EQUILIBRIUM REAL EXCHANGE RATE IN BRAZIL ESTIMATION AND POLICY IMPLICATIONS

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Abstract

This paper examines the determinants of the real effective exchange rate (REER) in Brazil, from 1994 to 2003. Building on a standard theoretical model and based on the Johansen cointegration estimation, the main finding is that much of the long-run behavior of the REER can be explained by relative productivity differentials, real commodity prices, government expenditures on tradables and non-tradables, trade openness and real interest differentials. On the basis of these fundamentals, the level of misalignment of the Real was found to be surprisingly modest during the Real Plan (1994-1998). As of end 2003, the Real was found to be slightly appreciated with respect to the estimated equilibrium level, although the extent of the misalignment appears to be small as well. The paper also discusses the implications of these findings with regard to trade competitiveness. (135 words)

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I. INTRODUCTION

Ten years after the beginning of the Real plan in Brazil, the controversy surrounding the role of the exchange rate between 1994 and 1998 seems to have somewhat vanished, as many see the demise of the plan as a story whose plot was basically foretold long before the Real collapsed in January 1999[2]. To be sure, the 1999 Brazilian crisis seems to fit a familiar pattern in countries that use the exchange rate as a nominal anchor to stabilize inflation: the usual real exchange rate appreciation which follows exchange rate stabilization programs leads to unsustainable current account deficits and eventually currency collapse[3]. After the East-Asian crisis, the Russian crisis in 1998 and more recently, the spectacular failure of Argentina's currency board system in 2001, have reinforced this perception. It is important to note that the later two cases –as in Brazil- one of the crucial elements was the unsustainability of the fiscal accounts. The conventional wisdom of the early 1990s regarding the superiority of nominal anchors in fighting inflation has given rise to a new enthusiasm about flexible exchange rates in order to avoid growing currency misalignments and costly exit strategies.

However, it is interesting to recall that the issue of real exchange rate misalignment was heavily debated during the Real plan. Few economists disagreed over the fact that the Brazilian currency was overvalued during the Real plan, but there was no consensus over the size of the overvaluation. This had a lot to do, at the time, with the complexity of measuring prices indices properly in the midst of a major price stabilization effort and with the currency reform introduced in the course of 1994[4]. In addition, interest in the overvaluation issue seemed to vary according to the international atmosphere: "*when markets were buoyant, the issue was left aside; when they were, instead, sluggish, the currency was overvalued by 25% or more, or at least, market participants seemed to consume more intensively the 25% overvaluation.*"[5] As an illustration, BACHA [1997] estimated that the real overvaluation was a modest 6% in 1996, while other Brazilian authors' estimations pointed to misalignment levels close to 40% during the same period[6]. The position of the IMF on the issue is also reported to have moved from an initial perception of 33% overvaluation in early 1995 to a more hesitant view about the level of misalignment[7]; in late 1998, the IMF staff apparently believed that that the Real was overvalued by 15-20%, i.e. a somewhat smaller level of overvaluation than that reported by other outside assessments[8]. Against this background, this paper attempts to examine the determinants of the real exchange rate in Brazil both during and after the

[2] CARDOSO [2000], p.70.
[3] From 1994 to early January 1999, Brazil's exchange rate policy was technically that of a European-style managed currency band regime (crawling peg).
[4] See FRANCO [2000], pp.7-8. In particular, one should recall that one of the central elements of the Real plan was the introduction of the Real, on July 1st, 1994. But the actual introduction of the new currency was preceded by a period of four months, during which contracts, prices, wages and the exchange rate (then still for the *cruzeiro real*) were linked to a single unit of account adjusted on a daily basis, the *unidade real de valor* (URV).
[5] FRANCO [2000], p.78.
[6] See DORNBUSCH [1997] pp.379-380.
[7] It is reported (IMF [2003]) that in 1997, the staff began to recalculate the real effective exchange rate relative to the 1994 average.
[8] See IMF [2003], pp.124-125.

Real plan, with the view of investigating the evolution of the misalignment issue in calculating the deviation from the "equilibrium" real exchange rate implied by the model. The objective of this investigation is not only to shed some light on real exchange rate fundamentals, but also to derive some policy implications regarding the competitiveness of the Brazilian economy in general, ten years after the launching of the Real plan. The paper is organized as follows: section II presents some background information on real exchange rate developments in Brazil in the 1990s; section III introduces the theoretical model underlying the analysis, which happens to be a standard internal-external equilibrium model borrowed from the works of HINKLE & MONTIEL [1999]; section IV presents the estimation technique and the results; section V discusses some general policy implications with respect to competitiveness since the 1999 devaluation and section V offers some concluding remarks.

II. REAL EXCHANGE RATE DEVELOPMENTS IN BRAZIL DURING THE LAST DECADE

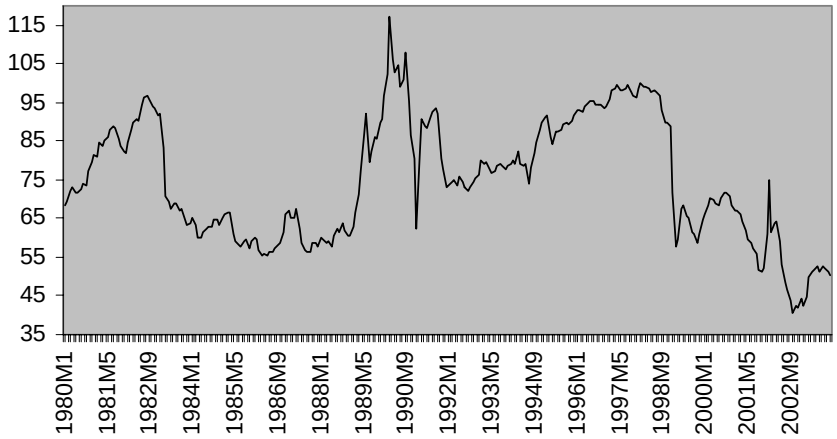
As shown by Chart 1, the (multilateral) real trade-weighted exchange rate (REER) appreciated by a sizable amount between 1994 and 1998, but the choice of the base period is of course crucial to determine the extend of the misalignment. Compared to the preceeding fourteen years, the REER appreciated around 25%, but the misalignment was only about 14% compared to early 1994 levels (Table 1). Note also that the misalignment of the 1989-91 period, associated with the failure of the Verão plan and the beginning of the Collor stabilization plan, was much larger[9]. Interestingly, the REER has exhibited a fair amount of volatility since the January 1999 devaluation, although following a depreciating trend. As of end 2003, the REER was at levels, close to those of the mid-1980s, that is, to its lowest levels.

Alternatives measures of the real exchange rate (either using producer prices instead of "traditional" consumer prices, or real wages) indicate a similar appreciating trend during the crawling peg period, as shown in Chart 3. Another popular measure is the famous "Big Mac Index" published by *The Economist* since the early 1990s, and relying on an extreme version of the purchasing power parity, i.e. the law of one price. Even if strong reservations can (and should) be made regarding the Big Mac Index[10], the implied overvaluation during the Real Plan period was similar to that implied by other methods. Interestingly, the Real appears to be significantly undervalued as of April 2004 according to the Big Mac Index (Chart 4), a claim that will be examined later in the paper on the basis of our results. In any case, irrespective of the measure chosen, the bulk of the appreciation intervened in 1994 and 1995, as shown in Chart 5.

[9] CARDOSO [2000], p.80 notes that the only real exchange rate misalignment comparable to that of the Real plan was the 1980-82 period, but Chart 1 seems to indicate that the 1989-91 period offers a more striking case.

[10] As it is well known, absolute PPP is supposed to hold in the long run only, and rests on restrictive assumptions. Furthermore, departures from PPP in the short run are common, owing to various factors including the existence of barriers to trade (tariffs, taxes and transportation costs), the inclusion of non-traded elements in the price index used, and pricing to market. As shown by PAKKO & POLLARD [2003], differences in "Big Mac" prices across countries ultimately reflect differences in net hourly wages, thereby suggesting that deviations from PPP are driven by the Balassa-Samuelson effect.

Chart 1. Real Effective Exchange Rate (1990=100)



Source: International Monetary Fund (IMF)

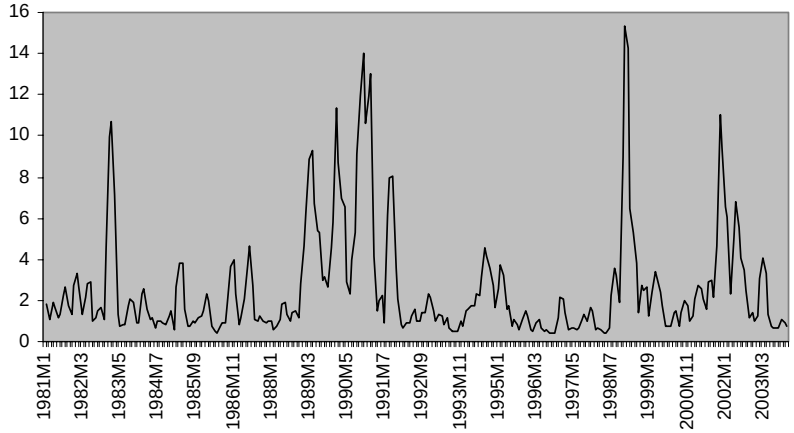
Note: the REER is calculated using the IMF methodology, i.e. $REER = \frac{CPI_{Brazil}}{E \cdot \sum_{i} CPI_{\text{Trade Partner i}}}$.

Therefore, a rise in the index represents an *appreciation* of the real effective exchange rate, i.e. a rise in the price of non-tradables relative to the price of tradables.

