PUBLIC DEBT, EXCHANGE RATE SHOCKS AND INFLATION TARGETS

Affonso Celso Pastore
Maria Cristina Pinotti
Leonardo Porto de Almeida

INTRODUCTION

The operation of monetary policy under an inflation target regime has been notably successful in Brazil. Inflation has remained under control even in the face of strong shocks, and fluctuations in output have been minimized. Over these past five years, the Brazilian Central Bank has promoted empirical studies of fundamental importance to the operation of monetary policy, supplied the necessary information at the quarterly Inflation Reports and Monetary Policy Committee meeting minutes for a transparent understanding of its decisions, operated with a high degree of *de facto* independence, and established strong credibility. Taken together, this has given it the power to influence expectations and minimize the cost of fighting inflation.

The greatest difficulties to the operation of an inflation-targeting regime come from the extreme exchange rate volatility in Brazil. Less intense exchange rate shocks cause inflation to rise temporarily, but without pushing it out of the target interval, and the primary inflationary effects can be accommodated by calibrating the interest rate to dissipate the secondary effects. Stronger shocks, however, as occurred in 2002, require heavier artillery. In 2002, the Central Bank, without abandoning the long-term target, chose to permit inflation to outstrip the target in the short-run, but to preserve its credibility, compensated this greater flexibility with a strong commitment to a pre-established convergence to the long run target. But the Central Bank could not act alone under those circumstances. The effects of the weaker real exchange rate, higher real interest rates and the consequent economic slowdown, changed the dynamic of the public debt, requiring the government to raise the primary fiscal surplus. Finally, the strong exchange rate volatility required interventions in the foreign exchange market, which would have been impossible without the backing of an agreement with the IMF.

The example of 2002 showed that a volatile exchange rate, in Brazil, is not an intrinsic characteristic of the inflation target regime, but rather comes from important imbalances that cannot be dealt with only by monetary authorities within the operation of the inflation targeting regime.

These imbalances derive, first, from the extremely high public debt, a large portion of which is dollar-denominated so that its dynamic is influenced by the real exchange rate. The mere expectation that the government may stray from it commitment to high enough primary surpluses to lower the debt/GDP ratio causes capital inflows to shrivel, and since the exchange rate is highly dependent on capital flows it depreciates, and raises the debt/GDP ratio, producing a crisis with a strong element of self-fulfilling prophecy. But changes in risks of the public debt sustainability are not the only factor that determines the sharp moves in the behavior of capital flows. Shocks that alter the risk aversion of the international financial market or the degree of international liquidity also have important effects, interfering in the dynamic of the public debt and affecting the behavior of the exchange rate and inflation.

In the second place, they come from the fact that the Brazilian economy is still relatively closed to international trade, meaning that in face of a sudden stop in capital flows the exchange rate has to fall much more than it would otherwise be necessary to close the balance of payments financial requirements. Although in the past two years Brazil's current account deficits have turned into surpluses, reducing the downward pressure on the exchange rate in the event of a reduction of capital inflows, the public and private foreign debts falling due in the near future are still high, and in case of a new sudden stop, of even of a moderate reduction in capital inflows, they will require generating even greater current account surpluses and can potentially put extra pressure on the exchange rate and on inflation.

The third characteristic comes from the low level of bank lending to the private sector, which has real effects on the economy. This reduces the effectiveness of one of the channels of transmission of the monetary policy - the credit channel -, and on the other side pushes the country towards the *original sin,* increasing the level of liability dollarization. Although Brazil has never reached such a high level of liability dollarization as in economies adhering to some form of a hard peg, the private banking system cannot supply enough financing for needed investments in increased industrial capacity, forcing businesses in large measure to borrow abroad. This level of liability dollarization may not be high enough to produce a contractionary devaluation, as occurred in some countries during the Southeast Asian crisis or more recently in Argentina, but the empirical evidence shows that it has an important stanching effect on investments. In the same way the strong *real* of 1994-98 helped jack up companies' the net worth, raising investments, the

devaluation of the *real* in 2001-2002 caused investments to dry up, and although this did not cause output actually to fall, it certainly slowed its growth.

