "resource balance gap" it is necessary to make assumptions about the long-run differencial between the real interest rate and the growth rate of the economy . Following Corsetti, Pesenti and Roubini (1998a) we assume that r-g equals 1%. Using actual Brazilian data, the historical difference between r and g during the 90s is 5%. However, this does not imply a significant change in the results presented in Table 3.

stable. However, from 1995-1998, a positive and growing "gap" was registered. In order to maintain the stability of the growing debt/GDP ratio every year, it was necessary to obtain a substantial reversal in the trade balance. This reversal consisted of US$ 11,510 million in 1995, US$ 15,379 million in 1996, US$ 18,762 million in 1997, and US$ 18,530 million in 1998. Despite this, in terms of GDP percentage, the estimated "gap" in 1997 (2.33%) was still lower than that registered[10] in 1996 for Korea (4.4%), Thailand (6.9%), Indonesia (3.3%), the Philippines (6.5%), and similar to that of Malaysia (2.3%).

Although the solvency conditions of the Brazilian external debt were not close to those observed in some of the Asian countries, there was a visible trend of deterioration in the country's external condition. However, the "resource balance gap" as an indicator of external imbalance is quite limited. It indicates how the external situation of one country evolves over time, and how the country compares with others but does not establish if the country is solvent or not. This is the reason why we turn to intertemporal tests for a more thourough assessment of the behavior of the Brazilian current account deficits.[11]

3 External budget balance

In this section we derive the solvency condition for international borrowing. Assuming that all bonds have a one period maturity, the external budget constraint at period t can be written as:

$$M_t - X_t + r_t B_{t-1} = \Delta B_t = B_t - B_{t-1} \qquad (1)$$

where M_t is imports, X_t is exports, B_t is the foreign debt, and r_t is the (one-period) interest rate. Equation (1) is the usual external budget equation stating that a current account deficit should be financed by new debt creation.

10 According to the calculations done by Corsetti, Pesenti and Roubini (1998).

11 The tests based on the intertemporal budget constraint that will be presented are not, however, free of criticisms. As observed by Corsetti, Pesenti and Roubini (1998a, p. 8) "*the intertemporal budget constraint of a country imposes only very mild restrictions on the evolution of a country's current account and foreign debt. Any path of the current account such that the present discounted value of the current and future trade surpluses is equal to the current external debt position is consistent. A country could run very large and persistent current account deficits and remain solvent, as long as it can generate trade surpluses (of the appropriate size) at some time in the future.*"

Solving the sequence of period by period constraints of the type (1) leads to the following equation:

$$B_0 = \sum_{t=1}^{\infty} \frac{1}{(1+r)^t}(X_t - M_t) + \lim_{n\to\infty} \frac{1}{(1+r)^n} B_n \qquad (2)$$

Equation (2) is the intertemporal external budget constraint. It states that when the last term equals zero, the amount that a country borrows (lends) in international markets equals the present value of future trade surpluses (deficits). When the limit term does not equal zero the country is "bubble financing" its external debt, that is, it is paying the old maturing debt by issuing new debt.

In order to derive a testable empirical model, it is necessary first to assume that the world interest rate is stationary with unconditional mean r. Adding and subtracting rB_{t-1} to the left hand side of equation (1) results:

$$E_t + (1+r)B_{t-1} = X_t + B_t \qquad (4)$$

where $E_t = M_t + (r_t - r)B_{t-1}$

Equation (4) can be solved forward to obtain:

$$M_t + r_t B_{t-1} = X_t + \sum_{j=0}^{\infty} \beta^{j-1}(\Delta X_{t+j} - \Delta E_{t+j}) + \lim_{j\to\infty} \beta^{t+j} B_{t+j} \qquad (5)$$

where $\beta = 1/(1+r)$ and Δ is the first-difference operator. The left hand side of (5) represents spending on imports as well as interest payments (receipts) on net foreign debt (assets). If X_t is subtracted from both sides of (5) and each side is multiplied by minus one, them the left hand side becomes the country's current account.