Table 1. Real Exchange Rate Misalignments in Brazil

Average 1994-98 overvaluation relative to average 1980-93	24%
Median 1994-98 overvaluation relative to median 1980-93	27%
Average 1994-98 overvaluation relative to early 1994 levels	14%
Average 1989-91 overvaluation relative to 1980-88	31%

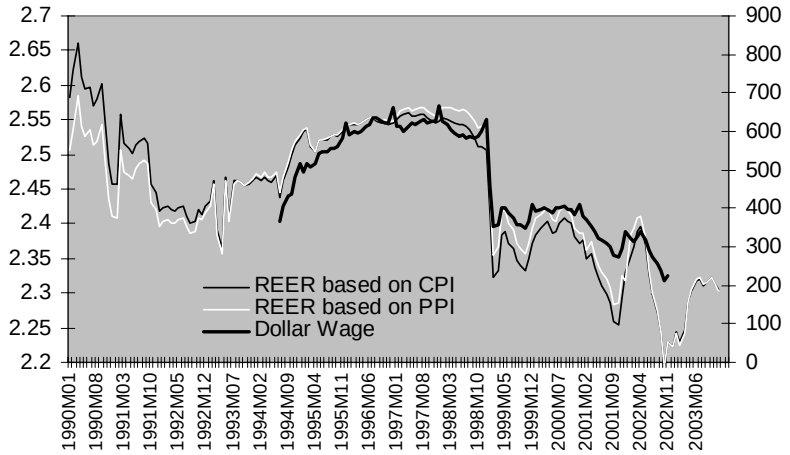
Chart 2. Real Exchange Rate Volatility



Note: Volatility is measure as the 4-month moving average of the standard deviation of the real effective exchange rate series

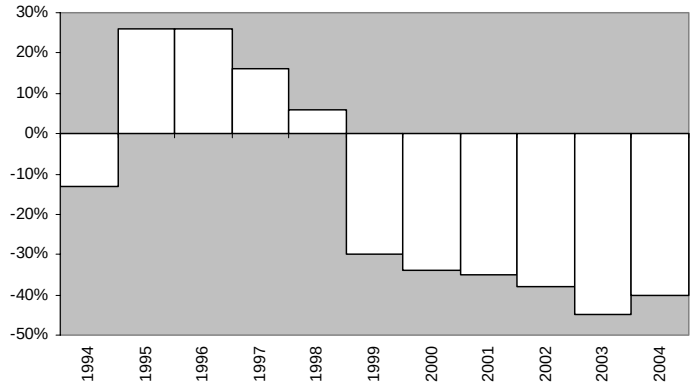
Source: author's calculations on the basis of IMF data

Chart 3. Different Measures of Real Exchange Rates, 1990-2003



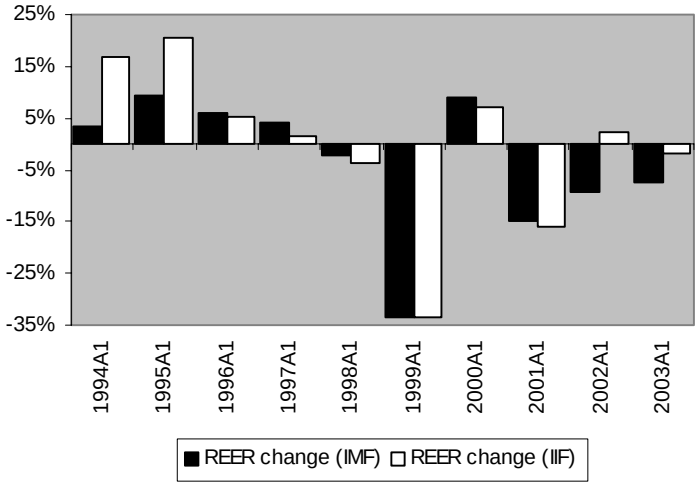
Source: IMF, *Banco Central do Brasil*

Chart 4. Currency Over/under valuation according to the Big Mac Index



Source: *The Economist*

Chart 5. REER Change (YoY, %)



Source: IMF, Institute of International Finance (IIF)

It is important, however, to distinguish the share of the real appreciation that is justified by changes in fundamentals from the share signaling a competitiveness problem, and hence, a real overvaluation problem. This is easier said than done in practice, as a fair amount of controversy surrounds the measurement of some key variables, such as productivity gains. The productivity issue was actually at the heart of the debate between the Brazilian authorities and the IMF at the beginning of the Real plan, as the former insisted on the fact that some portion of the appreciation reflected higher productivity gains, associated with the structural reforms taking place in Brazil (i.e. privatization).

As shown in Chart 6a, productivity appears indeed to have increased sharply in 1993-1994, with productivity changes more or less matching changes in the real effective exchange rate, but the story is different for 1995, when productivity plummeted while real appreciation continued. Productivity increased back during 1996-1997 as part of the investment cycle[11]. Yet, a substantial portion of the productivity gains was passed on wages in the early years of stabilization[12], producing a significant increase in real wages (Chart 7), which negatively affected competitiveness. Even more revealing is the fact that dollar wages increased substantially in the *beginning* of the stabilization program, whereas the combination of trade opening and stabilization should have induced the opposite effect in the short run. In addition, as noted by DORNBUSCH [1997], the productivity argument deserves close scrutiny, because all too often, "*large productivity gains may simply mean high unemployment*"(p.386). In the Brazilian case, it is widely recognized that the increase in productivity during 1991-1994 was achieved mainly through employment reduction, and (official) unemployment figures show indeed a deterioration between 1991 and 1993 and between 1993 and 1998, which indeed suggests that firms found it very hard to compete[13], especially at the time when the economy was liberalizing its trade regime. Following the January 1999 devaluation, productivity changes have been much more modest, however, and even negative in 2001, although it is to be noted that real wages have only adjusted back to their pre-Real Plan levels.

[11] OECD [2001], pp.43-44.
[12] DORNSBUSCH [1997], p.375, reports that the real income of the bottom 50% of the income distribution rose by 35% between 1993 and 1995.
[13] CAMARGO, NERI & CORTEZ REIS [1999] note that although employment increased in the service and commerce sectors, these increases were not enough to compensate for the global decline in employment levels.

Chart 6a. Productivity and REER changes, 1993-1998

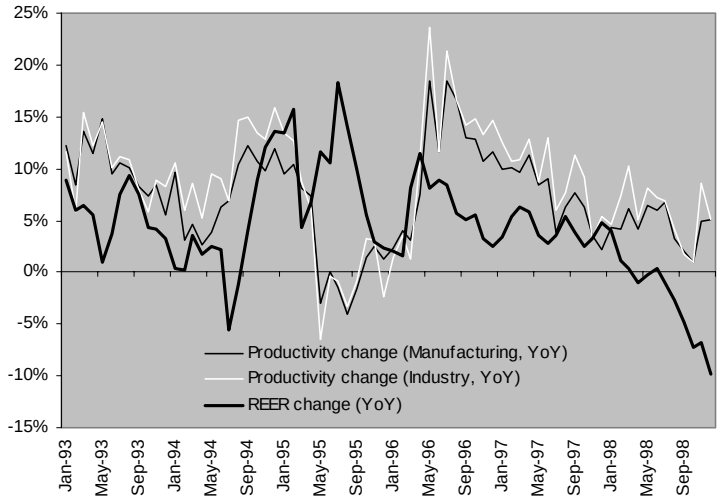
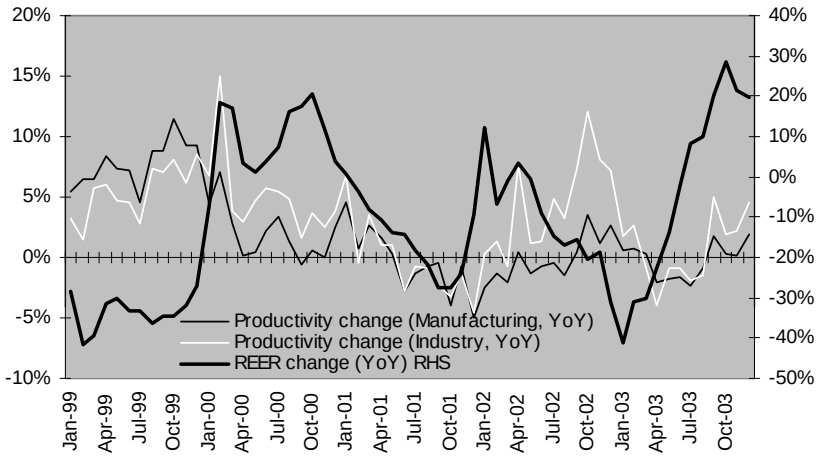
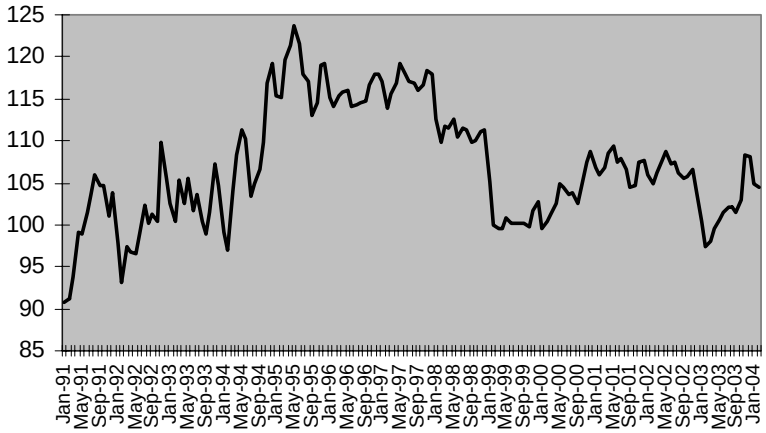


Chart 6b. Productivity and REER changes, 1999-2003



Source: Author's calculations on the basis of IBGE and IMF data
Note: The manufacturing productivity index comes from IBGE. Industrial productivity was calculated as the ratio of production index to the number of paid hours (*Horas pagas - na produção*)

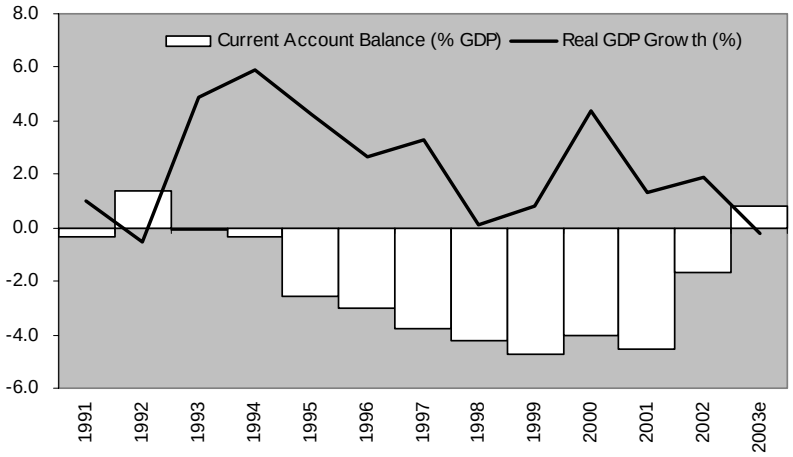
Chart 7. Real Wages (Manufacturing, 1992=100), 1993-2003