It is clear that the experience in operating a monetary regime always suggests ways to improve it. But the most important improvement in the inflation-targeting regime in Brazil lies outside the scope of monetary policy. The most important improvement is in fiscal policy: Brazil needs to reduce the debt/GDP ratio and the proportion of the public debt tied to the dollar. The second is in the field of bank lending: Brazil has to find a way to heighten the level of financial intermediation, to raise the proportion of lending to the private sector in *reais* and correspondingly cut the degree of liability dollarization. The third is to open the economy further to international trade, contributing to the reduction of the exchange rate volatility. Finally the fourth is to give the Central Bank legal rather than just de facto independence, to increase central bank's credibility in the conduct of the monetary policy.

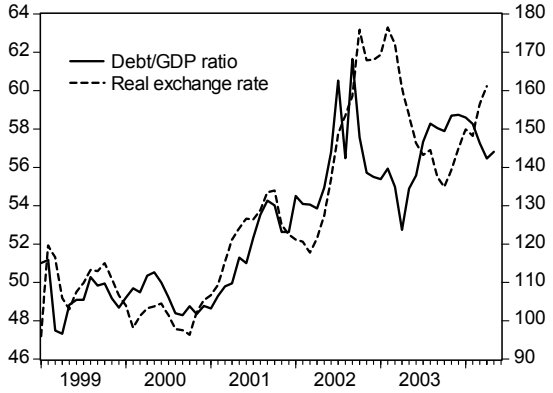
THE EXCHANGE RATE, PUBLIC DEBT DYNAMIC AND CURRENT ACCOUNTS

The true test of the efficacy of inflation targeting in Brazil occurred with the shocks that pushed inflation above the upper limit of the target interval in 2001 and again in 2002. In neither year did inflation rise because of excessively accommodative monetary policy that overheated the economy. The evidence from the Central Bank's reaction curve shows that in both years the bank responded to the surge in inflation (current or expected) by raising the nominal interest rate more than the growth in inflation [Minella, Freitas, Golfajn and Muinhos (2002), and Fraga, Goldfajn and Minella (2003)]. The impulse that caused the jump in inflation was in both cases a weakening exchange rate[1].

What was behind such sharp drops in the exchange rate in 2001 and 2002? The answer lies in the interaction of three factors.

[1] In Brazil, the pass-through of a fall in the exchange rate to consumer prices tends to be low on average, although higher than in G7 countries [Belaisch (2003)], and there are indications that it varies with the position of the economic cycle and the degree of exchange rate misalignment [Goldfajn e Werlang (1999)]. In 2002, the economy was in full recovery and the real exchange rate was significantly more depreciated than in 2001, which led to a bit higher pass-through than in 2001. In that earlier year, the factors that contributed to a lower pass-through were, besides the economic slowdown: a) contagion from the Argentine crisis, which touched off the falling exchange rate; and b) the fact the real exchange rate was below equilibrium, generating current account deficits of around 4% of GDP.

Graph 1
Debt/GDP Ratio and Real Exchange Rate



The first is linked to fiscal policy and the behavior of the exchange rate. On the one hand, Brazil's public debt is large, with a high proportion tied to the dollar, making its dynamic very sensitive to the real exchange rate. On the other hand, the behavior of the exchange rate depends predominantly on capital flows, whose oscillations are affected by the market's evaluation of the government's commitment to a sustainable public debt. The contagion from Argentina in 2001 and the fear that the new government would abandon fiscal austerity in 2002 dried up demand for Brazilian bonds and pushed down the exchange rate. Even in the face of primary surpluses seeking to stabilize the debt/GDP ratio, calibrated in function of its size, the real interest rate and rate of economic growth, public debt went up with the weaker real exchange rate in 2001 and 2002, as shown in Graph 1.

The second factor is associated with the magnitude of the exchange rate depreciation necessary to change the current account deficit. The behavior of the exchange rate does not depend only on capital flows, but also on the current account balance, in a form similar to that suggested by Dornbusch and Fischer (1980). Since Brazil's economy is relatively closed, the amount of devaluation needed to cut current account deficits tends to be greater. In situations of sudden stops of capital flows and high current account deficits, as occurred in 2002, the downward pressure on the exchange rate is strong, which produces significant effects on the debt/GDP ratio. To this effect must be added the additional demand for foreign currency to service public and private debts as they mature, which in the case of a sudden stop in capital flows must be partly covered by generating a current account surplus.