Assume that X and E are both non-stationary processes, each integrated of order 1. In particular assume that X and E follow random walks with drift:

$$X_t = \alpha_1 + X_{t-1} + \varepsilon_{1t} \qquad (6)$$

$$E_t = \alpha_2 + E_{t-1} + \varepsilon_{2t} \tag{7}$$

where α_j are drift parameters (possibly equal to zero) and the ε_{jt} are stationary processes. In this case, (5) can be rewritten as:

$$X_t = \alpha + MM_t - \lim_{j\to\infty} \beta^{t+j} B_{t+j} + \varepsilon_t \tag{8}$$

where $MM_t = M_t + r_t B_{t-1}$; $\alpha = [(1+r)^2 / r](\alpha_2 - \alpha_1)$; and $\varepsilon_t = \sum \beta^{j-1}(\varepsilon_{2t} - \varepsilon_{1t})$

Assuming that the limit term in (8) equals zero, then (8) can be rewritten as the following regression equation:

$$X_t = a + bMM_t + e_t \tag{9}$$

Under the null hypothesis that the economy is satisfying its external budget constraint b=1 and e_t would be stationary. In other words, if X and MM are nonstationary, then under the null, they are cointegrated.[12] The condition b=1 it is not a necessary condition for the economy to be obeying its intertemporal budget constraint. In the case where there is initial external debt, b need only be less than or equal to 1 for the constraint to hold. However, if b<1 (and trade flows are measured relative to GNP) this condition is inconsistent with the requirement of a finite external debt-GNP ratio, and as is with the government's ability to market its debt. In other terms, there is an incentive for the country to default on its international debts.

4 Data source and empirical evidence

The data used in this paper are annual, nominal, nonseasonally adjusted flows of aggregate exports of goods and services (X_t) and imports of goods and services including

12 As Hakkio and Rush show in the context of government finance, cointegration is a necessary condition for the government to obey its present value budget constraint but b=1 is not. When the initial external debt is positive, b need only be less than or equal to 1 for the constraint to hold. If, however, b<1 (and exports and imports are measured relative to GNP), the real value of the ratio debt/GNP diverges to infinity, and so the external deficit is not sustainable. In fact, there is an increasing incentive for the country to default and consequently the government will have severe difficulties to market its debt.

net interest payments (MM_t) over the period 1947-1997. The data used is extracted from several issues of *Boletim do Banco Central do Brasil*.

Table 4 reports Augmented Dickey-Fuller (ADF) and Phillips and Perron's (PP) tests for unit roots. We use the PP unit roots test because it is robust to heteroscedasticity.

Table 4
Unit Roots Tests

Variable	ADF (no. lags)a	PP
X_t	0.464 (3)	0.439
ΔX_t	-3.842 (2)*	-6.166**
MM_t	-0.256 (3)	0.437
ΔMM_t	-4.918 (2)**	-4.443**

Notes :a Tests include constant and trend. Critical values are –3.53 and –4.20 for the 5% and 1% significance levels respectively. The number of lags was chosen to ensure that the errors are uncorrelated.
* and ** represent rejection of the null of a unit root at the 5% and 1% significance levels respectively.

The results indicate a failure to reject the unit root null for the levels of each of the variables, but rejection for the first differences. This is consistent with each variable being stationary in first differences.

After checking that X_t and MM_t each have a unit root, we go on to test for cointegration between these two series.[13] As established before, cointegration between these two variables is a necessary condition for the present value constraint holding. We employ the

13 Before proceeding one question still have to be taken into consideration. The interpretation of the interest rate in equation (1) depends on how exports and imports are measured. When variables are nominal we have the nominal interest rate, when variables are real we have the real interest rate, when variables are real per real GDP we have the real interest rate minus the rate of growth of real GDP. Given that the test was derived under the assumption of a stationary interest rate, we should first verify the behavior described by the interest rates. When we perform a Dickey-Fuller test on the prime-rate series for the period 1981-1997 we conclude that this series is stationary, and that there is no problem in working with exports and imports in nominal terms.

testing procedure developed by Engle and Granger (1987) for residuals of the "equilibrium"or "cointegration" regression $X_t = a + bMM_t + e_t$. In a cointegration setting, the choice of which variable occupies the left hand side is, however, arbitrary. The test is, then, performed first using exports as the regressand, and then using imports as the regressand.[14] The results are given in Table 5.