Source: *Instituto de Pesquisa Econômica Aplicada (IPEA)*

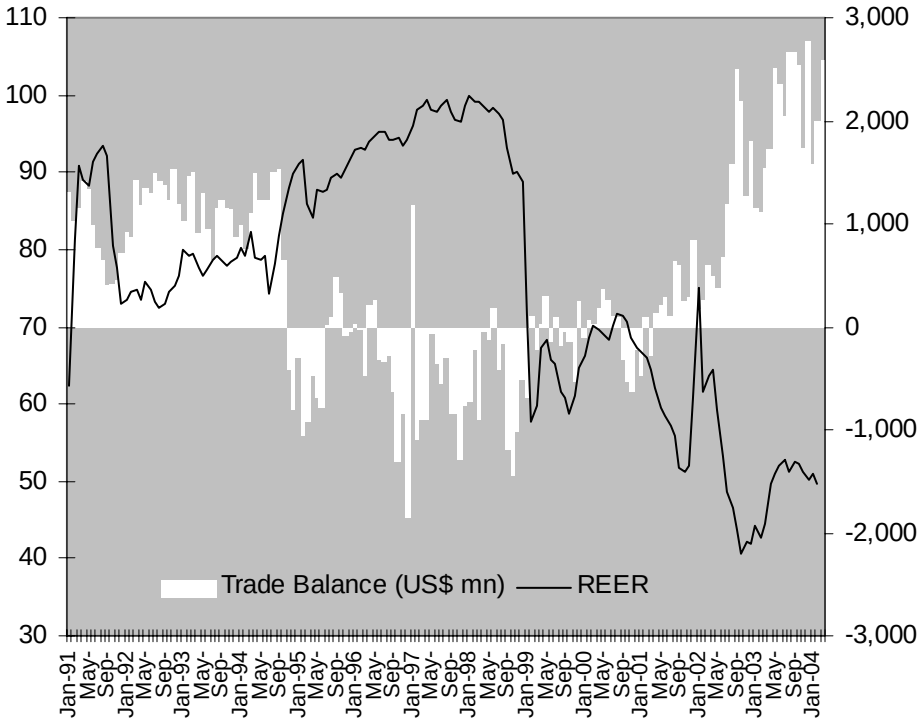
The productivity puzzle remains heavily debated, essentially because the structural reforms launched in the mid-1990s as part of the stabilization plan made it difficult at the time to properly gauge the precise magnitude of the disequilibrium. But the one dimension which is rarely debated is that competitiveness issues are likely to arise when real appreciation is associated with a serious loss of growth and high external imbalances, leading to rapidly unsustainable debt financing situations. From this perspective, the impact of the Real plan on the trade balance suffers little discussion: Brazil moved from a situation of current account equilibrium in 1992-1993 to a rapidly growing external deficit, as evidenced by Chart 8, while real GDP growth declined drastically from 1994 to 1998. The impact of the combination of real exchange rate appreciation and far reaching trade liberalization is also quite visible on trade flows: the trade surplus, which had been generally positive before the Real plan, turned negative (Chart 9), as import growth outgrew export growth until the devaluation (Chart 10). Note also that total export earnings growth has been fairly flat over the last decade, increasing only recently as a result of booming commodity prices. Chart 10 also makes clear that in 2001 and 2002, the bulk of the emerging trade surplus was the result of import contraction, and not export growth.

Chart 8. Current Account Balance and GDP Growth, 1991-2003



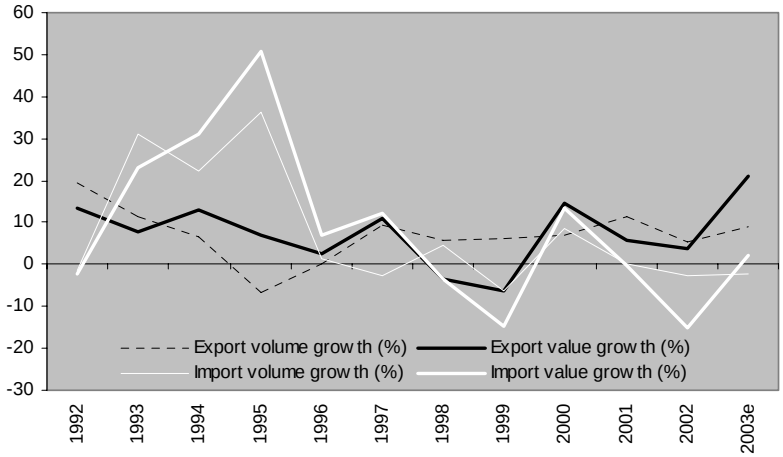
Source: IIF

Chart 9.
Trade Balance (US$ mn), 1991-2003



Source: *Banco Central do Brasil*, IMF

Chart 10. Export and Import Growth Rates, 1992-2003

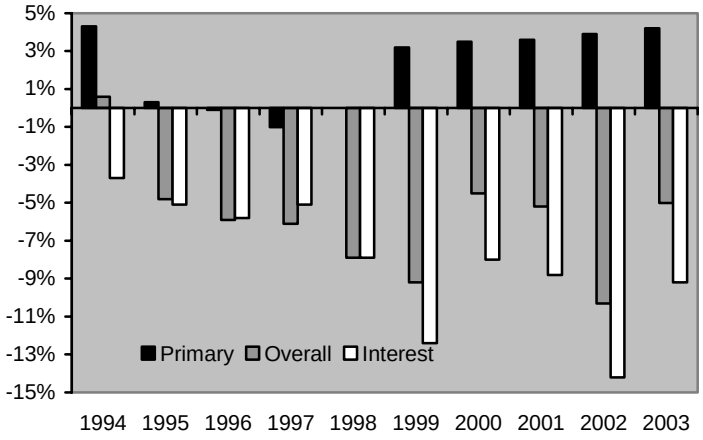


Source: IIF
Note: "value" of imports and exports refers to the total value (price and quantity)

Lastly, another factor supporting the appreciating trend of the exchange rate in Brazil has been the prevalence of extremely high interest rates, both in nominal and real terms. As it is well known, the weakest link in the Real plan was fiscal adjustment, as the progress achieved in 1994 rapidly lost steam. The emergence of growing deficits at the state level, the recognition of contingent liabilities in state-owned enterprises (state banks in particular), the exponential costs of the pension system as well as some expenditure fever led to growing primary and consolidated deficits (Chart 11). Naturally, the need for increased deficit financing put upward pressure on already high interest rates. Additional pressures included the tendency to use tight monetary policy as a substitute for fiscal reform[14], and declining domestic savings in the face of growing current account deficits. This made foreign savings a key part in the equation, hence the need to maintain high interest rates in order to keep attracting capital inflows. To be sure, the average real interest rate from 1995 to 1998 was around 15%, with a peak at 34% in 1997. During the same period, net equity investment reached US$18-20 bn (Chart 12), on average, that is more than a ten-fold increase compared to the period 1983-1993. This inflow of capital contributed to a sizable accumulation of international reserves, and fueled (or at least sustained) the overvaluation of the currency, despite the sterilization policy conducted by the monetary authorities and the imposition of capital controls on short-term flows.

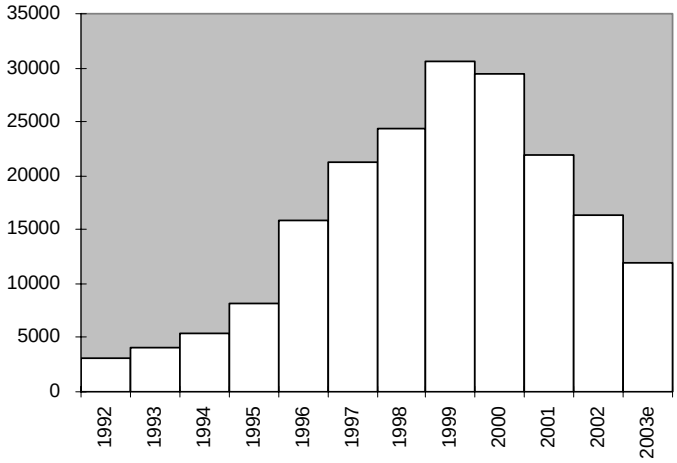
[14] See CARDOSO [2000], p.77-78.

Chart 11. Fiscal Balance (% GDP), 1994-2003



Source: World Bank Global Development Indicators

Chart 12. Net Equity Investment (US$ mn), 1992-2003



Source: IIF

Ex-post, it appears that all these factors contributed to increase the vulnerability of the Brazilian economy to foreign shocks, despite an impressive record on curbing inflation. Does it automatically mean that in early 1994, the exchange rate was at a point where it inevitably had to return, although at a "glacial rate" of 15% a year (ROGOFF [1996]) ? *Prima facie*, Brazil's case seems to be consistent with GOLDFAJN & VALDEZ [1999]

findings that the probability of smooth return appreciations is very small for currencies which happen to be misaligned by 35% or more. Indeed, the combination of high financial needs to finance the public sector's deficit and extremely high interest rates , made the sustainability of the debt increasingly questionable, especially given the financial turbulence associated with the East Asian crisis. Although the real appreciation of the currency declined in 1998 (the REER actually depreciated 3%), the Russian crisis worsened investors' sentiments *vis-à-vis* Brazil, and devaluation expectations started to build up rapidly. In fact, the Real was allowed to float freely less than five months after the collapse of the Russian Rouble, amid fears of full-blown financial crisis[15]. And even though the chain of events leading to the 1999 devaluation was mainly driven by the lack of fiscal adjustment in Brazil and by a suddenly risk-adverse external environment, it is pretty clear that the *perceived* misalignment of the currency was part of the equation, not least because it was a byproduct of loose fiscal policy and very tight monetary policy. The Russian crisis apparently convinced both foreign investors and local residents to speculate about devaluation, thereby precipitating the fall of the Real[16].