A third factor comes from dollarization of liabilities. Although Brazil has never gone to the extreme of some sort of hard peg, as in Argentina, domestic lending from the banking system in *reais* is only around 30% of GDP. This forces firms to look abroad to finance

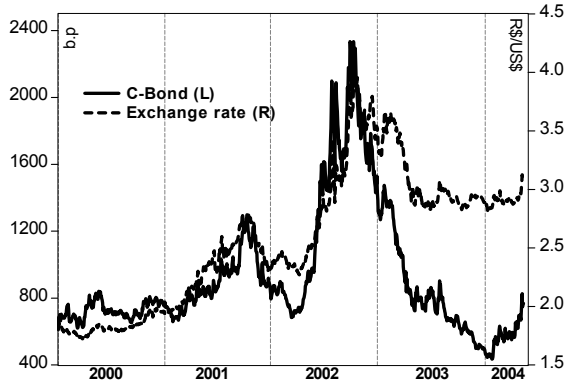
capital investments, causing a relatively high degree of liability dollarization. In the presence of a weaker real exchange rate, this leads to a balance sheet effect, to a contraction in gross fixed capital formation and the use of installed capacity. Since the degree of liability dollarization is not extreme[2] and the lower exchange rate also raises net exports (tending to boost the overall economy), the devaluation does not necessarily cause output to fall, but it certainly cuts the rate of GDP growth, which affects the dynamic of the public debt and interferes with the execution of monetary policy.

All these problems happened in 2001, and even more so in 2002, obliging the Central Bank to adjust its actions within the inflation target regime. We first examine the empirical evidence available for each of these factors, and then briefly analyze how it was possible to deal with these effects within the inflation target regime.

CAPITAL FLOWS AND CURRENT ACCOUNTS

In 2001, the contagion from the Argentine crisis contracted demand for Brazilian bonds abroad, which depressed their prices on the secondary market, raised risk premiums and discouraged new bond issues, reducing the inflow of capital and depreciating the *real*. In 2002, this scenario repeated itself even more starkly, due partly to uncertainties over the fiscal policy that the Lula government would follow and partly to a higher level of general risk aversion in the international market.

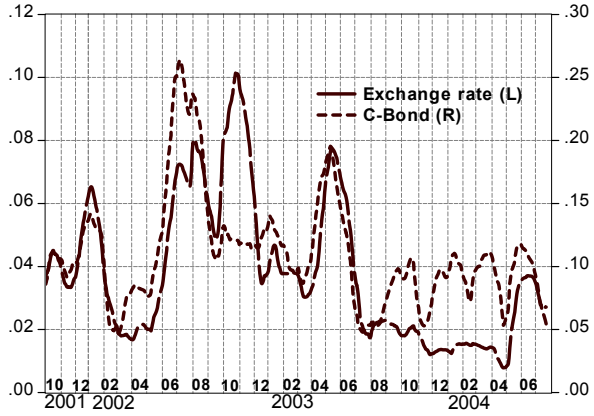
Graph 2
Risk Premium and Nominal Exchange Rate



[2] The exchange rate risk to the private sector is partly covered by the exchange rate hedge supplied by the government, which reduces the effects of dollarization of liabilities, but creates problems of sustainability of the public debt.

Graph 3

Volatility of Risk Premium and Nominal Exchange Rate



Graph 2 clearly shows the positive correlation between risk premiums and the nominal exchange rate. In Graph 3 we compare the volatility of these two variables, estimated by their coefficients of variation computed in a moving 60-day window applied to daily data. The risk premium is more volatile than the exchange rate, the former with an average coefficient of variation of 0.11 and the latter of 0.04, and the simple correlation coefficient between the two variables is 0.69. The simple correlation coefficient between the absolute values of the risk premium and exchange rate shown in Graph 1 from 2000 onward is 0.58.

