Current account balance and the real exchange rate: the Brazilian case in the last two decades

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ABSTRACT

This paper focus on the existence of a long-term equilibrium between real exchange rate and current account balance. It applies a structural model to understand the relationship among the movements of current account deficit, real exchange rate, national income and world trade. Thus, it will be possible to test for a long-run relation among these variables movements as well as the short-term disequilibrium effects on the current account deficit. The empirical part of this paper applies the Johansen procedure with the objective to find cointegration relations among the variables mentioned. This analysis will permit to separate long- run relation from short-term dynamics in such a way as to permit to understand the impact of shocks on the equilibrium relation among the variables.

Key words: exchange rate, Real Plan, stabilization, trade deficit.

RESUMO

Este estudo analisa a existência de um equilíbrio de longo prazo entre a taxa real de câmbio e a conta de transações correntes do balanço de pagamentos. Foi aplicado um modelo estrutural para entender a relação entre o déficit em transações correntes, taxa real de câmbio, renda nacional e comércio mundial. Assim, foi possível testar a relação de longo prazo entre essas variáveis bem como os efeitos do desequilíbrio de curto prazo no déficit em conta corrente. A parte empírica aplica a metodologia de Johansen com o objetivo de encontrar as relações de cointegração entre as variáveis mencionadas. Esta análise permite separar a relação de longo prazo da dinâmica de curto prazo de modo a permitir o entendimento do impacto de choques no equilíbrio dessas variáveis.

Palavras-chave: taxa de câmbio, Plano Real, estabilização, déficit comercial.

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1 Introduction

The relationship between the exchange rate and the current account balance has been an important topic of empirical research. Recent events in the world economy beginning with the Mexican crisis of 1994 and followed by the Asian turmoil of 1997 and the Russian default on the domestic and foreign debt in 1998, led to additional questioning about devaluation of currencies as a tool to correct trade unbalances. The preoccupation in the literature has been with each issue separately. Many studies on the exchange rate have only relied upon the purchasing power parity conditions.(Abuaf and Jorian, 1990; Cheung and Lai, 1993; Baxter, 1994; Alves, Cati and Fava, 1997· Edison, Gagnon and Melick, 1997; and Lothian, 1997)

The overvaluation of the Brazilian currency increased sharply after the 1994's "Real Plan", due to the use of a exchange rate "anchor" to curb inflation. Similar to other stabilization attempts based on the exchange rate, the current account deficit soared leaving the country vulnerable to speculative capital movements.

Brazil in recent months appeared as one more emerging market entering in the turmoil of currency confidence. From September 1997 to November 1997 close to US$ 30 billions were spent to defend the currency against speculative attacks. The preoccupation with current account balance and exchange rate entered the research agenda. The determination of the real exchange rate and trade balance became an important issue to be addressed as trade unbalance and exchange rate overvaluation entered the political and economic debate. The down turn in stock exchange market prices and short term capital movement have led to increasing worries about the capacity of Brazil and other Latin American countries to defend their currencies. The capital inflow requirements to close huge deficits in current account were reaching insurmountable magnitudes. Developed countries, worried with possible impediments to trade, started to make arrangements to supply the necessary capital inflow to finance the external deficits under an agreement with the IMF, under the traditional conditionalities necessary to cut excess demand for foreign exchange and to maintain exchange rate policies in such a way as to prevent large movement in exchange rates.

In the research arena a recent work by Pastore, Blum and Pinotti (1998) attempts to shed light on the exchange rate impact on trade deficit looking on short run movements of real exchange rate and its impact on Brazilian trade.

This paper focus on the existence of a long-term equilibrium between real exchange rate and current account balance. Specifically, it applies a structural model to understand the

relationship among the movements of current account deficit, real exchange rate, national income and world trade. Thus, it will be possible to test for a long-run relation among these variables movements as well as the short-term disequilibrium effects on the current account deficit.

The empirical part of this paper applies the Johansen procedure with the objective to find cointegration relations among the variables mentioned. This analysis will permit to separate long- run relation from short-term dynamics in such a way as to permit to understand the impact of shocks on the equilibrium relation among the variables.

2 Current account balance and the real exchange rate

Brazil started to face growing current account deficits after 1994. It coincides with the beginning of the stabilization program which was based in the exchange rate overvaluation to keep inflation down. As a price stabilization program the Real Plan, as it became known, was a success. For the first time in fifty years inflation rates were bellow the two digit mark. However current deficits soared. Figure 1 presents the current account deficit and the real exchange rate behavior. It is possible to observe a down turn of real exchange rate followed by a growing current account deficit after the middle of 1994.

Figure 1 shows a pattern of current account balance and real exchange rate where deficits coincides with appreciation of the currency. Starting in the third quarter of 1994 the deficit was growing and the currency was appreciating. Before that, Brazilian current account was characterized by surpluses with short periods of deficits of small magnitude It is clear that after the Real Plan, the Brazilian current account presented growing deficits and at the same time the exchange rate appreciated when compared to the exchange rate before the third quarter of 1994.