Although a detailed analysis of the Real crisis lies outside the scope of this paper, it is crucial for the purpose of the analysis to underscore the very rapid post-crisis recovery. As noted by CARDOSO [2000], "*Brazil has navigated its way through the Real crisis with extraordinary ease and speed*" (p.87), especially with respect to the inflation situation, which was, one of the greatest fears associated with the devaluation. Despite some initial instability, the behavior of the REER and the remarkable post-devaluation stabilization may indicate that the real exchange rate returned to some form of equilibrium. As this discussion suggests, there is plenty of *ex-post* anecdotal evidence pointing to the significant overvaluation of the Real during the Real Plan, and to the possible undervaluation of the currency at the end of 2003. This evidence needs to be tested empirically on the basis of an economic model which will be introduced in the next section.

[15] On this, see BLUSTEIN [2001], chapters 12 and 13, for a vivid description of the '*bailing-in*" of Brazil, and GRUBEN & WELCH [2001].

[16] See for instance BAIG & GOLDFAJN [2000], who note that Brazilian resident reinforced the speculation once they realized that foreign investors had joined the outflow.

III. ANALYTICAL BACKGROUND

The concept of real equilibrium exchange rates has generated a large body of literature[17], driven by the emerging consensus that the standard purchasing power parity (PPP) is not an appropriate model of real equilibrium exchange rates, owing to persistent deviations from PPP, which may be explained by permanent real shocks. As a result, the real exchange rate is very often non-stationary. The usual suspects in terms of real shocks include productivity differentials, based on the Samuelson-Balassa hypothesis[18], as well as the underlying net foreign assets position, which determines whether the exchange rate is consistent with the current account balance. These effects have been traditionally integrated in simple two good/two country models, where the real equilibrium exchange rate clears both internal and external balances. The theoretical framework described below actually fits into the same category of models. Under some assumptions discussed in HINKLE & MONTIEL [1999], the internal balance condition is defined as follows:

$$y_N(e,\phi,\delta) = (1-\theta)ec + g_N \qquad \partial y_N/\partial e < 0,\ \ \partial y_N/\partial \phi < 0,\ \partial y_N/\partial \delta < 0 \tag{1}$$

Where y_N and g_N are, respectively, the level of output of non-traded goods in the economy and the government's consumption of such goods, e is the "importables" real exchange rate[19], ϕ is the productivity differential of tradables , δ is the terms of trade, c is private absorption (measured in terms of tradables) and θ is the share of tradables in private absorption. Note that an improvement of the terms of trade lowers the relative price of non-traded goods, and therefore, reduces the supply of non-traded goods y_N . The locus of points for which the internal balance is in equilibrium is shown as the IB schedule on Chart 13, indicating a negative relationship between private consumption and the real exchange rate: as a rise in private consumption creates an excess demand for non-traded goods, the real exchange rate has to decline to restore equilibrium, hence $\partial e/\partial c < 0$.

The external balance condition sets the current account deficit equal to the sustainable level of capital flows, as defined in equation (2):

$$\pi^* f = b + z + r^* f = \delta y_{EX}(e,\phi,\delta) + y_{IM}(e,\phi,\delta) - g_{IM} - [\tau+\theta]c + z + (r^*+\pi^*)f \tag{2}$$
$$\partial y_{EX}/\partial e > 0,\ \ \partial y_{EX}/\partial \phi > 0,\ \partial y_{EX}/\partial \delta > 0$$
$$\partial y_{IM}/\partial e > 0,\ \ \partial y_{IM}/\partial \phi > 0,\ \partial y_{IM}/\partial \delta < 0$$

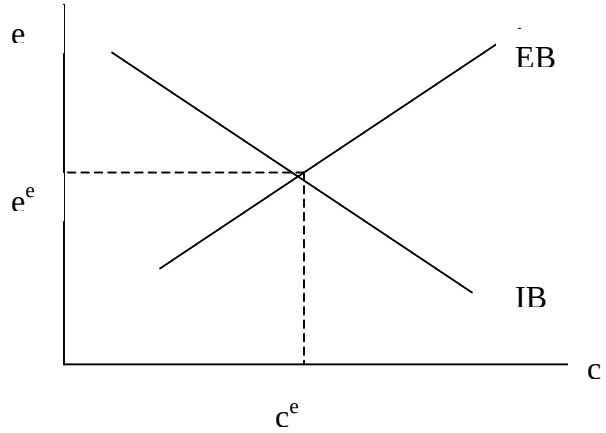
[17] See ROGOFF [1996] for a survey.

[18] The Balassa-Samuelson effect describes the role of differential productivity growth rates in the tradable and the non-tradable sectors in real appreciation of the real exchange rate. This typically happens in countries undergoing price stabilization and trade opening.

[19] Defined as the price of traded goods in terms of non-traded goods, i.e. $e = EP_T^*/P_N$, with E being the nominal exchange rate, while the price of traded goods is expressed in foreign currency.

Where f , b and z are, respectively, total net foreign assets, the trade balance and the value of international transfers received by the country; r* is the real interest rate on foreign assets, π* is the foreign inflation rate, e is the real exchange rate, y_{EX} and y_{IM} are, respectively, the domestic production of exportables and importables, g_{IM} is government's consumption on importables, and τ is the transaction cost of consumption[20]. The difference between the production of tradable goods and the associated domestic demand is the domestic excess supply of tradable goods $\delta y_{EX} + y_{IM} - \left[(\tau + \theta)c + g_T\right]$, which is equal to the trade balance surplus. Adding up the net interest receipts from abroad and the value of international transfers yields the standard balance of payments. External balance can be assumed to hold when the level of net foreign assets has reached steady-state equilibrium. In this context, the locus of points for which the external balance is in equilibrium is shown as the EB schedule in Chart 13, indicating a positive relationship between private consumption and the real exchange rate: a rise in private consumption generates a trade deficit, which requires an increase in the real exchange rate (real depreciation) to restore equilibrium, hence $\partial e/\partial c > 0$.

Chart 13. Internal and External Balance



The equilibrium real exchange rate e^e , given by the intersection of the IB and EB schedules, is that which is simultaneously consistent with internal as well as external balances in the long run. Combining equations (1) and (2) and solving for the equilibrium real exchange rate, yields equation (3):

[20] In Montiel's model, this cost motivates the holding of money.

$$e^e = e^e\left(g_N, g_T, (\{r^*+\pi^*\}f + z), \tau, \phi, \delta\right) \quad \text{with} \tag{3}$$

$$\partial e^e / g_N < 0$$

$$\partial e^e / g_T > 0$$

$$\partial e^e / \partial(\{r^*+\pi^*\}f + z) < 0$$

$$\partial e^e / \partial \tau > 0$$

$$\partial e^e / \partial \phi < 0$$

$$\partial e^e / \partial \delta < 0$$

Equation (3) simply suggests that the long run equilibrium exchange rate will be affected by a combination of exogenous and endogenous factors (the service balance $\{r^*+\pi^*\}f$ as well as the transaction cost τ), which depend on the specifications of the full model. Note also that the effect of an improvement in the terms of trade δ is generally associated to an *appreciation* of the real exchange rate through the income effect (higher export prices triggers higher private consumption of both tradables and non-tradables, with requires an appreciation of *e* to restore domestic balance), assuming that the latter is stronger than the depreciation of the real exchange rate which is required to restore external balance (an improvement of the terms of trade tends to worsen the trade balance). The next step is to recognize that transaction costs (measured by τ) depend on the ratio of money holdings in the Montiel model, and therefore, on the nominal interest rate, which is the opportunity cost of holding money. Assuming that international transfers are negligible, steady-state debt service becomes, under certain conditions, a function of the real foreign interest rate r*. For simplicity, the role of interest rates on the demand of money and on the service account can be captured by a real interest differential[21]. Finally, it is also possible to include in the model a measure of trade policy stance, denoted as η, which is bound to affect both internal and external balances[22], thereby implying that a tightening of trade policy would result in an appreciation of the real exchange rate, i.e. $\partial e^e / \partial \eta < 0$. Factoring these different elements into equation (3) yields equation (4):

[21] This is a departure from Montiel's original model, and to some extent, a rough approximation of the dynamics involved. In Montiel's model, the nominal domestic interest rate is tied down in the long run to the domestic inflation rate of tradables and to a time preference rate (not shown for simplicity). Domestic inflation is thus part of the fundamentals, and well as the foreign real interest rate r* plus the foreign rate of inflation π^*. The role of the time preference rate is ignored here, and the relevant variables become the nominal domestic interest rate R, and the term ($r^*+\pi^*$). Assuming that $\pi=\pi^*$ (fixed exchange rate case), and defining $R=r-\pi$, the real interest rate differential summarizes the role the relevant variables.

[22] See HINKLE & MONTIEL [1999], pp.288-89.

$$e^e = e^e\left(g_N, g_T, (r - r^*), \phi, \delta, \eta\right) \quad (4)$$

$\partial e^e / g_N < 0$

$\partial e^e / g_T > 0$

$\partial e^e / \partial(r - r^*) < 0$

$\partial e^e / \partial \phi < 0$

$\partial e^e / \partial \delta < 0$

$\partial e^e / \partial \eta < 0$

Accordingly, *the long-run equilibrium real exchange rate is a function of the import content of government expenditure (fiscal stance), the real interest differential, the terms of trade, the trade policy stance, and productivity differentials capturing the Balassa-Samuelson effect*.

IV. ESTIMATION AND RESULTS

In order to operationalize equation (4), let us assume that the long-run relationship existing between the actual real exchange rate and its fundamentals is linear and can be captured by simple log transformation of the variables. The relationship to be estimated takes the form of equation (5):

$$\ln e_t = \beta' X_t + \varepsilon_t \quad (5)$$

with *X* being a vector of permanent values of the fundamentals, and ε_t being a mean-zero white noise disturbance term.