Besides political uncertainties about the new Brazilian government, the higher risk aversion due to the accounting scandals in 2002 also played an important part in the retraction of capital flows. Megale (2003) showed that Brazil's risk premium grows with worse economic fundamentals, among them those connected with the size of the public debt dynamic, and the rate of economic growth, but also because of changes in international liquidity and the level of risk aversion. A simplified version of his model is estimated below[3].

$$\underset{\quad\ (14.487)\ (11.625)\qquad\qquad (3.227)}{Log(EMBI) = 10.565 - 3.474\ log(RATING) + 0.094\ log(Fedfund) +}$$

$$\underset{\quad\ (9.729)\qquad\qquad (2.727)\qquad\quad (3.563)}{+ 0.525\ log(HIGHYIELD) + 0.246\ dumBR + 0.392\ dumRUSS}$$

$$R^2 = 0.774 \quad S.E. = 0.185 \quad F = 74.015$$

[3] In this, as in all the other equations below, the numbers in parentheses below the coefficients are the Student's T values.

In this model, the "fundamentals" of the Brazilian economy are gathered in a single variable, which is Brazil's rating from S&P, with the other variables being the Fed funds rate, the spreads on high-yield bonds (acting as a proxy for the level of risk aversion), and two dummies, one for the Russian crisis and another for the Brazilian devaluation. The risk premium grows with increased risk aversion and the higher Fed funds rate[4].

Despite the low levels of Fed funds, the increased risk aversion sharply raised the spreads on high-yield bonds and contributed to reduce capital flows to emerging economies, pushing up the risk premiums of all of them in 2002. This was an important additional cause of Brazil's weakening exchange rate in 2002.

But capital flow movements are not the only force explaining the falling depreciating exchange rate in 2002. The other can be seen more clearly by evaluating the real exchange rate depreciation needed to reduce the high current account deficits, which have been growing since introduction of the *real* in 1994. In economies more closed to international trade, the depreciation needed to close a current account deficit tends to be greater. This characteristic was used by Calvo, Izquierdo and Mejia (2004) in evaluating the role of balance sheet effects in generating contracted outputs by emerging economies faced with sudden stops in capital flows, and by Calvo, Izquierdo and Talvi (2003) in explaining the Argentine crisis.

Brazil's economy, despite great strides toward more openness, is still relatively closed to international trade. At the end of 2000, it had a current account deficit approaching 5% of GDP and a clearly overvalued exchange rate. Based on quarterly data from national accounts, we can estimate the depreciation required in the real exchange rate to close that deficit. In the equation below, we regress the quotient between the current account balance and real GDP over the real effective exchange rate estimated by the Central Bank and the endogenous lagged variable.

[4] The positive sign of the Fed funds rate is intuitive, but is far from being a consensus among economists. Frenkel and Roubini (2003), for example, show empirical evidence of a negative sign for a group of emerging countries. The analysis of Megale shows a positive sign is only obtained when a proxy is included in the model for the level of risk aversion. Note that since the spreads on high-yield bonds are influenced both by the degree of risk aversion and the Fed funds rate, its coefficient in the above equation cannot be interpreted as capturing only the effect of risk aversion, since "everything else constant" does not hold. It captures a mixture of the effects of international liquidity and risk aversion, and since a piece of the effect of liquidity is captured in this coefficient, there is also a bias in the coefficient of the Fed funds rate. It is closer to the truth to assume that the joint effect of liquidity and risk aversion is captured by the two variables together.

$$log[(X-M)/y]_t = - 0.233 + 0.048\ log(CR)_t + 0.678\ log[(X-M)y]_{t-1}$$
$$(5.400) \quad (5.385) \qquad\qquad (10.279)$$

$$R^2 = 0.925 \qquad S.E. = 0.011 \qquad F = 276.269$$

In this estimate, the long-term elasticity of *(X-M)/y* with relation to the real exchange rate is equal to 0.148 (=0.048/(1-0.678)), which implies that a variation in the current account balance in relation to GDP of 5 percentage points requires the exchange rate to fall by around 35%. It is clear that this adjustment process contains some elements of overshooting, because the dynamic of exchange rate adjustment is strongly influenced by capital flows, and during 2002-2003 the real exchange rate depreciated much more than this estimate. But after overcoming this overshooting of 2002-3, the real exchange rate has depreciated approximately 40% when comparing its level in the past six months, during which the current account is posting a small surplus, with that of the average for the period 1999-2000.