Under quasi-fixed exchange rate - the main anchor for the stabilization program - the necessary foreign capital requirements grew steadily and high domestic interest rates were the tool to maintain a steady inflow of foreign capital. The program ran smoothly until the Mexican crisis of 1994 when some adjustment in the stabilization program was implemented. Domestic interest rate went up and some restriction on imports were imposed. The nominal exchange rate was devaluated at a faster rate but still not enough to compensate for the difference between domestic and external inflation rate. The second round of problems began with the Asian and Russian exchange rate crisis of 1997/1998. The successive exchange rate crisis in emerging countries brought about a reshuffling of capital movements due to increasing risk of currency devaluation.

Figure 2 presents a schematic view of the current account of Brazil's balance of Payment. txc_0 can be interpreted as the exchange rate after the Real program. It is an exchange rate out of equilibrium. The equilibrium exchange rate is txc_1^e
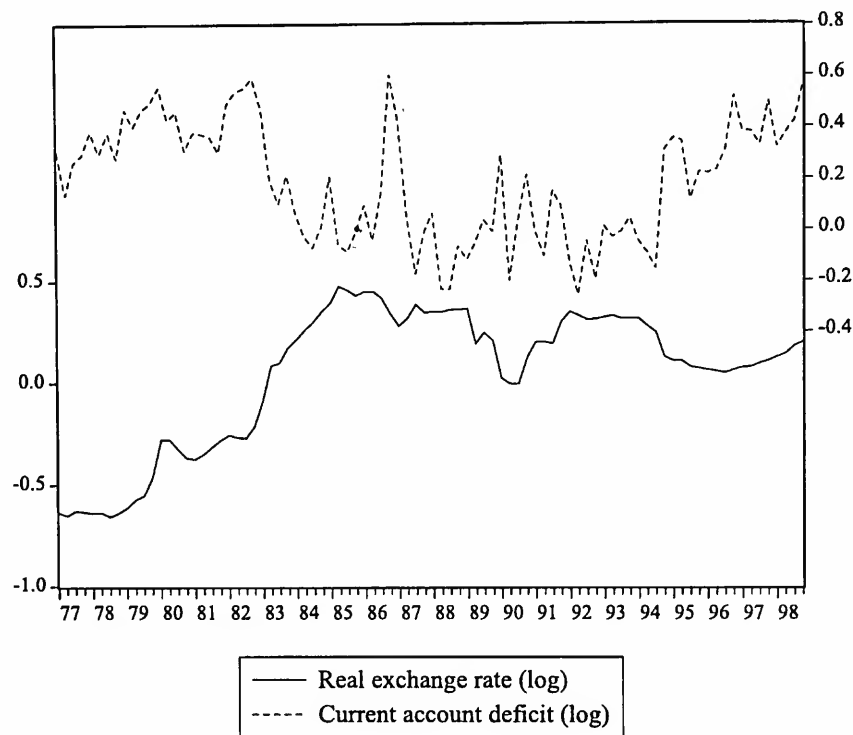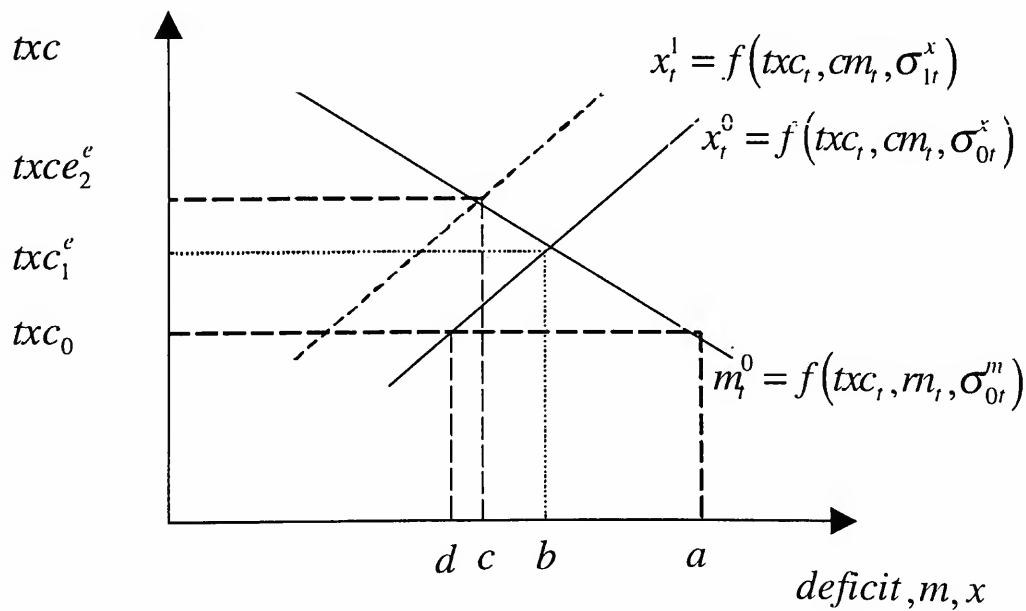
Figure 1

Real exchange rate (log)
---- Current account deficit (log)