In order to investigate the existence of a long-run relationship among the model variables, the Johansen maximum likelihood estimation technique is used, through a vector error-correction specification. Let us recall briefly that the Johansen procedure is based on reduced rank regressions. When the multivariate model contains I(0) and/or I(1) variables, the testing procedure is fairly standard. The model to estimate is as follows:

$$X_t = A_1 X_{t-1} + ... + A_k X_{t-k} + \mu + \Psi D_t + \varepsilon_t \quad \text{t = 1,..,T} \quad (5)$$

Where X_t is a $p\times$ 1 vector of stochastic variables, $X_{-k+1},...,u_0$ are fixed, ε_t is the uncorraleted Gaussian error term , and D_t is a vector of non-stochastic variables such as seasonal dummies or even weakly exogenous variables which can be excluded from the cointegration space. The model is then reformulated in the following error-correction form:

$$\Delta X_t = \Gamma_1 X_{t-1} + ... + \Gamma_{k-1} x_{t-k+1} + \Pi X_{t-1} + \mu + \Psi D_t + \varepsilon_t \quad \text{t = 1,..,T} \quad (6)$$

The hypothesis of cointegration is formulated as a reduced rank of the Π-matrix: $H_1(r): \Pi = \alpha\beta'$ where α and β are $p \times r$ matrices of full rank (α represents the speed of adjustment to disequilibrium and β is a matrix of long-run coefficients). The hypothesis H1(r) implies that the process ΔX_t is stationary, X_t is non-stationary, but $\beta' X_t$ is stationary[23].

With this framework in mind, we now turn to the specifics of the model estimated. Regarding the estimation period, it is fair to recognize that Brazil does not provide an easy training field for the researcher, having gone through six different stabilization plans from 1986 to 1994. The fact that various currencies and different exchange rate systems were present until the adoption of the Real plan in January 1994 suggests that any econometric investigation venturing before 1994 exposes itself to serious risks of structural breaks. Notwithstanding these difficulties, some authors (e.g.MERLIN & PORTUGAL [2002]) have addressed this risk with the use of dummy variables to control for the various stabilization periods and for the 1989-91 REER peak noted in section II. The use of dummy variables does not solve the structural break issue, however, nor does it alleviate the problem of "transitioning" between different currencies. These authors estimated a real exchange rate model similar to the used in this paper, and found a level of real overvaluation close to 7% in 1998, using quarterly data from 1994 to 2000. Earlier empirical work on the issue simply did not try to control for possible structural breaks. For instance, AGENOR, HOFFMEISTER & MEDEIROS [1997], estimated a near-VAR model using monthly data and linking capital flows, interest rate differentials, government spending, money-base velocity and the REER from 1988 to 1995, and found that world interest rate shocks had a significant impact on both capital inflows and the REER. Other studies covering roughly the same period include MELO [1998], who concludes that the REER was continuously undervalued up to 1995, and HOLANDA [1999], who estimated that the REER was overvalued by about 15% in the second quarter of 1998. The existence of five years of data following the devaluation allows us, however, to use the Real Plan as a starting time in order to avoid dealing with potential breaks in the series. This approach involves tradeoffs, however, as the length of the sample will be inevitably shorter. To circumvent this problem, it was decided to conduct the estimation using monthly data from July 1994 (i.e. formal introduction of the Real) through December 2003. Arguably, this choice is questionable, especially given the noise associated with higher frequency data; likewise, monthly data are usually not available, and must be extrapolated using quarterly data –which ruins the potential usefulness of the exercise. Fortunately, this is not an issue in the case of Brazil, because a significant number of time series are published in a monthly basis in Brazil. What is still debatable, however, is the relevance of some macroeconomic aggregates (e.g. GDP) on a monthly basis and the seasonality issue in such data.

With these important caveats in mind, we turn now to the description of variables entering vector Xt:

[23]See JOHANSEN [1991] and JOHANSEN & JUSELIUS [1990].

The *real effective exchange rate* (REER) was constructed for the purpose of the estimation as a geometric weighted average of the seasonally adjusted consumer price index and the exchange rate index, US dollar per national currency, period average (IMF methodology). Please note that an increase of REER denotes an *appreciation*, meaning that REER actually represents the relative price of non-tradable goods, whereas the theoretical model presented in section III uses the mirror definition of the real exchange rate. The trade weighting used are the average weighting for Brazil's ten largest trading partners from 1995 to 2003. The variable is in logarithmic form.
Sources: International Finance Statistics (IFS), Banco Central do Brasil

Productivity differentials are traditionally captured by relative sector prices, proxied by the indexed trade-weighted ratio of relative prices between Brazil and its main trading partners (RELP). More precisely, the index takes the following form, as in ALBEROLA *et alt*. [1999]: $RELP = \frac{CPI/PPI}{CPI^*/PPI^*}$
The trade weighting used are the same as for REER and the variable is in logarithmic form. An increase in the index denotes a rise in the relative price of non-tradables versus tradables, and is therefore associated with an appreciation of the real exchange rate.
Sources: International Finance Statistics (IFS), Banco Central do Brasil

The impact of government expenditure and the fiscal stance in general on the real exchange rate is not *a priori* clear-cut, mostly because it depends a lot on the share of tradables and non-tradables in government spending. In order to differentiate government spending, one possibility is to use *government investment spending* as a proxy for government consumption of tradables (mostly because the import content of investment is likely to be higher) and *government recurrent spending* as a proxy for government consumption of non-tradables[24]. Recurrent expenditure is defined here as total expenditure minus investment spending and debt servicing spending. An important caveat is that the data refers to the cash execution of the *Tesouro Nacional*, as published by IPEA. Data coverage is therefore limited, which means that the two constructed variables GOV1 (log of government investment to GDP) and GOV2 (log of government recurrent expenditure to GDP) are –at best- only partial proxies of primary expenditures trends[25]. With this caveat in mind, a rise in GOV1 is associated with a depreciation of the REER, while a rise in GOV2 is associated with an appreciation of the REER.
Source: Instituto de Pesquisa Econômica Aplicada (IPEA)

In order to capture the terms of trade effect, two alternatives variables were constructed, following a recent trend in the literature. Rather than using a standard terms of trade ratio ($P_{exports}/P_{imports}$), two real commodity price indices were constructed, to reflect the role of primary products in Brazil's trade structure. More specifically, the variables are computed as the weighted average of Brazil's top five commodity export nominal prices (i.e. *Sugar, Soy, Iron, Coffee* and *Tobacco*) deflated either by a trade-weighted price index for the exports from a group of industrialized countries (Germany, Korea, Japan,

[24] This approach actually follows HINKLE & MONTIEL [1999], Chapter 10.
[25] Moreover, the mismatching problem between accrued and recorded expenditures is particularly acute with high frequency data.

the UK and the US), or by the US CPI index [26]. These two proxies are referred to as RELCOM and RELCOM2, and are expressed in logarithmic forms. As for the standard terms of trade ratio, the intuition is that higher commodity prices tend to drive up wages, thus leading to an increase in non-tradable prices[27].
Sources: Banco Central do Brasil, IFS, IMF's Direction of Trade Statistics, and Instituto de Pesquisa Econômica Aplicada (IPEA)

The *trade stance* variable is proxied by a "standard" openness ratio (OPEN), calculated as the ratio of exports and imports to GDP. An increase in trade flows is usually associated with a more liberal trade stance.
Source: Banco Central do Brasil

The real interest rate differential (IDIF) was calculated as the difference between the real overnight interest rate in Brazil (SELIC) and the real 90 day US T-bill rate[28].
Sources: International Finance Statistics (IFS), Banco Central do Brasil

Finally, in order to control for the devaluation of the Real, which intervened in January 1999, a post-devaluation dummy variable (DEVAL) is added to the estimation, taking the value of 1 from January 1999 onwards. This post-devaluation dummy is assumed to pick up the likely overvaluation of the real exchange rate preceding the devaluation as well as the possible overshooting subsequent to the devaluation. The sign of this variable is expected to be negative.

The different variables are presented in Chart 14. We now proceed with the cointegration analysis. As shown in Table 2, all variables are I(1) at the 10% level. Note that the unit root test for the real interest differential is actually quite close to the critical value but this may well reflect the fact that nominal interest rates were extremely high at the onset of the Real plan, which my create a statistical illusion of convergence over time.

Two alternative models are estimated, using the different real commodity variables, between 1994:7 and 2003:12. The results of the VAR estimation are reported in Table 3 and 4. In order to ensure that the residuals are Gaussian "white noise", that is, to make sure they do not suffer from autocorrelation or non-normality, the lag order was tested using the Schwartz criterion.

[26] See MCDONALD & RICCI [2003].
[27] See CAHSIN, CESPEDES & SAHAY [2002]. Note that real commodity prices have been traditionally deflated by export prices of industrialized countries, referred to as the MUV index, in the empirical literature. This index is only computed on an annual basis by the World Bank, making any data extrapolation impossible. The export price series has therefore been recreated on a monthly basis, using IFS data.
[28] Real interest rates are proxied by the nominal monthly rate minus the annualized monthly inflation rate.