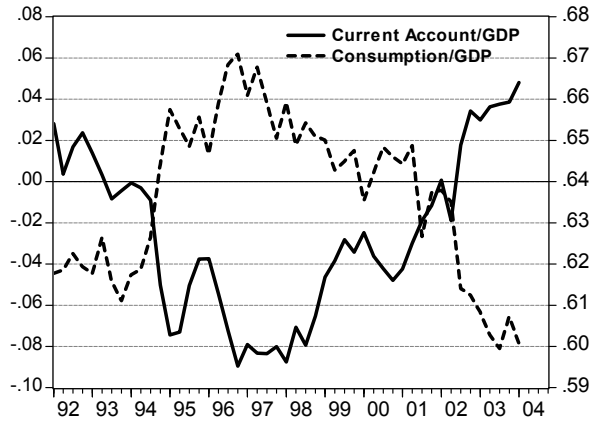
EXCHANGE RATE DEPRECIATION, ABSORPTION AND BALANCE-SHEET EFFECT

The counterpart of contracting current account deficits is the effect of exchange rate depreciation on absorption. For absorption to fall, either government or private sector saving must go up relative to investments, and in the absence of changes in government savings and mechanisms to contract investments, the entire adjustment occurs with the fall in private consumption. For this reason, there should be no surprise that faced with a current account balance moving from a deficit of 5% of GDP to equilibrium, or even a small surplus, consumption should have fallen.

We have already seen that a devaluation reduces the current account deficit, and a comparison between the consumption/GDP and current account/GDP ratios shows a clear inverse correlation between these two variables, as shown in Graph 4, indicating that part of the fall in absorption in 2001 and 2002 came from fall in real income, i.e., the fall in real wages produced by the depreciation in the real exchange rate.

Graph 4

Current Accounts and Consumption



A clearer test of how this adjustment operates is given by estimating the consumption function based on quarterly data from the national accounts. The equation below shows that consumption (*C*) is sensitive to real income (*y*), but contracts with depreciation of the real exchange rate (*RE*). There are also indications, albeit a bit weaker, that elevation of the real interest rate (*r*) contracts consumption. These results indicate that the inverse correlation shown in Graph 4 is fundamentally generated by the behavior of the real exchange rate.

$$C_t = 0.224 + 0.425\, y_t - 0.007\, RE_t - 0.0007\, r_t + 0.383\, C_{t-1}$$
$$(0.754) \quad (6.195) \quad (6.275) \quad (1.375) \quad (4.979)$$

$$R^2 = 0.985 \quad S.E. = 0.140 \quad F = 705.666$$

It so happens that investments in relation to GDP also show a strong inverse correlation with current accounts in relation to GDP, as shown in Graph 5, suggesting that a falling exchange rate also acts to reduce investments. This contraction would be the consequence of a balance sheet effect that makes the exchange rate depreciation lead to a contraction in companies' net worth.

