AN INTEGRATED APPROACH TO DEBT PROJECTION: THE BRAZILIAN CASE

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Introduction and Purpose

Prior to the emergence of the debt crisis in late 1982, most of the research on developing country borrowing was on measuring their debt carrying capacity rather than policy design. As McDonald[1] summarizes in his review of the literature, some of these studies have used the Harrod-Domar growth model to derive the possible paths of economic growth and external borrowing implicit therein. This approach is marked by an emphasis on the country's growth objectives which are combined with its current domestic savings rate and a constant capital/output ratio to compute its foreign borrowing needs. Specifically, the difference between the necessary net investment to attain the targeted growth rate and the domestic savings out of incomes generated by this growth yield the corresponding level of foreign borrowing.

While the debt positions predicted by this model proved to be sensitive to its assumptions and to the specification of its behavioral equations[2], other studies treating borrowing requirements as residuals resulted in indefinitely increasing or explosive debt accumulation paths[3]. One conclusion McDonald drew from this is that the effects of domestic policy, especially in Latin America, must be understood and incorporated into the models. Furthermore, given that the need for foreign loans can also be formulated as the excess of the current account deficit over the net capital inflows into a country, the domestic policies that need to be examined closely are not limited to those related directly to trade. Such deficits may arise from a multitude of interrelated factors as excess domestic spending, misaligned prices (including interest and exchange rates) and supply bottlenecks as well those beyond the control of the policy makers such as adverse external shocks[4]. Following the debt service disruptions, attention turned to the design of structural adjustment policies and the short-term financing arrangements necessary to accommodate these policies. While the adjustment policies typically required contractionary measures, thus abdication of the debtor country's growth targets, the refinancing arrangements had to be based upon the prospects of repayment. Consequently, the problem of debt repayment was framed in terms of the likelihood that an economy under the constraints of the austerity programs (which they had to adopt for continued access to the international financial markets) would be able to attain the current account positions compatible with the debt they would be carrying. In other

words, the *future* external positions became the criterion by which the availability of *current* financing was to be determined. This lead to more frequent use of projection models to determine which debtors were *insolvent* as opposed to *illiquid*[5] so that the latter would be financed without as much emphasis on structural adjustment as the former.

Several of the studies concerning this distinction among debtor countries were based upon sets of assumed domestic variable values, such as real GDP growth and inflation[6]. These values were fed into the projection model (along with various scenarios pertinent to expected external conditions) to obtain future positions. Therefore, the impact of policy on domestic conditions were not explicitly specified.

On the other hand, a significant portion of the research on structural adjustment policies employed the monetary approach to the balance of payments[7]. This approach, while exploring the endogenous relationships among domestic variables - including policy variables - reduces the external position of a country to a single indicator, namely, its foreign currency reserves. Consequently, the sources of a deficit are masked and only the size of the deficit is projected.

Typically, developing countries carry current account deficits because they import mostly manufactured products and export primary goods. Both the unit values and the volume of their exports are thus vulnerable to the business cycles in the industrialized nations whereas adjustments in the level of imports are often slow and painful since they represent vital components of production. Therefore, a surplus in the capital account, generated by a net inflow of foreign capital is necessary to offset the current account deficit. If such inflows are not sufficient to cover the current account deficit there are two possible reasons: either the incentives for direct foreign investment are not attractive enough[8] or too large a portion of the inflows are debt financing, which, while adding to the capital account surplus at the time they were acquired, also add to the current account deficits, in the form of debt service payments, in the subsequent periods[9].

Thus, while looking to the future to determine debt repayment capacity was a positive step in suppressing any panic in the international financial community, models using this approach must be extended to account for the attainability of the internal conditions on which the projections are founded.

The purpose of this paper is to describe a model in which the domestic variables are computed endogenously (in which the only exogenous variables are policy variables) before being combined with various scenarios of external conditions. Consequently, the projected external position of a debtor country, given the international economic conditions, will be firmly anchored to the policy choices made by the authorities throughout the period of adjustment. In part

I, the specification of the model and the definitions used in projecting debt levels will be discussed. Part II will follow with a brief evaluation of the simulation performance of the model. Results obtained from the application of the model to the Brazilian case along with some preliminary linkages emerging from these results are described in part III. Final remarks on the shortcomings of the model and directions for further research can be found in part IV.