Table 5
Tests for Cointegration

Variables	τ statistic	Lags
X/MM	-2.08	0
MM/X	-1.75	0

Note : The asymptotic critical value at the 5% level is –3.24.

The cointegration tests do not reject the hypothesis of non-cointegration, indicating a violation of the external budget constraint.

Further evidence suggesting that the intertemporal budget constraint is violated comes from the equilibrium regression results. As West (1988) points out, if two non-stationary variables are cointegrated, ordinary least squares estimates are normally distributed and consistent when the variables have a drift. However, the estimated standard errors are not correct. West derives a correction that allows a consistent estimate of the asymptotic variance-covariance matrix even if the disturbances are autocorrelated and conditionally heteroskedastic. We, then, test the significance of the coefficient values of the cointegrating equation using West's adjusted t statistic. The results are presented in Table 6.[15]

---

14 An alternative method which does not impose such an arbitrary normalization is the maximum likelihood test for cointegration due to Johansen (1988). Using the Schwarz criterion, the optimal lag length for the VAR is eight. This implies a long dynamics for the period under analysis (just 51 annual observations). When we use shorter lags, however, only in some cases the non-cointegration results are confirmed.

15 The West (1988) adjusted t statistic for b equals 1 is defined as $\tau(b,x) = (b-1) / se^*(b,x)$ where $se^*(b,x)$ is the West adjusted standard error for b and x is the number of lags used in computing the standard error. It is necessary to perform West's adjustment because X_t and MM_t are non-stationary. As West shows the estimates from the cointegrating regression will follow, asymptotically, a normal distribution only with the proper adjustment.

Table 6
Estimates of the Equilibrium Regression

Estimates[a]	
a	1018.176
t_{west}	1.376
b	0.854
t_{west}	-2.095

Note: The statistic t_{west} is the t statistic incorporating West's (1988) adjustment for non-stationary regressors. The t_{west} tests the null hypothesis that a equals zero and b equals one.

The estimate of b from Table 6 is 0.854. The West ajusted statistic do not allow us to accept the hypothesis of b=1. As discussed before, this condition is consistent with a strict interpretation of the government's intertemporal budget constraint but it is inconsistent with the government's ability to market its debt in the long run.

Finally, we test whehter the budget deficit is stationary. This test is related to a test of b=1, because the budget deficit constrains the parameters of the cointegrating regression to be a=0 and b=1. The results (Table 7) are consistent with the ones obtained before. The budget deficit is non stationary, and the intertemporal budget constraint is violated.

Table 7
Tests for the Stationarity of the Deficit

Statistics	
$\tau_{c,t}$	-1.35 (0)
τ_{c}	-1.21 (0)
τ	-1.05 (0)