Graph 5

Current Accounts and Investments

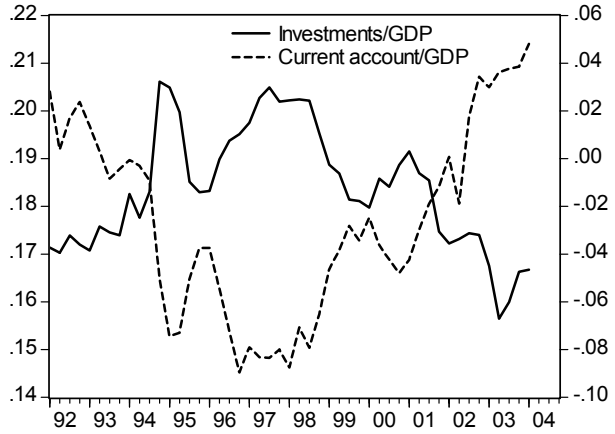


Table 1
Demand for Investments

Variables	*Equation 1*	*Equation 2*	*Equation 3*
Constant	0.430 (2.018)	0.146 (0.851)	-0.138 (0.684)
Real GDP	0.023 (1.441)	0.117 (5.623)	0.233 (4.428)
Real Interest Rate	-0.001 (2.364)	-0.0003 (0.827)	-0.00008 (0.273)
Real Exchange Rate	-	-0.004 (5.618)	-0.003 (2.770)
Stock of Capital	-	-	-0.009 (2.380)
Endogenous at t-1	1.064 (8.429)	0.746 (6.641)	0.625 (5.285)
Endogenous at t-2	-0.313 (2.663)	-0.299 (3.309)	-0.169 (1.657)
R^2 *S.E.* *F*	0.917 0.110 121.939	0.952 0.084 171.630	0.958 0.080 159.484

A more precise test of the contractionary effect of exchange rate depreciation on gross fixed capital formation is presented in Table 1. In the first column, the gross fixed capital formation is regressed over real GDP, the real interest rate and the gross fixed capital formation at *t-1* and *t-2*. In the second column, we add the real exchange rate, and finally, in the third column, we add an estimate of the capital stock, whose construction will be explained below. The inclusion of the real exchange rate in column 2 significantly

improves the estimates, and even after including the stock of capital its coefficient remains negative and differs significantly from zero.

The present equation (as well as all other presented above) is a reduced form, and its coefficients measure the total effect of all forces explaining the investment behavior in a broader general equilibrium model, as in Céspedes, Chang and Velasco (2002). These results show that one cannot reject the hypothesis that exchange rate depreciation tends to contract gross fixed capital formation, which is indicative of a balance-sheet effect: a more depreciated real exchange rate increases debt, reducing the net worth of enterprises and increasing risk premiums. Just as the strong *real* of 1994-1998 led to current account deficits and raised investments in relation to GDP, the devaluation of 2001-2002 contracted current account deficits and investments.

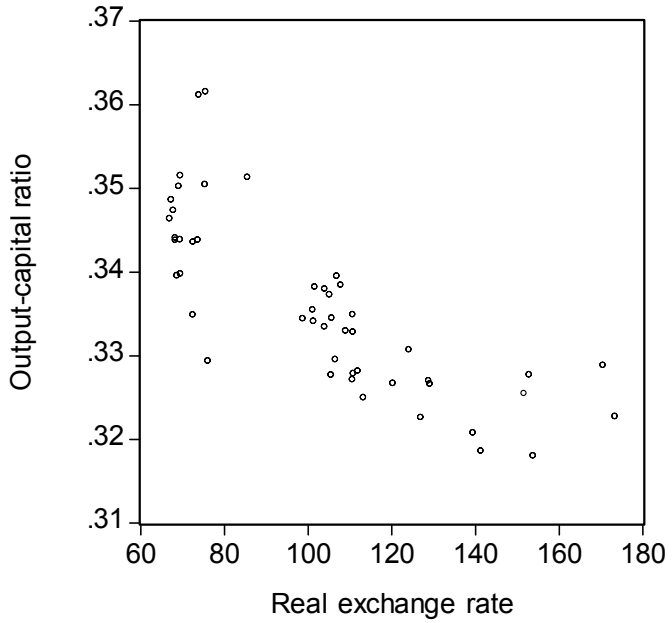
Lesser investment flows does not lead to a contraction in the stock of capital, but only to a slow-down in its growth, and consequently, everything else constant, lead to a slowdown in output growth. But output is by definition given by $y_t = \alpha_t K_t$, where K_t is the stock of capital and α_t is the output/capital ratio, and it is possible that just as the flow of investments contracts with devaluation, the output/capital ratio also shrinks.