Figure 2

$$x_t^1 = f\left(txc_t, cm_t, \sigma_{1t}^x\right)$$

$$x_t^0 = f\left(txc_t, cm_t, \sigma_{0t}^x\right)$$

$$m_t^0 = f\left(txc_t, m_t, \sigma_{0t}^m\right)$$

At the txc_0 exchange rate the demand for foreign exchange is larger than the quantity supplied by the da amount. Before July 1994 the exchange rate was closer to the equilibrium exchange rate. The stabilization program brought an increasing overvaluation of the currency. The result was increasing deficits in current account. Before the Mexican crisis there were enough financial capital to finance the current account deficits and at the same time reserves were increasing. But the advent of the international crises in Asia and Russia increased the risk of devaluation and capital losses in emerging markets and led to the need for very high domestic interest rate in order to attract foreign capital to finance the current account deficit. Beginning in September of 1998, the outflow of foreign capital started to be larger than the inflow, reducing foreign reserves and leading to a IMF rescue package in order to reestablish the confidence in the Brazilian currency. In Figure 2 this new situation is depicted by the shift in the supply if foreign exchange from x_t^0 to x_t^1 This movement can be interpreted as if the argument of the supply of foreign exchange, σ_t had shift. This shift is given by the movement of σ_t, from σ_t^0 to σ_t^1 The net outcome of the world financial markets turmoil can be interpreted by the movement of the supply of foreign currency from x_t^0 to x_t^1 due to an increase in risk leading to a smaller quantity of foreign currency to be supplied for the same exchange rate and same level of interest rate. In Figure 2 this result is represented by a higher current account deficit for the undoing and still overvalued exchange rate and for the same level of interest rate. The recent past has shown that there is a limit for the effectiveness of interest rate rising to cope with current account deficits in a high-risk environment. The IMF agreement seems to confirm this hypothesis. High interest rate is a strong tool to reduce domestic demand and thus to lower import demand; however, it seems to be ineffective after a certain level to attract foreign capital   Figure 2 is an exercise in comparative static. It has no dynamics. It helps to understand reality but it assumes that only one variable would change at each time. The reality is dynamic. The nominal exchange rate moves, as well as domestic and external prices. World commerce, represented by the cm_t variable as well as the domestic income represented by the rn_t variable also move, in general rising their values over time. The new equilibrium exchange rate is given by txc_2^e which shows a higher equilibrium exchange rate than the original one. At this new equilibrium the deficit would be higher than the starting one, *da*. After the adjustment to the new external market conditions the deficit will rise to *fa*. One might ask if this deficit is too large. The answer to this question is very simple and there is another question: Is there a way to finance it sustainable? If there is a way it is not too large. In other words if at a reasonable level of interest rate there is a way to finance the current account deficit without increasing the Brazilian external vulnerability, then it is not too large. In the

Brazilian case it seems that the ceiling for interest rate has been reached and there is no way to finance current account deficit - in the short run - outside the IMF framework.

Another obvious tool that can be used to curtail current account deficit is trough exchange rate devaluation. It is clear in Figure 2 that a change in real exchange rate to make it closer to the equilibrium exchange rate txc_2^e, would reduce the current account deficit to a manageable amount. The deficit can even disappear when the equilibrium exchange rate is reached. It seems a sensible policy to be followed however there are strong arguments against exchange rate devaluation.

The real exchange rate is defined as the nominal exchange rate times the foreign price level and divided by the domestic price level. Under the assumption that price levels - external and domestic- are given, a nominal depreciation of the currency will lead to depreciation in real terms of the Real. A depreciation of the real exchange rate affects the trade balance and the current account balance through the following mechanism:

Decrease in import expenditure: depreciation makes foreign goods more expensive in the domestic market leading to a shift in domestic demand toward the domestic goods and way from imports. The relative price of imports increases and domestic income decreases, both reducing imports.

Increase in export revenue: the change in relative prices, will make domestic goods relatively cheaper abroad making foreigners to buy more domestic goods. In other words it improves the competitiveness of the domestic goods abroad. Besides that, the reduction of the domestic absorption will lead to higher exports ("vent for surplus" type of result).

Service payments abroad decrease, since now, profits, dividends, international travels and other remittances to the rest of the world are more expensive in the domestic currency.

The model up to now do not take into account the dynamic of the adjustment of the current account balance following a real depreciation of the exchange rate. It is time to introduce it. Let us return to the effects of the exchange rate devaluation on the current account balance. If the Marshall-Lerner condition[1] holds, devaluation would lead to an improvement in the current account balance. But these effects are not instantaneous. They

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1   See Blanchard (1997).

take time. For instance, let us look at the possible dynamic effects of a 10% devaluation of the exchange rate in Brazil. In the first months following the depreciation, the effects of the depreciation is likely to reflect much more in prices than in quantities.[2] The domestic prices of imports would go up and the price of Brazilian exports in abroad would go down measured in foreign currency. But the quantity of exports and imports is likely to adjust at a slower pace: it takes some time for consumers to realize that relative prices have changed, it takes a while for firms to find cheaper suppliers and so one. Thus depreciation might in the beginning lead to a deterioration of the current account balance; txc changes, but neither x or m adjusts very much initially, leading to an increase in the deficit.