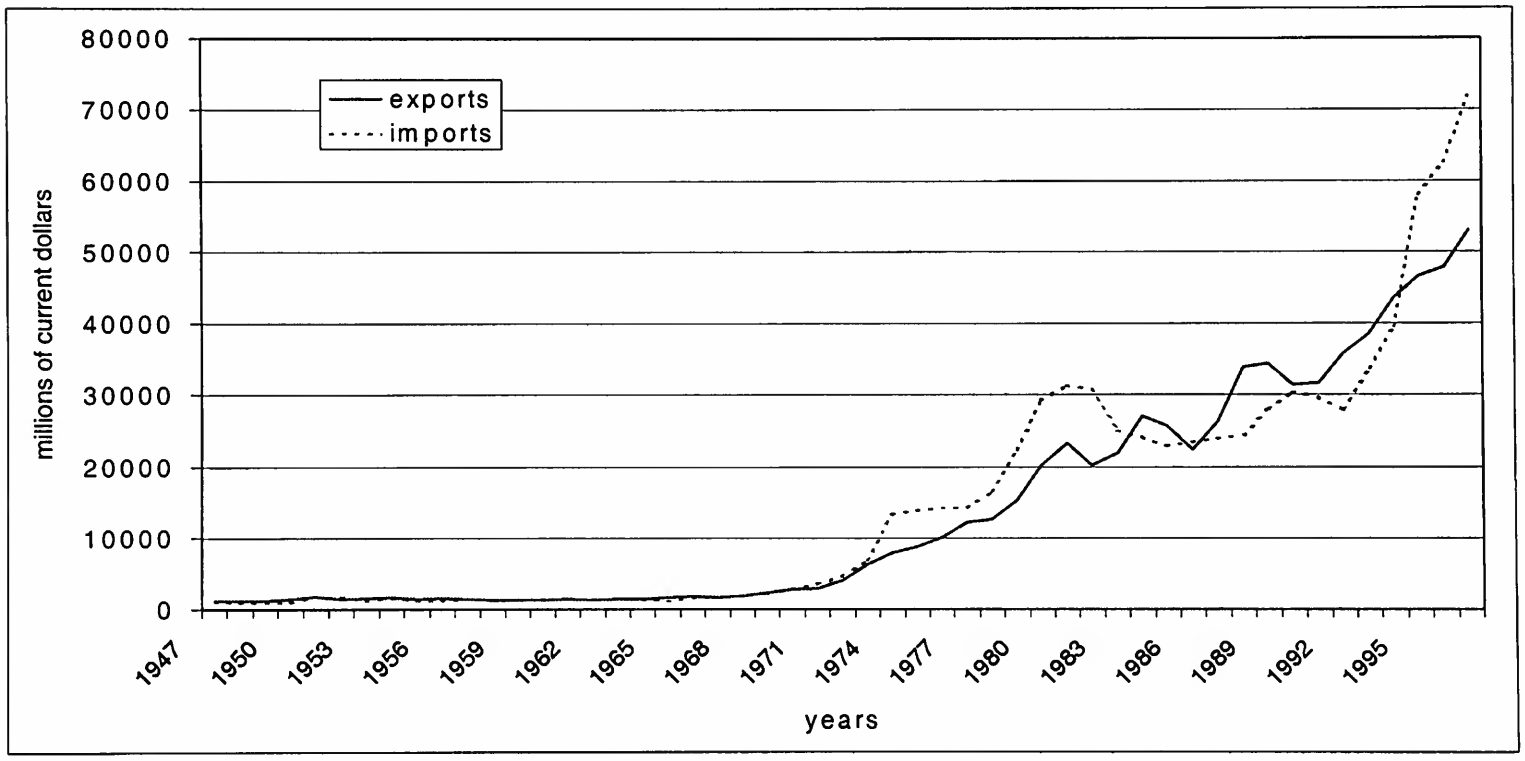
Notes: $\tau_{c,t}$ is the statistic based on a Dickey-Fuller regression including a constant and a trend, τ_c is the statistic based on a Dickey-Fuller regression including just a constant, and $\tau$is the statistic based on a Dickey-Fuller regression with no constant or trend.

Asymptotic critical values at the 5% level are –3.41, -2.86, and –1.95 for τ_{ct}, τ_c, and τ respectively.

5 Testing for intertemporal budget balance in the presence of regime changes

The results obtained before suggest that the Brazilian current account is nonstationary, and therefore that Brazil is violating its intertemporal budget constraint. They also imply that current deficits are not sustainable, since there is a possibility that they could grow without limit. Looking at Figure 1, we observe that exports and imports tracked each other relatively close till 1977. However, after that they began to grow at very different rates (at first imports were greater than exports, then exports were greater than imports, and in the 90s the situation reverses again). Several events during the 80s, including two huge devaluations of the Brazilian currency, suggest that a structural break in the deficit process may have taken place.[16] Unless such a shift is taken into consideration, the results of these tests for intertemporal external balance would be invalid.