Chart 14. Determinants of the Real Effective Exchange Rate, 1994-2003

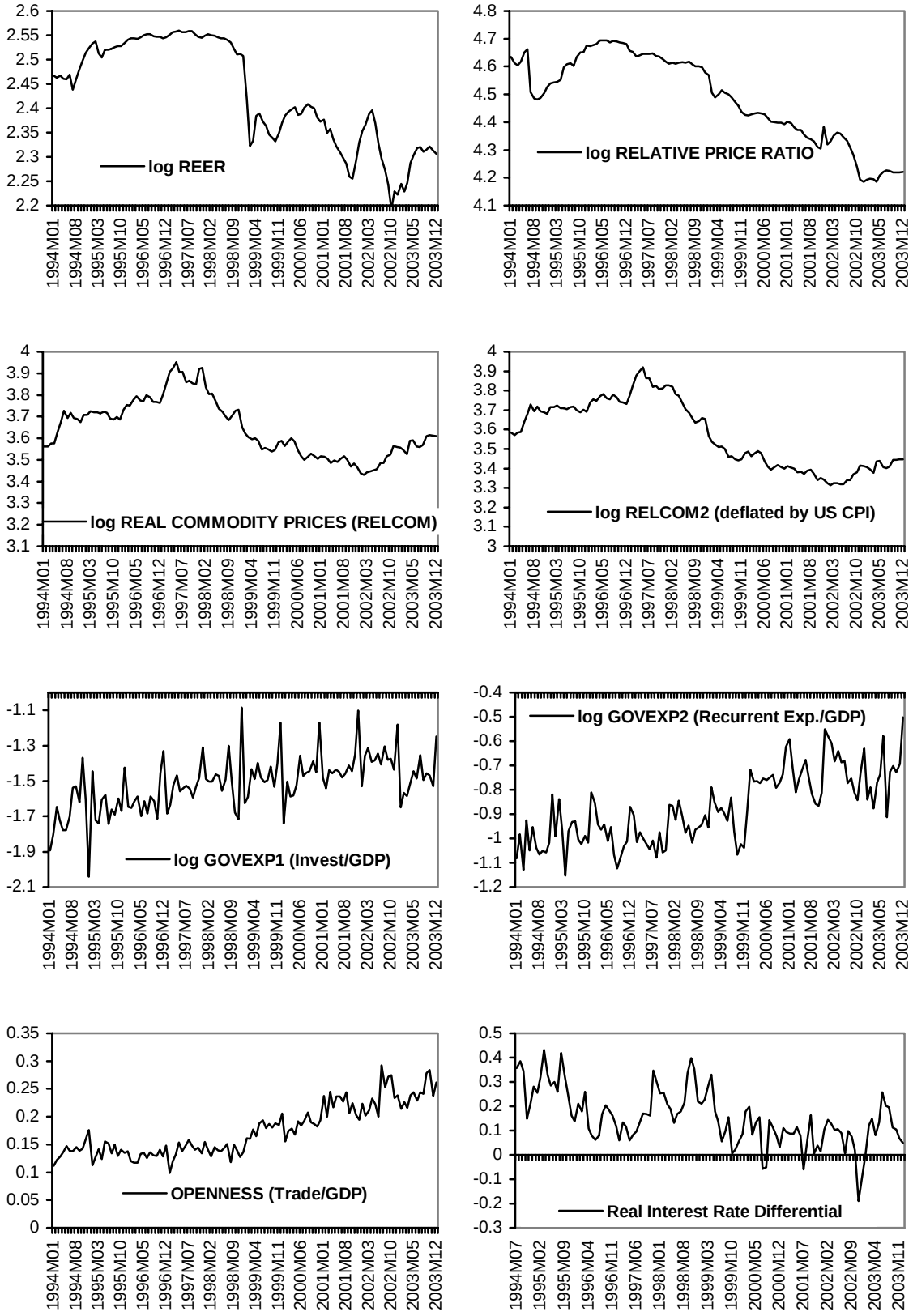


Table 2. Unit Root Tests

Variable Name	No trend ADF ADF Statistics	Lag length	1% level	5% level	10% level	Integration order
REER	-1.31	1	-3.48	-2.88	-2.57	I(1)
RELP	-0.27	1	-3.48	-2.88	-2.57	I(1)
IDIF	-2.49	4	-3.48	-2.88	-2.57	I(1)
RELCOM	-1.30	1	-3.48	-2.88	-2.57	I(1)
RELCOM2	-0.81	1	-3.48	-2.88	-2.57	I(1)
GOV1	-2.35	3	-3.48	-2.88	-2.57	I(1)
GOV2	-1.68	2	-3.48	-2.88	-2.57	I(1)
OPEN	1.22	1	-3.48	-2.88	-2.57	I(1)
dREER	-7.16**	0	-3.48	-2.88	-2.57	I(0)
dRELP	-9.70**	0	-3.48	-2.88	-2.57	I(0)
dIDIF	-12.56**	1	-3.48	-2.88	-2.57	I(0)
dRELCOM	-9.09**	0	-3.48	-2.88	-2.57	I(0)
DRELCOM2	-8.78**	0	-3.48	-2.88	-2.57	I(0)
dGOV1	-15.85**	2	-3.48	-2.88	-2.57	I(0)
dOV2	-9.86**	1	-3.48	-2.88	-2.57	I(0)
dOPEN	18.77**	1	-3.48	-2.88	-2.57	I(0)

(**) denotes the rejection of the null-hypothesis of a unit root at the 5%.
ADF tests carried out with intercept. Lag order determined in minimizing the Schwartz criterion.

Table 3. Johansen Cointegration Tests

Model 1

Eigenvalue *Lag order=1*	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.286476	126.2149	109.99	119.80	None **
0.262517	88.07291	82.49	90.45	At most 1 *
0.235588	53.66305	59.46	66.52	At most 2
0.137196	23.30574	39.89	45.58	At most 3
0.038839	6.630593	24.31	29.75	At most 4
0.017848	2.154244	12.53	16.31	At most 5
0.001054	0.119218	3.84	6.51	At most 6

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Model 2

Eigenvalue *Lag order=1*	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.290843	127.1156	109.99	119.80	None **
0.270040	88.27986	82.49	90.45	At most 1 *
0.205250	52.71141	59.46	66.52	At most 2
0.148853	26.75218	39.89	45.58	At most 3
0.054731	8.539973	24.31	29.75	At most 4
0.017476	2.179688	12.53	16.31	At most 5
0.001658	0.187465	3.84	6.51	At most 6

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Table 4. Normalized Cointegrating Coefficients

Model 1 (lag order=5)								
Standardized	**REER**	**RELP**	**RELCOM1**	**RELCOM2**	**GOV1**	**GOV2**	**OPEN**	**IDIF**
eigenvector	1	-0.20	-0.21		0.46	-0.46	0.57	-0.001
	Std Error	(0.07)	(0.08)		(0.12)	(0.11)	(0.13)	(0.00)
	T-Ratio	*(-2.88)*	*(-2.48)*		*(3.06)*	*(-4.17)*	*(4.18)*	*(-2.44)*
Speed of adjustment of REER	*-0.14*							
Std Error	(0.06)							
T-Ratio	(-2.33)							
R²	0.53							
R²-adjusted	0.31	Included observations =113 after adjusting endpoints						
Log Likelihood	991.68							
Model 2 (lag order=5)								
Standardized	**REER**	**RELP**	**RELCOM1**	**RELCOM2**	**GOV1**	**GOV2**	**OPEN**	**IDIF**
eigenvector	1	-0.32		-0.27	0.046	-0.17	0.16	-0.0005
	Std Error	(0.04)		(0.06	(0.06)	(0.06)	(0.07)	(0.00)
	T-Ratio	(-7.58)		*(-4.11)*	*(0.68)*	*(-2.86)*	*(2.15)*	*(-2.17)*
Speed of adjustment of REER	*-0.23*							
Std Error	(0.08)							
T-Ratio	(-2.76)							
R²	0.54							
R²-adjusted	0.33	Included observations =113 after adjusting endpoints						
Log Likelihood	1005.7							

The results reported in Table 4 show evidence of one cointegrating vector for each model at the 1% level (possibly two cointegration vectors at the 5% level), suggesting a long term relationship between the real exchange rate, relative prices, real commodity prices, government expenditures on tradables and on non-tradables, the openness ratio and the real interest rate differential.

Model 1

$$REER = 0.20RELP + 0.21RELCOM1 - 0.46GOV1 + 0.46GOV2 - 0.57OPEN + 0.001IDIF$$

Model 2

$$REER = 0.32RELP + 0.27RELCOM2 - 0.05GOV1 + 0.18GOV2 + -0.17OPEN + 0.0005IDIF$$

In both models, all variables have the expected sign and are statistically significant, with the exception of the dummy variable which was not statistically different from zero at the 10% level in either specifications (and therefore not reported in Table 4). In model 1, government expenditure on non-tradables appears to have a strong positive impact on the real exchange rate: a 1% increase in this type of government expenditure is associated with a 0.46% REER appreciation. The effect is smaller, however, in the second model,

raising some stability issues. Government expenditure on tradables also has a strong impact, in the opposite direction, as a 1% increase in the coefficient triggers a 0.46% depreciation of the REER. Other important effects include the positive impact of real commodity prices, irrespective of the denominator chosen, and the negative impact of the trade stance variable, which certainly picks up the impact of trade liberalization initiated in the early 1990s. A somewhat surprising result is the relatively small size of the relative productivity ratio (RELP) compared to international evidence: according to model 1, a 1% increase in the relative price ratio (higher non-tradable prices) is associated with a less than proportional real exchange rate appreciation or about 0.2%, whereas its impact is three to four times as large in other countries (ALBEROLA et.al.[1999]). In contrast, in their REER estimation covering the 1984-2000 period, MERLIN & PORTUGAL [2002] found a relative productivity estimate close to 1.5, which appears to be much larger than results obtained in other countries. This difference could reflect a number of factors, including cross-correlation with other variables[29], or the fact that the relative price ratio performs poorly as a proxy of productivity differential because of the different composition of indices in terms of tradables and non-tradables in Brazil and abroad. Lastly, the impact of the real interest rate differential on the real exchange rate is positive, as one should expect, but the size of the coefficient is very small (i.e. a 1% increase in the differential is associated with a 0.001% increase in REER). This could be either due to measurement problems, or to the series of capital controls and sterilization policies conducted during the Real plan aimed at slowing down real currency appreciation in the face of strong capital inflows.

The speed of adjustment between the real exchange rate and its long term equilibrium value, as measured by the error correction term reported in Table 4 is ranging from 0.14 to 0.23, depending on the model specification, implying that that about 15-20% of the gap is eliminated every period and that full adjustment takes place within a maximum of one year and a half, in the absence of other shocks[30]. This seems to be relatively fast, but given the high volatility of the real exchange rate in the 1990s and the 1999 devaluation, this is certainly plausible.

As regards the short run dynamics, most short-run effects were found to be insignificant at the 10% level (and therefore not reported in the interest of space), with the exception of innovations in the real exchange rate and government expenditures (GOV1 and GOV2). As regards the latter, a change in GOV1 was associated with an appreciation of the real exchange rate in the short run while an increase in GOV2 was associated to a real exchange depreciation. This could well reflect the traditional overshooting impact effect in a sticky price environment.

As far as the robustness of results are concerned, it should be noted that the choice of the real commodity price variable does have an impact on the size of the coefficients, as

[29] When the estimation is performed on the basis on a "reduced form" of the model, using the same relative price ratio as well as net foreign assets (i.e. the left-hand side of equation 2), the coefficient of RELP "raises" to about 0.60, which is close to international evidence.

[30] With model 1, half of the gap is closed after seven months, implying that full adjustment takes place within 1 year and a half. With model 2, the full gap is closed in less than one year.

evidenced by the differences between model 1 and model 2 (table 4). One should also emphasize that although neither models exhibits any autocorrelation, other statistical properties (tests for skewness, kurtosis and normality of the residuals, and eigenvalue stability condition test) yielded mixed results, which calls for caution in the interpretation of results[31].