As time goes on, the effects of the changes in the relative prices of imports and exports became stronger. The response of the quantities of exports and imports eventually becomes stronger than the adverse price effects and the overall result of the depreciation is to reduce the current account deficit. In Figure 1 it can be seen that the real exchange rate has similar movement than the external deficit: the appreciation was associated with a large deterioration of the current account balance after July of 1994 when the Real stabilization program started, and the depreciation after 1983 was followed by the accumulation of current account surplus. The response of the external deficits to changes in real exchange rate is not necessarily instantaneous. Lags in the response of the external deficits to changes in real exchange rate are usual. The empirical part to be presented next is an attempt to introduce dynamics in the analysis of the current account deficit and the exchange rate as a tool to promote adjustment in the Brazilian Balance of Payment.

3 Empirical evidence

The empirical verification of a long-term equilibrium relationship among the variables related to the balance of current account is achieved by means of cointegration analysis. The variables considered here are:

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2   The price of imported goods may not go up by the full amount of the exchange rate devaluation. The importers may have contracts to deliver at some agreed upon real price, they might decide to pass along only a part of the real depreciation and take a reduction on their profit margins. The same logic is valid for exports. We abstract from these problems in this paper.

DEF_t - the deficit in current account is the ratio of the exit of exchange values (goods and services imported plus unilateral transferences) to the entrance of exchange values (goods and services exported plus unilateral transferences);

RER_t - the real exchange rate that corresponds to the nominal rate deflated by IPC-Fipe and inflated by the American CPI;

GDP_t - the Brazilian gross domestic product;

WTR_t - the amount of international trade of the rest of the world.

As there are more than two variables, the procedure proposed by Johansen (1988) will be used, instead of that presented previously by Engle and Granger (1987).

The Johansen method applies to a vector X_t that contains N variables integrated of order 1 - $X_t \sim I(1)$ - and there will, therefore, be cointegration if it is possible to obtain more than one and less than N linear combinations of these variables that produce a stationary series. In this case, vector X_t will be cointegrated of order (1,1) - $X_t \sim CI(1,1)$. Thus, to implement the procedure it is necessary to test the hypothesis that $X_t \sim I(1)$, that is, that all the series contained in the vector have a unit root. Once this condition is met, the existence of cointegrating vectors is tested.

In this article, $X_t = \{DEF_t, RER_t, GDP_t, WTR_t\}$ All variables are expressed in logarithms. Quarterly data was utilized and include the period that extends from the first quarter of 1977 to the last quarter of 1998. In order to check the eventual impact of the Real Plan on the long-term relationship among those variables, the period before its implementation is also analyzed.

To test the existence of a unit root, the ADF tests proposed by Dickey and Fuller (1979, 1981) and Said and Dickey (1984) were used. These tests consist in estimating equation (1) by ordinary least squares and the hypothesis of a unit root, indicated by H_0: $\gamma = 0$, is tested by means of the t-statistic referring to $\hat{\gamma}$:

$$\Delta y_t = \alpha + \beta t + \gamma \, y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-1} + \varepsilon_t \tag{1}$$

where y_t is the series whose stationarity is being tested and ε_t is a white noise. The estimator $\hat{\gamma}$ no longer has standard distribution and the appropriate critical values can be found in

Fuller (1976) and MacKinnon (1991). The intercept and trend can be excluded from equation (1) if they are not statistically significant.[3]

The application of the ADF test to the four series that compose vector X_t produced the results contained in Table 1. The intercept and trend were significant only for variable WTR. The appropriate number of lags (k) for each case was defined based on the significance of the highest lag, starting from $k\,max = 12$, and on the autocorrelation of the residuals.

Adopting a 5% significance level, the hypothesis of a unit root is not rejected for any of the variables analyzed. The next step is to verify whether they have only one unit root. For this, the procedure proposed by Dickey and Pantula (1987) is used, as the application of the ADF test to the first difference of the variables is not valid from the statistical viewpoint.

Dickey and Pantula (1987) adopt the 'general-to-specific' strategy. The first hypothesis to be tested is H_0: $d = r$, that is, there are at most r unit roots. Keeping in mind that the non-stationary economic series are, in general, integrated of order 1 or 2, it is reasonable to initiate the test taking $r = 2$. Thus, the first step has the following hypotheses: H_0: $d = 2$ and H_a: $d = 1$. To test them, equation (2) is estimated by ordinary least squares and the equivalent hypotheses become H_0: $\beta_1 = 0$ and H_a: $\beta_1 < 0$. The test statistic is t calculated for $\hat{\beta}_1$ here denominated t_1, and the critical values are the same utilized in the ADF test.

$$\Delta^2 y_t = \beta_0 + \beta_1 \Delta y_{t-1} + \varepsilon_t \tag{2}$$

If the null hypothesis is rejected, the last step of the procedure is to test H_0: $d = 1$ against H_a: $d = 0$. Equation (3) is now estimated and the hypotheses tested are H_0: $\beta_2 = 0$ and $\beta_1 < 0$ against H_a: $\beta_2 < 0$ and $\beta_1 < 0$. The test statistics are t calculated for $\hat{\beta}_1$ and $\hat{\beta}_2$, t_1 and t_2, respectively.