To evaluate this effect, we construct an estimate of the output/capital ratio. We start from a perpetual inventory model, expressing $K_t = (1-\delta')K_{t-1} + I_{t-1}$, where δ' is the quarterly rate of depreciation of the stock of capital. Substituting successively $K_{t-1}, K_{t-2}, ...K_{t-n} = K_0$ gives us $K_t = \sum_{j=0}^{n-1}(1-\delta')^j I_{t-j} + (1-\delta')^n K_0$. We have taken the values of K_0 and δ' from Gomes, Pessoa and Velloso (2003): K_0 is their estimate of the capital stock at the end of 1990, and δ' corresponds to the annual rate of depreciation $(\delta = 0.035)$, being given by $\delta' = \exp\left[\frac{\log(1+\delta)}{4}\right] - 1 = 0.0086$. Finally, we compute the output/capital ratio by dividing quarterly GDP by the quarterly estimate of the stock of capital.

Graph 6 contains the scatter diagram between the real exchange rate and output/capital ratio. There is a clear negative correlation between the two variables, suggesting that the level of use of the capital stock also contracts in the presence of a currency devaluation[5].

[5] The behavior of the output/capital ratio is very similar to that of a particular measure of the output gap – that obtained by the deviations of current output in relation to a log-linear trend. The reason for this derives from the fact that the growth in the stock of capital can be approximated by a log-linear trend. A consequente is that

Graph 6
Scatter diagram between the real exchange rate and output/capital ratio



Although our evidences show a contraction of the investments and indicate that the output-capital ratio may contract with the real exchange rate depreciation, they are too rudimentary to lead to the conclusion that in Brazil a devaluation contracts the output. The conditions for a contractionary devaluation "in the pampas" of Latin America were evaluated by Céspedes, Chang and Velasco (2002), that concluded that "capital market imperfections and balance sheet effects matter in two senses. First they magnify the domestic real effects of adverse external shocks, such as a fall in export volumes or an increase in the world real interest rate. Second, devaluation may be expansionary (as in the standard model) or contractionary. The second result requires particularly strong balance sheet effects, arising from both high sensitivity of risk premia and large inherited dollar debts. Then, and only then, does IS-LM-BP turn out to operate differently in the *pampas*."

Some of the conditions pointed out by Céspedes, Chang and Velasco are present in Brazil, but we do not have a complete model to reach such conclusion. However, our evidences are enough to show that together with expansionary effects coming from the net exports, there

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the output/capital ratio can interpreted as an estimation of the output gap. A more frequent measure of output gap is obtained by computing the deviations of current production in relation to a Hodrick-Prescott filter. If we apply a Hodrick-Prescott filter to our output/capital ratio series and multiply the stock of capital by this "trend", we very closely reproduce the estimate of potential output obtained by the Hodrick-Prescott applied directly to the data on real current GDP.

are contractionary effects on the flow of investments, and possibly on the degree of utilization of the capital stock.

GREATER FLEXIBILITY?

There is no doubt that faced with a sudden halt in capital flows, the operation of an inflation target regime requires a greater degree of flexibility. Exchange rate shocks affect inflation, but also have real effects, some of them negative, decelerating investments. Even with low pass-through, inflation rises above the target when pressed by a strong devaluation, and if the Central Bank does not accommodate this shock by permitting inflation to temporarily rise above the target, the cost from falling output will be extremely high. But the excessive volatility of the real exchange rate is also undesirable in and of itself because of its real effects.

The route taken by the central bank in 2002, accommodating a growth in inflation and dissipating such inflation in a longer time horizon is correct in a situation of sudden stop, but cannot be used indiscriminately in other circumstances. The key factor in the operation of inflation targeting is the capacity of the Central Bank to influence expectations, which constitute the nominal anchor that keeps prices stable. Although the inflation target regime permits a margin for discretion not allowed by rigid rules, this discretion must be used parsimoniously so as not to erode the all-important credibility.

The relatively wide interval of plus or minus 2.5 percentage points around the inflation target already carries with it a good degree of flexibility, which permits comfortable accommodation of the primary inflationary effects of moderate shocks. And the experience of 2002 shows how heavier artillery can be deployed effectively in the presence of stronger shocks, permitting greater flexibility in the operation of monetary policy. Having learned to deal with these shocks, the Central Bank has done part of the task. The other part does not rest with just how to react to shocks, but how to reduce them, which implies progress in the field of fiscal policy, expansion of bank credit to the private sector, further economic opening and *de jure* independence for the Central Bank.

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