Notwithstanding these borderline statistical properties, the next step is to compute some measures of the equilibrium real exchange rate and to analyze the implied real exchange rate misalignment. Three alternative measures can be constructed, ranging from "naïve" to "sophisticated". The first one is purely mechanical and consists of calculating the *median real equilibrium exchange rate since the 1999 devaluation*[32] and to use this permanent value as a benchmark against which to measure potential misalignments, treating the equilibrium REER as constant . The second measure is to use the cointegration vector reported in Table 4 to calculate the level of the real exchange rate, which is consistent in *the long run with the equilibrium values of the explanatory variables*. Typically, this type of measure involves neutralizing the temporary fluctuations in the cointegration relationship with the Hodrick-Prescott filter, a smoothing technique which has been extensively used in the recent literature[33]. Lastly, the third measure is *to compute the real equilibrium exchange rate using both the long-term cointegrating vector as well as the short run deviations of the ECM representation reported in Table 4, thereby decomposing the real exchange rate into permanent and transitory components*, using the method originally proposed by GONZALO & GRANGER[1995]. The main advantage of the proposed decomposition between I(1) and I(0) components is that the transitory component does not "Granger cause" the permanent component in the long run, which is itself a linear combination of contemporaneously observed variables.

Let us define the orthogonal components $\alpha\perp$ and $\beta\perp$ as the eigenvectors associated with the unit eigenvalues of the matrices $(I-\alpha(\alpha'\alpha)^{-1}\alpha')$ and $(I-\beta(\beta'\beta)^{-1}\beta')$, respectively, with $\alpha'_{\perp}\alpha = 0$ and $\beta'_{\perp}\beta = 0$. X_t can thus be written as equation (7):

$$X_t = \beta_{\perp}\left(\alpha'_{\perp}\beta_{\perp}\right)^{-1}\alpha_{\perp}X_t + \alpha\left(\beta'\alpha\right)^{-1}\beta' X_t \qquad (7)$$

where $\beta_{\perp}\left(\alpha'_{\perp}\beta_{\perp}\right)^{-1}\alpha_{\perp}X_t$ captures the permanent component and $\alpha\left(\beta'\alpha\right)^{-1}\beta' X_t$ depicts the transitory component.
Using model 1, all three measures are reported in Chart 15, together with the actual real exchange rate between 1991 and 2003, and the implied misalignment of the REER is

[31] Specifically, although the hypothesis of normality of residuals could not be rejected, the eigenvalue stability condition test indicated that one of the 35 eigenvalue modulus was equal to 1, which is normally a sign of instability.
[32] The choice of the benchmarking period is key for the usefulness of this approach, which has been applied in some investment bank reports on emerging markets. It is to be noted that this is close to an extreme PPP version, as it assumes that the REER is constant in the long run.
[33] The smoothing parameter was set to 14400, as usually suggested for monthly data. It is fair to recognize, however, that the HP filter has its drawbacks, the most serious being that the filter seems to perform poorly at the beginning and the end of the series.

reported in Chart 16. As can be expected, the three measures convey slightly different stories regarding the misalignment of the Brazilian currency over time[34].

Chart 15. Real Effective Exchange Rate vs. Alternative Equilibrium Levels (1994-2003)

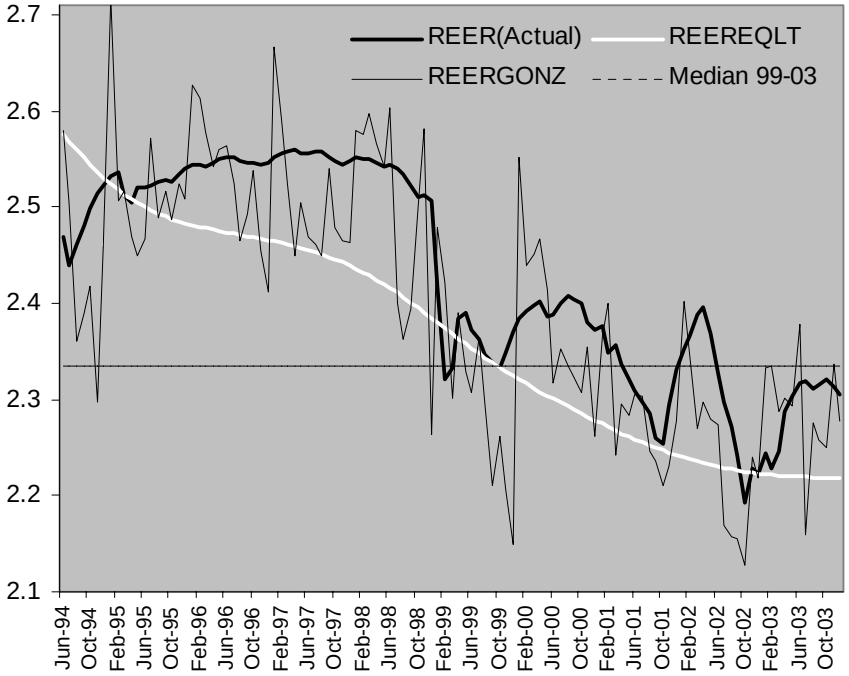
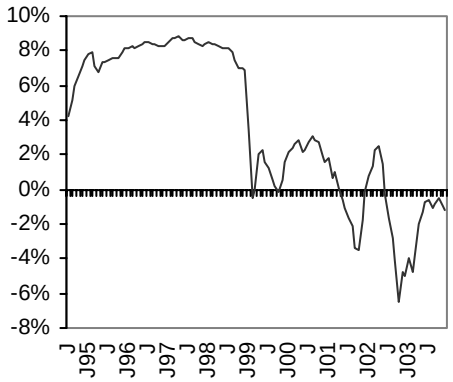
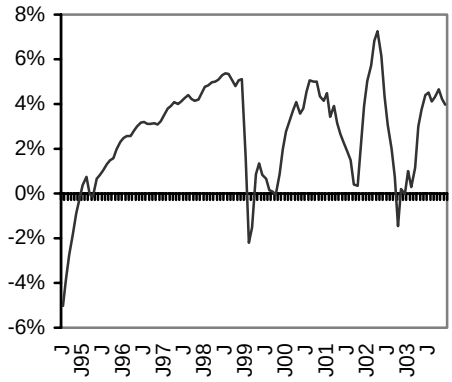


Chart 16. Implied Real Effective Exchange Rate Misalignment (Percentage Deviation from Actual REER)

a. Median Value 99-03

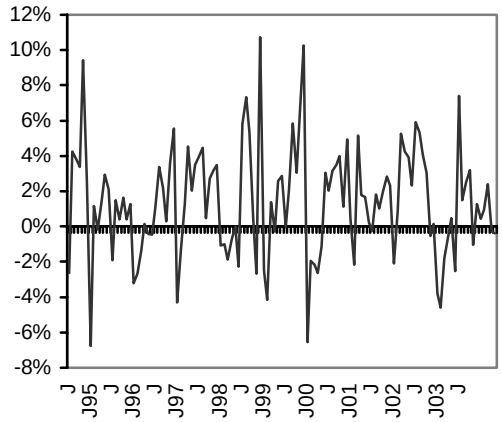


b. Long-Run Value



[34] It should be noted that the choice of the model does not fundamentally affect the results.

c. Permanent & Transitory Components



Interestingly, irrespective of the measure chosen, real exchange rate misalignments seem to have been *moderate* in the 1990s, including during the period immediately preceding the devaluation of the Real. The growing overvaluation of the currency in real terms is picked up both by the "naïve" and the "long run" approaches, but the magnitude of the actual misalignment appears to be surprisingly small, i.e. around 5-6%. It is also worth noting that the decomposition between permanent and transitory components yielded rather unhelpful results, exhibiting some fair amount of noise while closely replicating the actual REER path. This is perhaps not overly surprising, however, given the use of high-frequency data. These results are broadly consistent with those of MERLIN & PORTUGAL [2002]), which raise some interesting questions regarding the evolving nature of fundamentals during the inflation stabilization period. Actually, the misalignment puzzle discussed in section II seems to strike back. This is not to say that the real exchange rate was not *overvalued* (numerous indicators point to the contrary), but our results show that the underlying fundamentals were consistent with the growing real appreciation of the real from 1995 to 1998. Another consideration to be kept in mind is that the Real appreciated the most in the initial phase of the disinflation program, between 1994 and 1996, that is at the beginning of our sample. This could well bias the alleged misalignment downwards, as illustrated by our discussion of overvaluation estimates in section II.

In any case, our estimation gives some support to the supply-side influences as well as demand-side influences on the real exchange rate path, as noted in IMF[1998]. The real appreciation of the exchange rate not only reflected productivity growth and the restructuring of the economy (the supply-side, mostly driven by the Balassa-Samuelson effect), but also by important demand elements, such as the widening of the public sector deficit. Indeed, a real appreciation driven by a rise in public expenditure (and the associated decline in the fiscal position) leads to growing misalignments. It is fair to admit that both supply and demand effects actually counterbalanced each other as

determinants of the real exchange rate, as evidenced by the small "overall misalignment" reported on the basis of our estimation. However, it seems plausible to assume that the existence of strong demand elements had an impact on the sustainability of the current account deficit, especially given the fiscal situation, as discussed in section II.

The other interesting result is that misalignment swings seem to have been more pronounced in the years following the devaluation than during the years before. In particular, important departures from equilibrium are picked up by the model in 2002, which certainly reflects the large nominal volatility recorded that year, as markets became increasingly nervous in the lead up to the October 2002 presidential election. Lastly, and although caution is required given the inherent limitations of this exercise, the Real appeared to be more or less aligned as of end 2003, with a minor misalignment range (-4 to +4%), depending on the benchmark used as the "equilibrium" REER. Compared to its long-run equilibrium, the actual REER may even be slightly overvalued. In any case, our results strongly reject the massive undervaluation of the Real implied by the Big Mac Index discussed in section II.