$$\Delta^2 y_t = \beta_0 + \beta_1 \Delta y_{t-1} + \beta_2\, y_{t-1} + \varepsilon_t \tag{3}$$

The results of the second step of the Dickey and Pantula test are also found in Table 1. In the first step, the hypothesis of two unit roots is rejected for all variables because the t_1

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3   Dickey and Fuller (1981) present the tests for a and b and the corresponding tables of critical values. Enders (1995) suggests a sequence for the realization of the tests with respect to the deterministic terms of equation (1).

statistics are lower than the corresponding critical values.[4] In the second step this result is maintained and the t_2 statistics are higher than the critical values, which leads to the non-rejection of the null hypothesis in this step, that is, the series in question have only one unit root.

<div align="center">

Table 1
Unit Root Tests

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series and	Augmented Dickey-Fuller test			Dickey-Pantula test	
period	model	lags	t statistics	t_1 statistics	t_2 statistics
DEF					
1977:1-1998:4	Without trend or intercept	3	-0.9656	-9.8880	-2.7217
1977:1-1994:2	Without trend or intercept	3	-1.4605	-9.3897	-2.1121
RER					
1977:1-1998:4	Without trend or intercept	10	-1.8436	-6.7338	1.5067
1977:1-1994:2	Without trend or intercept	10	-1.5713	-6.0467	1.5037
GDP					
1977:1-1998:4	Without trend or intercept	12	1.6797	-10.9113	-1.1585
1977:1-1994:2	Without trend or intercept	12	1.2192	-9.1309	-1.8309
WTR					
1977:1-1998:4	With trend and intercept	12	-3.3938	-17.8175	4.9269
1977:1-1994:2	With trend and intercept	12	-3.1456	-15.6008	4.4528

Note: The variables are expressed in logarithms. At the 5% significance level, none of the null hypotheses of one unit root are rejected and the null hypotheses of two unit roots are rejected. The critical values are from MacKinnon (1991).

Once the unit root tests indicated that vector X_t is $I(1)$, the hypothesis that its variables are cointegrated is tested, following the Johansen procedure, which begins with a VAR (Vector Auto-Regression) specification for X_t, as proposed by Sims (1980). Equation (4) represents a VAR(p) model

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \cdots + \Pi_p X_{t-p} + \Psi D_t + \varepsilon_t \qquad (4)$$

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4 The values of t_1 statistics were very similar to those obtained in the second step.

where D_t is a matrix of deterministic terms and ε_t is a vector with distribution $N_p(0,\Omega)$. Equation (4) can be rewritten as

$$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + \Gamma_{p-1} \Delta X_{t-p+1} + \Psi D_t + \varepsilon_t \qquad (5)$$

where $\Gamma_i = -\sum_{j=i+1}^{p} \Pi_j$, $i = 1, 2, ..., p\text{-}1$ and $\Pi = -\Pi(1)$

The cointegration issue is decided based on the rank of Π. There are three possible situations: *i)* if $0 < [\text{rank}(\Pi) = r] < N$, the variables in X_t cointegrate; *ii)* if $\text{rank}(\Pi) = 0$, there is no cointegration; *iii)* if $\text{rank}(\Pi) = N$, the variables in X_t are not I(1), as initially supposed, but rather stationary.

Johansen (1988) proposed an estimator of maximum likelihood for the factorization of Π, subject to the restriction that the matrix has reduced rank. Supposing that D_t contains only the intercept and trend , equation (5) can be expressed as

$$\Delta X_t = -\alpha\beta' X_{t-1} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + \Gamma_{p-1} \Delta X_{t-p+1} + \mu + \delta t + \varepsilon_t \qquad (6)$$

where $\mu = \alpha\mu_1 + \alpha_\perp\mu_2$ and $\delta = \alpha\delta_1 + \alpha_\perp\delta_2$; β is a matrix (N x r) that contains in its columns the cointegrating vectors and a is the adjustment matrix, also (N x r). Equation (6) is known as VEC (Vector Error Correction) model.

The rank of Π is equal to the numbers of eigenvalues different from zero given by

$$\left| \lambda S_{11} - S_{10} S_{00}^{-1} S_{01} \right| = 0 \, , \quad S_{ij} = T^{-1} \sum_{t=1}^{T} R_{it} R_{jt}' \text{ for i, j = 0, 1, } R_{0t} \text{ and } R_{1t} \text{ are, respectively, the}$$

residuals of the regressions of X_t and X_{t-1} against $\Delta X_{t-},\Delta X_{t-2},...,\Delta X_{t-p+1}$ [5] Putting the eigenvalues in increasing order ($\hat{\lambda}_1 > \hat{\lambda}_2 > \cdots > \hat{\lambda}_N$), the corresponding eigenvectors are $\hat{W} = \{\hat{W}_1, \hat{W}_2, \cdots \hat{W}_N\}$ normalized by $\hat{W}'S_{11}\hat{W} = I$ The estimator of maximum likelihood of β is then given by $\hat{\beta} = \{\hat{W}_1, \hat{W}_2, \cdots, \hat{W}_r\}$ and that of the adjustment matrix α is $\hat{\alpha} = -S_{01}\hat{\beta}$

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5   For more details on the procedure, consult Johansen (1988, 1995).