Brazilian Exports and Imports



Following Tanner and Liu (1994) we model this change as a one-time upward shift in the constant component of the deficit (a). As we have seen before, assuming that exports

16 Another structural point would be the beginning of the 90s, when the liberalization of trade in goods and services and direct investment started to take place. We do not have enough observations, however, to test if it represents a significant break.

and imports plus interest payments follow a random walk with drifts α_1 and α_2 respectively, from an infinite-horizon budget constraint, it can be shown that $a = [\alpha_1 - \alpha_2] / r = \delta / r$ Formally, a can be interpreted as a constant component of the limiting present value of the debt. The break may be modelled as a shift in a to a^D It is assumed that this shift is not known until the break date. This assumption implies the existence of two different infinite-horizon budget constraints: one conditional on information available prior to the break date, and one conditional on information available after the break date. Given the first constraint, the estimating equation is $X_t = \delta / r + bMM_t + e_t$ for t less than the break date, where δ / r is the limiting present discounted value term conditional on information available before the break date. The second constraint gives the estimating equation $X_t = \delta^D / r + bMM_t + e_t$ for t greater than or equal to the break date, where δ^D / r is the limiting present discounted value conditional on information available after the break date. Combining these two equations we obtain

$$X_t = a + a^D D_t + bMM_t + \varepsilon_t$$

We still have to choose the date of break. We follow Christiano's (1992) procedure to determine the break date. Since his test is univariate, we again impose the restriction b=1 in the cointegrating equation. More precisely, the following equation is estimated:

$$\Delta DEF_t = \alpha + \alpha^D D_t + \gamma DEF_{t-1} + \sum_{i=1}^{I} \pi_i \Delta DEF_{t-1}$$

where I is the number of lags used.

We estimate the above equation with the dummy defined as D^{K_t} =0 for all t=1,.., K-1 and 1 otherwise, where K includes all dates in the sample except the first and last 15% of observations. For each value an F-test for α^D=0 is performed. The value of K which gives the maximal value of the F-test sets the correct break date. Non-stationarity tests on the coefficient of DEF_{t-1} based on each value of K are also performed. Results for these tests are summarized in Table 8. The standard critical values for the F-test and non-stationarity tests are, however, no longer valid. Using 52 observations, the 90% and 95% critical values obtained by Tanner and Liu (1994) are 16.043 and 18.227 respectively.[17]

17 Tanner and Liu (1994) follow Christiano (1992) to construct the set of critical values that account for the pre-test and the number of observations. They claim that their critical values are close to Christiano's.

Table 8
Stationarity with Structural Break

$$\Delta DEF_t = \alpha + \alpha^D D_t + \gamma DEF_{t-1} + \sum_{i=1}^{3} \pi_i \Delta DEF_{t-1}$$

Test Statistic	
Break date [a]	1982
F-test for break [b]	13.469
Stationarity test	-1.106

Notes: a Break date is date at which F-statistic testing for a=0 in regression equation is maximized

b The F-statistic tests the hypothesis of a=0.

The results reveal a break date of 1982. However, the F-test and the stationarity test are not significant. Once again, it is not possible to reject the null hypothesis of non-stationarity. Thus, even when a break in the deficit process in 1982 is accounted for, conditions for intertemporal external balance are not satisfied.

6 Concluding remarks

Despite the recognition that what matters it the ability of a country to repay its debt in the long run, that is, its intertemporal solvency, the size and duration of the recent Brazilian current account deficits have raised concern.

The purpose of this paper is to investigate whether Brazil is violating its intertemporal external balance, or in other terms, whether the external debt is growing without limit. Econometrically, this unbounded growth of the debt corresponds to a non-stationary deficit or to the absence of a cointegrating relationship between imports, including interest payments, and exports. Our results suggest that the solvency conditions are not satisfied, and Brazil seems to have an external insolvency problem. We found a break in 1982 that could possibly have changed the underlying process of the debt. The break, though, does not seem significant and even when it is accounted for the results remain the same. Ponta (1996) and Sawada (1994) find similar results, although they do not test for a structural break.

In January 1999 the exchange rate regime collapsed after a speculative attack that dramatically reduced the foreign exchange reserves. Some economists believed that the external crises was simply the result of a irrational panic and a contagion effect. Other economists, on the other hand, believed that the current account was in disequilibrium and that the speculative crisis could have been easily predicted. More precisely, insolvency appears to be the ultimate force underlying the collapse of the exchange rate. Our results seem to indicate that the present value external constraint does not hold, and that the recent Brazilian current account deficits should be troublesome.