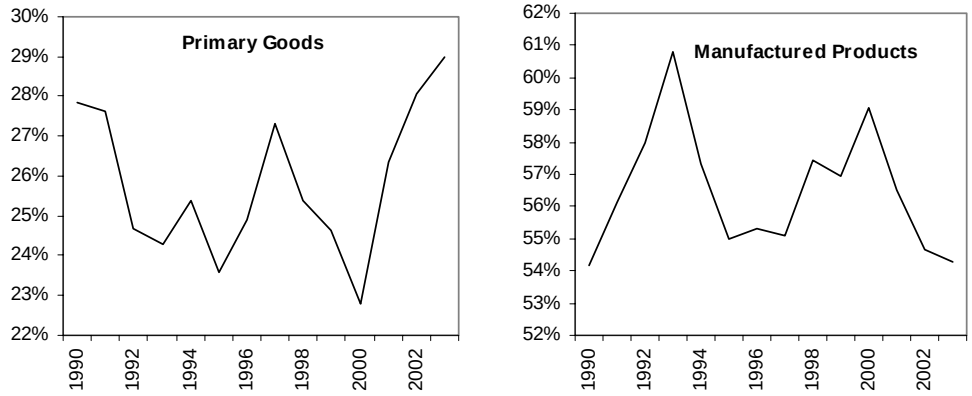
V. POLICY IMPLICATIONS REGARDING TRADE PERFORMANCE & COMPETITIVENESS SINCE THE 1999 DEVALUATION

Apart from the topical issue of the Real misalignment, the results presented in the previous section have also some policy implications regarding trade performance and competitiveness in Brazil. While the service balance (services, income and transfers) remain traditionally negative in Brazil owing to large net services imports and interest payments, the trade balance plays an important "damage limitation" role in total external balance. It is striking that *trade performance improved only very marginally between 1999 and 2002 (Chart 9), although the REER depreciated by some 35% following the devaluation of the Real*. The turnaround of the trade surplus actually materialized in the course of 2003, mainly driven by import contraction, as noted in section II.

If one accepts the conclusions drawn in the previous section regarding the absence of sizable real exchange rate misalignment at the end of 2003, it may be relevant to quickly analyze the main determinants of trade flows between 1999 and 2003, not only focusing on the role of the real exchange rate in Brazilian trade flows, but also on other determinants. Besides the actual level of the real exchange rate as a standard measure of price competitiveness, other factors are certainly relevant in the case of Brazil, such as REER volatility (which was high from 1999 to 2002). For instance, PAIVA [2003] investigated the issue of trade elasticities in Brazil from 1991 to 2001 and found, as expected, that trade flows were not only responsive to the real exchange rate, but also to real exchange rate volatility: in particular, real exchange rate volatility was found to have a negative impact on export volumes. The suspicion was not new, but earlier research proved inclusive (GONZAGA & TERRA [1997]). These recent results also showed that exports of primary goods seem to be more responsive to the real exchange rate than other categories of exports, which confirms the general observation that primary goods

typically have low income and high price elasticities[35]. Actually, trade figures reveal a resilient trend towards increased specialization in primary goods, a trend that was reversed in the 1980s, but which emerged again in the mid-1990s. As can be seen in Chart 17, the share of primary goods in total exports has increased significantly since 1999, whereas the share the manufactured goods declined during the same period. This is important for Brazil, as our results suggest that one of the determinants of the REER is real commodity prices, implying an interesting *inverse relationship between overall competitiveness and the terms of trade*. This may also explain the somewhat disappointing trade performance in the period immediately following the devaluation, since commodity prices and manufactured prices were quite depressed. By contrast, the recent burgeoning of exports in Brazil essentially captures booming commodity prices as well as the growing demand in China for some Brazilian export products -mainly soy and steel- , the two factors being closely related.

Chart 17. Share of Primary and Manufactured Products in Total Exports (%) (1990-2003)



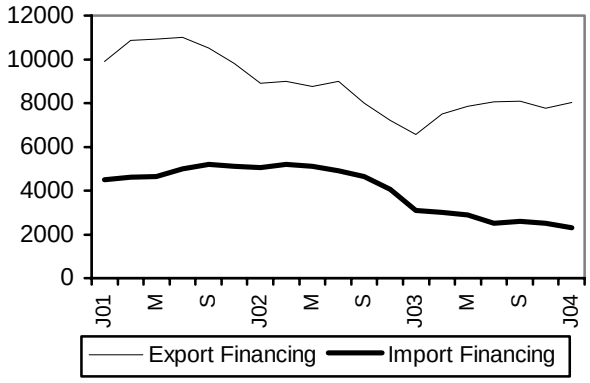
Source: FUNCEX

Another important conclusion of the analysis conducted by PAIVA [2003] is that the elasticity of imports to domestic income is approximately twice as high as the elasticity of exports to foreign income. This is of course a source of concern, as one of the possible implications is that, other things being equal, *domestic economic stagnation may favor the emergence of trade surpluses*. Although this may be an extreme statement, this illustrates the fact that the competitiveness of exports may also depend on other factors than the level or the volatility of the real exchange rate. Indeed, a country's comparative advantage depends not only on price and cost competitiveness, but also on *nonprice competitiveness*, such as technological innovation, investment in physical and human capital, and service-related factors. In the case of Brazil, one must emphasize the role of structural rigidities, i.e. the so-called "*Custo Brasil*". These costs include, *inter alia*, a very heavy tax system, infrastructure bottlenecks, a cumbersome legal system, labor productivity issues associated with the existing labor code, issues related to the general

[35] OECD [2001], p.142.

business regulations, and last but not least, lack of access to financing and high financial intermediation costs[36]. It seems indeed that the lack of availability of trade finance through the banking system significantly impacted trade flows since the 1999 devaluation, especially on the import financing side. As shown in Chart 18 below, import financing lines have basically been halved from 2001 to end 2003, whereas export financing restarted to grow at the beginning of 2003. Although other factors may be relevant, these financing problems are related to the level of interest rates in Brazil and to the very sizable banking spreads in general[37].

Chart 18. Trade Finance Lines (US$ mn), J2001-J2004

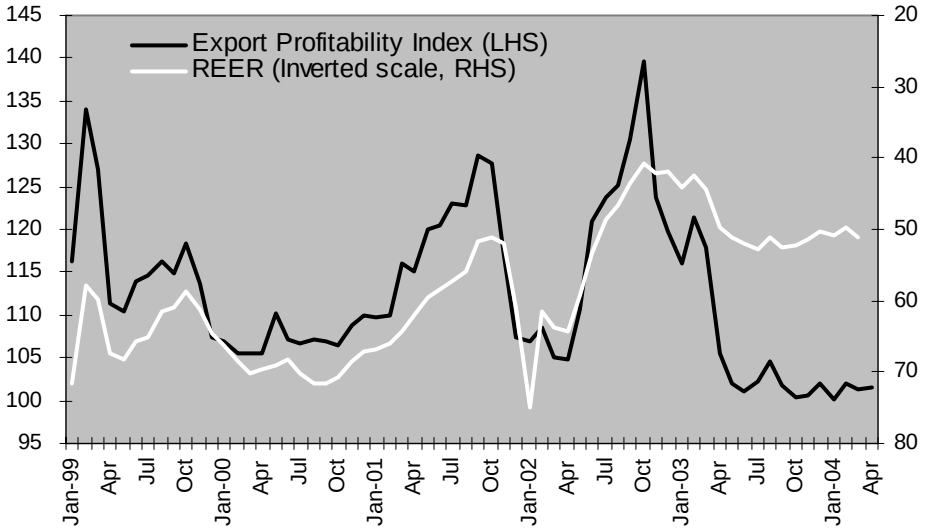


Source: Banco Central do Brasil

All in all, this very general discussion of the main determinants of trade flows since the 1999 devaluation hints some of the remaining challenges associated with export competitiveness, which go well beyond real exchange rate consideration. The best illustration is certainly the fact that the overall profitability of Brazilian exports seem to have deteriorated significantly since the third quarter of 2002, way beyond REER movements, as shown in Chart 19. As of April 2004, the profitability of Brazilian exports was actually back to its August 1994 starting value, i.e. right after the launching of the Real plan. This may actually reflect the pass-through effect of higher energy prices on transportation costs, among other things, but this remains odd.

[36] See WORLD BANK [2004].
[37] One may argue that large firms have usually recourse to external financing, but the issue is not fundamentally different as the cost of external financing depends on the country risk (usually measured by the spread over US Treasuy bills).

Chart 19. REER and Export Profitability (J1999-A2004)



Note: the Export Profitability Index (*Indice de Rentabilidade das Exportações Totais*) is computed by FUNCEX using the average nominal exchange rate corrected for the cost structure of exports and the differences between export and input prices across 35 sectors. Base: August 1994=100.
Source: FUNCEX, IMF

VI. CONCLUDING REMARKS

This paper provided an econometric analysis of the determinants of the real exchange rate in Brazil from 1994 to 2003, using an unrestricted vector autoregression technique. The results present evidence of a long-run relationship existing between the real effective exchange rate, relative productivity differentials, real commodity prices, the ratio of government expenditure on tradables to GDP, the ratio of government expenditure on non-tradables to GDP, trade openness and interest rates differentials. The analysis suggests, *inter alia*, that the speed of adjustment between the real exchange rate and its long term equilibrium value is relatively fast, with full adjustment taking place within a maximum of one year and a half, in the absence of other shocks. In addition, the results indicate that real exchange rate misalignments seem to have been surprisingly moderate in the 1990s, including during the period immediately preceding the devaluation of the Real, which supports earlier econometric work. Such results suggest that both supply-side effects and demand-side effects put pressure on the real exchange rate path, and tend to indicate that there was perhaps no inherent inevitability –from a misalignment standpoint *alone*- in the timing of the 1999 devaluation. However, given the borderline statistical properties of our estimates, and given the use of high frequency data, care is needed when interpreting these results. It seems safe to conclude that the misalignment puzzle is not totally exhausted and certainly deserves additional empirical investigation. Furthermore,

what constitutes an equilibrium in the non-trivial world of real exchange rate is still heavily debated, as it is not easy to choose the "right" benchmark.

The other finding of this paper is that as of end 2003, the Real was found to be slightly appreciated with respect to the estimated equilibrium level, although the extent of the misalignment appears to be small as well. Yet, as pointed out in section VI, the overall profitability of exports declined from mid 2002 to early 2004, despite favorable commodity prices. From a policy perspective, relying on a flexible exchange rate with an inflation targeting regime inevitably raises some difficult policy dilemma regarding the optimal rate of real exchange rate depreciation which would be consistent with stabilizing inflation and maintaining external balance, without hampering the growth of economic activity. In this respect, one logical conclusion is that additional structural reforms are needed in order to increase the competitiveness of the Brazilian economy. Furthermore, such reforms would no doubt reinforce the credibility of the inflation targeting regime, and thereby alleviating the policy dilemma highlighted before.

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