Two cointegration tests are formulated by Johansen. The first tests the hypothesis that there are at most r cointegrating vectors; the test statistic, called the trace statistic, is given

by $\eta(r) = -T \sum_{i=r+1}^{N} \ln(1 - \hat{\lambda}_i)$ In the second test, the hypothesis is that there are exactly r cointegrating vectors; the test statistic, now referred to as the maximum eigenvalue, is

$\zeta(r) = -T \ln(1 - \hat{\lambda}_{r+1})$ The critical values for both tests were tabulated by Johansen (1988), Johansen and Juselius (1990), and Osterwald-Lenum (1992).

Therefore, according to the Johansen procedure, the variables in $X_t = \{DEF_t, RER_t, GDP_t, WTR_t\}$ will be cointegrated if there is at least 1 and at most 3 cointegrating vectors.

Before applying the cointegration test to the series in analysis, the models orders were determined by means of the estimation of VAR's of orders varying from 1 to 6. The Schwarz and Hannan-Quinn information criteria as well as the joint significance test of the coefficients associated to the largest lag of X present in each model[6] selected p = 3 as the most appropriate order for the VAR for both periods. However, the residuals were not normally distributed, particularly due to an outlier in the *DEF* series. This outlier occurred in the fourth quarter of 1986 and first quarter of 1987, due to a drastic reduction in the amount of exports. It was decided then to place a dummy variable to capture the outlier effect. When redoing the estimation of the VAR models, the problem of non-normality of the residuals had been corrected and the models orders indicated by the criteria mentioned continued to be 3. So, the models with dummy were adopted, keeping in mind that the critical values of the cointegration tests are no longer completely valid when the model has deterministic variables other than the intercept and trend.

The inclusion of the intercept and trend was defined based on the *Pantula principle*.[7] The specification selected has only the intercept within the cointegrating vector.

The results referring to the model for 1977:1 to 1998:4 are found in Table 2. Neither the trace statistic nor the maximum eigenvalue reject the existence of one cointegrating vector at the 1% significance level. For the 1977:1-1994:2 period, the results can be observed in Table 3. In the latter period, the maximum eigenvalue statistic does not reject the hypothesis of only one cointegrating vector at the 1% significance level, while the trace statistic leads to the existence of two cointegrating vectors at the 5% significance level.

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6   See Hatanaka (1996) and Lütkepohl (1991).

7   See Harris (1995).

Table 2
Johansen Cointegration Test - 1977:1 to 1998:4

Ho: there are r		test statistics	
cointegration vectors	eigenvalue	Maximum eigenvalue	Trace
$r = 0$	0.370091	39.29**	64.54**
$r \leq 1$	0.140664	12.39	24.95
$r \leq 2$	0.085567	7.60	12.56
$r \leq 3$	0.054555	4.96	4.96

Note: ** denotes the rejection of H_o at the 1% significance level. The critical values are from Osterwald- Lenum (1992).

Table 3
Johansen Cointegration Test - 1977:1 to 1994:2

Ho: there are r		test statistics	
cointegration vectors	Eigenvalue	Maximum eigenvalue	Trace
$r = 0$	0.443546	39.27**	76.83**
$r \leq 1$	0.269756	21.06	37.56*
$r \leq 2$	0.151211	10.98	16.50
$r \leq 3$	0.078998	5.51	5.51

Note: * and ** denote the rejection of H_o at the 5% and 1% significance level, respectively. The critical values are from Osterwald-Lenum (1992).

The cointegration tests indicate, therefore, that there is a long-term equilibrium relationship between the current account deficit, real exchange rate, gross domestic product, and the international trade of the rest of the world, in both periods analyzed.

The cointegrating vectors, normalized for the variable DEF, as well as the adjustment coefficients are reproduced in Table 4. All the components of the cointegrating vector present the expected sign: increases in the real exchange rate and in the international trade of the rest of the world lead to a reduction in the current account deficit, while an increase in the gross domestic product exerts the opposite effect. All are also significant at the 1% level. As can be seen, the implementation of the Real Plan, anchored in the exchange rate, did not cause substantial changes in the cointegration vector.

Table 4
Standardized Eigenvectors and Coefficients of Adjustment

series	1977·1 to 1998:4		1977:1 to 1994:2[#]	
	β	α	β	α
DEF	1.0000	-0.2567	1.0000	-0.3209
RER	0.8158	0.0719	0.8919	0.1060
GDP	-2.2389	0.0119	-2.7915	0.0241
WTR	0.4128	-0.0100	0.5727	-0.0198
constant	4.8196		5.2695	

[#] First cointegration vector.