Two courses for future research seem promising. The first one is to explore the notion of current account sustainability established by Milesi-Ferreti and Razin (1996a, 1996b) that takes into account willingness to pay and willingness to lend in addition to the intertemporal solvency analysis. They compare a sample of countries (some were able to sustain persistent current account imbalances and some were not) in order to identify the major determinants of current account sustainability. The most important indicators, considering their samples (which do not include Brazil), seem to be 1) the size of the export sector and the level of international competitiveness 2) the burden of external debt service (adjusted for growth and real exchange rate changes) 3) the level of domestic savings 4) the composition of external liabilities 5) the strength of the financial system, and 6) the degree of political stability. The second one is to verify if the Brazilian current account balances are "excessive" by comparing actual imbalances to the "equilibrium" path of external imbalances or the imbalances predicted by theory (see for example, Ghosh and Ostry, 1995).

References

Ahmed, S. and Rogers, J. H. Government budget deficits and trade deficits: are present value constraints satisfied in long-term data? *Journal of Monetary Economics*, 36, p. 351-74, 1995.

Christiano, L. J. Searching for a break in U.S. GNP. *Journal of Business and Economic Statistics*, p. 237-50, July 1992.

Corsetti, G., Pesenti, P. and Roubini, N. *What caused the Asian currency and financial crisis*? Part I: Macroeconomic overview and Part II: The policy debate. 1998a.

_____. *What caused the Asian currency and financial crisis?* Part II: The policy debate. 1998b.

_____. *Fundamental determinants of the Asian crisis: a preliminary empirical assessment.* 1998c.

Engle, R. F. and Granger, C. W. J. Co-integration and error correction: representation, estimation, and testing. *Econometrica*, p. 251-76, March 1987.

Ghosh, A. R. and Ostry, J. D. The current account in developing countries: a perspective from the consumption smoothing approach. *The World Bank Economic Review* v. 9, n. 2, p. 305-33, 1995.

HakKio, C. S. and Rush, M. Is the budget deficit "too large"? *Economic Inquiry*, p. 429-45, 1991.

Hamilton, J. D. and Flavin, M. A. On the limitations of government borrowing: a framework for empirical testing. *American Economic Review*, 76, p. 353-73, 1986.

Husted, S. The emerging U.S. current account deficit in the 1980s: a cointegration analysis. *The Review of Economcs and Statistics*, p. 159-66, 1992.

Johansen, S. Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, p. 231-54, June 1988.

Kaminsky, G., Lizondo, S., and Reinhart, C. M. Leading indicators of currency crisis. *IMF Staff Papers*, March 1998.

Milles-Ferretti, G. M., and Razin, A. Sustainability of persistent current account deficits. *NBER Working Paper*, n. 5467, 1996a.

_____. Current account sustainability: selected East Asian and Latin American experiences. *NBER Working Paper*, n. 5791, 1996b.

Obstfeld, M. and Rogoff, K. *Foundations of international macroeconomics.* Cambridge, MA: MIT Press, 1995.

Ponta, A. F. A sustentabilidade do endividamento externo no Brasil: uma análise de co-integração. *Pesquisa e Planejamento Econômico*, v. 26, n. 3, p. 399-416, 1996.

Sawada, Y. Are the heavlily indebted countries solvent?: tests of intertemporal borrowing constraints. *Journal of Development Economics*, v. 45, p. 325-37, 1994.

Tanner, E. and Liu, P. Is the budget deficit "too large"?: some further evidence. *Economic Inquiry*, p. 511-18, July 1994.

Trehan, B. and Walsh, C. E. Testing intertemporal budget constraints: theory and applications to U.S. federal budget and current account deficits. *Journal of Money, Credit, and Banking*, v. 23,

p. 206-23,1991.

_____. Common trends, intertemporal budget balance, and revenue smoothing. *Journal of Economic Dynamics and Control*, p. 425-44, June 1988.

West, K. Asymptotic normality, when regressors have a unit root. *Econometrica*, 56, p. 1397-1418, 1988.

Wilcox, D. W. The sustainability of government deficits: implications of the present-value borrowing constraint. *Journal of Money, Credit, and Banking*, 21, p. 291-306, 1989.