Weak exogeneity tests[8] performed for the variables in X_t did not reject the hypothesis that only GDP and WTR are weak exogenous. Therefore, the short-run adjustments to deviations from the long-run relationship are achieved by means of both DEF and RER. The speed of adjustment in higher for the variable DEF and for the period before the Real Plan. As RER is not weak exogenous in relation to DEF, it is not correct to estimate a model for this variable, conditional on RER, as done in various empirical works.

It is worth stressing that the values of the coefficients of the cointegrating vector should not be interpreted directly as a measure of the impact of the innovations of each variable isolated from the rest. As Lütkepohl (1991) states, these coefficients do not take into account the relationships between the variables, expressed in the VAR model. Thus, a more appropriate way to evaluate the impact of the innovations is given by the impulse response function.

Figures 3 and 4 show the impacts on the current account deficit provoked by the increase in the standard deviation in the innovations of the other variables.[9] A positive shock in the real exchange rate reduces the deficit permanently. The increase of the gross domestic product also has a permanent effect, but in the opposite sense. However, positive shocks in the international trade of the rest of the world initially reduce the deficit, but this effect tends to be extinguished with time.

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8   See Engle, Hendry and Richard (1983) and Johansen (1992).

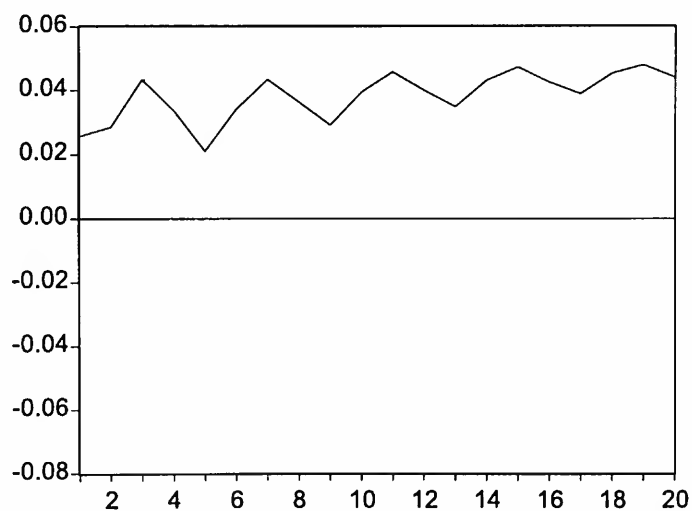9   The variables were ordered in different ways for the construction of the impulse response function but the results have not changed significantly.

Figure 3
Impulse Response Functions - 1997:1 to1998:4

Response to One S. D. Innovations
Response of LDEFICIT to LCREAL
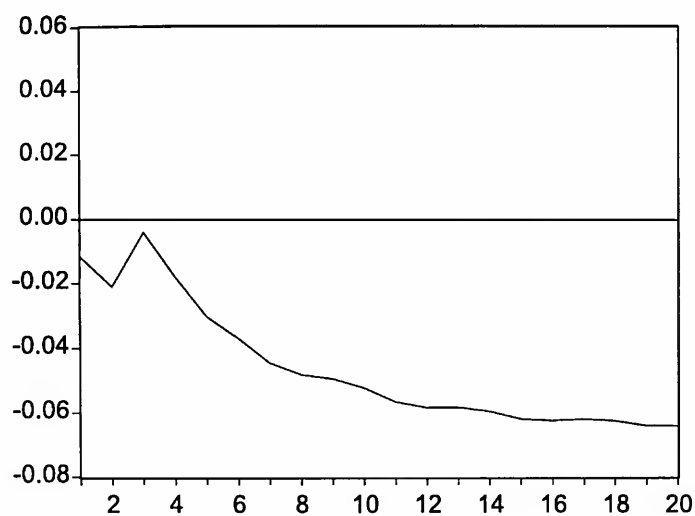
Response of LDEFICIT to LPIB

Response of LDEFICIT to LCOMUNDO

Figure 4
Impulse Response Functions – 1997:1 to1994:2

Response to One S. D. Innovations
Response of LDEFICIT to LCREAL

Response of LDEFICIT to LPIB
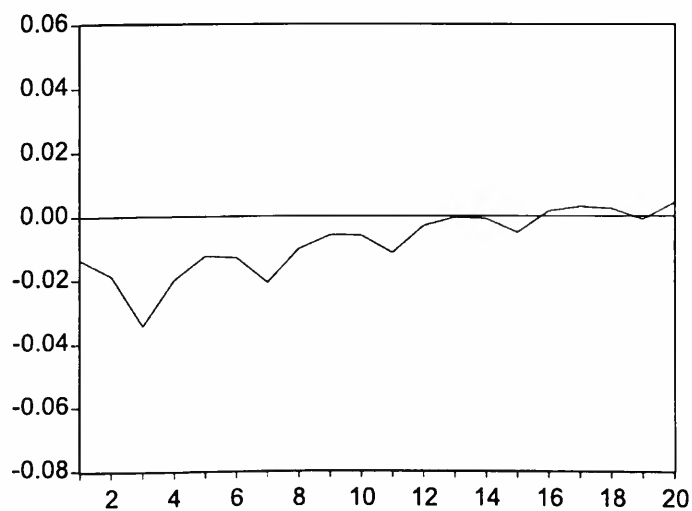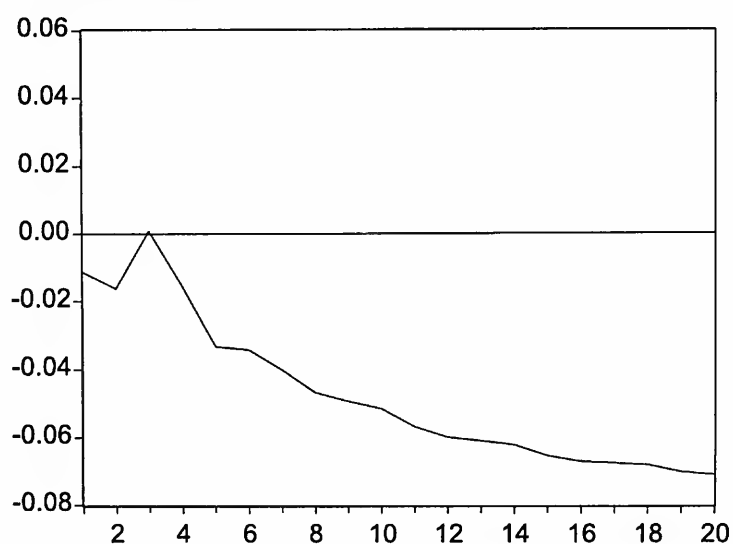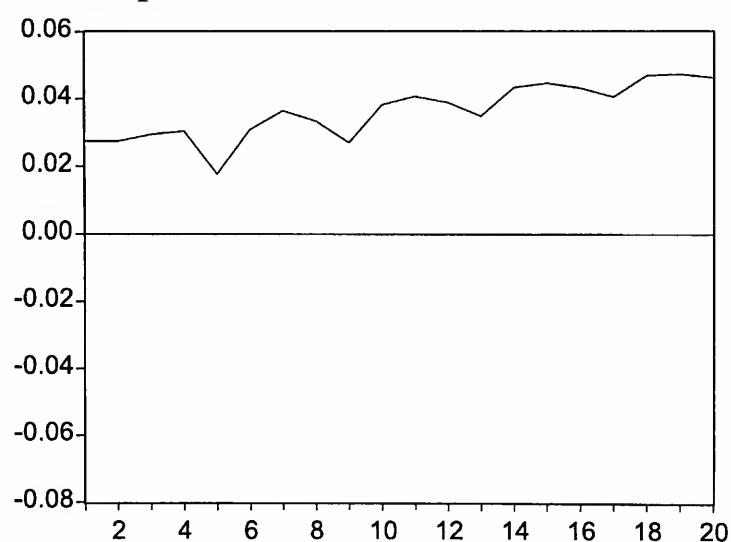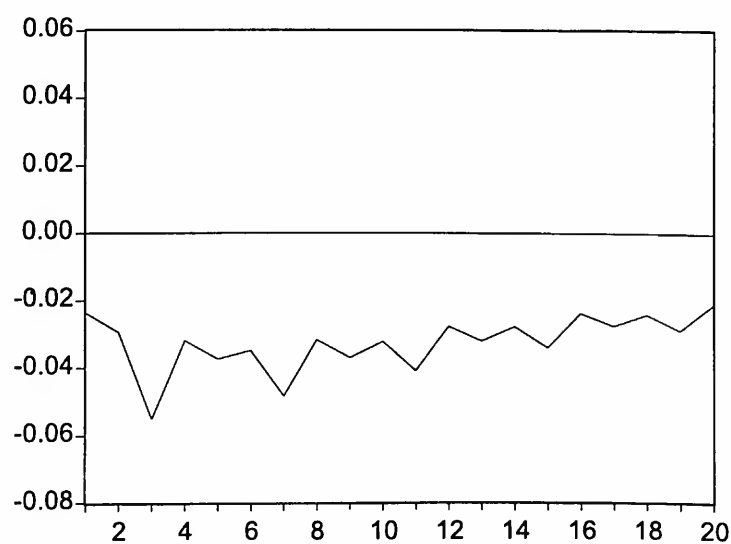

Response of LDEFICIT to LCOMUNDO

4 Conclusions

The relationship between current account deficit and real exchange rate was discussed in this paper.

In the first part we concluded that the exchange rate devaluation might improve the current account balance. However, the dynamics towards equilibrium might be complex. For instance, the devaluation might lead initially to an increase in current account deficit and after a while current account deficit might improve.

In the empirical section the dynamics was introduced in the analysis of the Brazilian case. We applied the Johansen procedure in order to check the existence of a long-term relationship among current account deficit, real exchange rate, gross domestic product and international trade of the rest of the word. We concluded that these variables cointegrated in both period considered.

The impulse response functions indicated that in the first moments the devaluation of the Brazilian currency increases the current account deficit. However, after two quarters, it contributes to a permanent reduction in the current account unbalance. The implementation variables considered. The estimated cointegrating vectors and the impulse response functions estimated for the 1977:1-1998:4 period and for the period before that Plan do not indicate any change in the dynamics of adjustment of the variables toward equilibrium.

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