I. Specification of the Model

The centerpiece of this study is the domestic economy in which the time paths followed by real GDP growth rate, international currency reserves and price levels are derived as consequences of the domestic credit and exchange rate policies implemented and the targeted long-term growth rate. Therefore, while the growth objectives of the country are not given up, the model also recognizes the role of policy making. The implied future debt levels under various combinations of credit expansion and exchange rate paths chosen can then be assessed in terms of their "sustainability"[10].

Once the future profiles of output growth, reserve accumulations and prices have been defined, under a given set of policies, they will be used to infer the corresponding paths of current account positions and debt levels for the same period. As a result, year-by-year adjustments as well as the positions attained at a future point in time will be observable. As Khan and Knight have noted, "..the time path that the variables follow during the course of a stabilization program is often just as crucial as the positions they ultimately reach."[11]

Domestic Economy

There are six behavioral equations and three identities that describe the domestic sector[12]. Domestic inflation relative to world inflation is specified as a function of the excess of previous year's supply of real money balances over current year's demand and of the deviation of domestic price levels from their foreign counterparts:

$$\Delta\, lnP_t = \alpha_1 + \gamma_1 \left[lnm_{t-1} - lnm_t^d \right] - \gamma_2 \left[lnP_{t-1} - \ln(\epsilon_{t-1} P_{t-1}^f) \right]$$

$$+ \gamma_3 \Delta \ln(\epsilon_t P_t^f) \qquad (1)$$

where P_t is the domestic price level in period t

P_t^f is the foreign price level in period t

m_t is real money balances in period t

e_t is the exchange rate (cruzeiros/dollar) in period t

Thus, in the steady state, the constant term α_1 captures the inflationary pressures stemming from long term output growth. Otherwise, excess money supply accelerates domestic inflation.

Demand for real balances, in turn, is defined as:

$$lnm_t^d = \beta_1 + \tau_4 \, lny_t - \tau_5 \pi_t \qquad (2)$$

where y_t is the current real income

π_t is the current expected rate of inflation

This definition implies that household demand for liquidity rises as incomes increase. However, expectations of higher inflation rates discourage holdings of cash balances due to anticipated loss of purchasing power.

Fluctuations in foreign currency reserves (in dollar terms) are also defined in terms of money market disequilibria and price competitiveness in the international markets:

$$\Delta \, lnR_t - \Delta \ln e_t = \tau_o[lnm_t^d - lnm_{t-1}] - \tau_7[lnP_{t-1} - \ln(e_{t-1}P_{t-1}^f) - \beta_t] \qquad (3)$$

where R_t is net stock of international reserves (in cruz.)

β_t is the purchasing power parity index

Therefore, as excess demand for real balances increases, domestic purchases of imported goods as well as foreign assets decrease. Consequently,

foreign currency reserve levels rise. On the other hand, as domestic prices relative to foreign prices rise above purchasing power parity, exports become less competitive and revenues fall, leading to smaller gains in reserve levels or possibly even loss of reserves.

The public sector expenditures and revenues are formulated as functions of their targeted levels. These targets, in turn, depend on the nominal income levels. Thus:

$$\Delta lnG_t = \tau_8 [lnG_t^* - lnG_{t-1}] \qquad (4)$$

where G_t is nominal government expenditures

G_t^* is the target level of spending

and $\ln G_t^* = \beta_2 + \tau_9 [\ln y_t + \ln P_t]$

By the same token;

$$\Delta lnT_t = \tau_{10} [lnT_t^* - lnT_{t-1}] \qquad (5)$$

where T_t is nominal public revenues

T_t^* is the target level of revenues

and $\ln T_t^* = \beta_3 + \tau_{11} [\ln y_t + \ln P_t]$

Real output growth rate is a function of excess supply of real balances and excess production capacity:

$$\Delta lny_t = \sigma_2 \tau_{12} [lnm_{t-1} - lnm_t^d] + \tau_{13} [lny_t^* - lny_{t-1}] \qquad (6)$$

where

$$y^* = y^* e^{g^* t}$$

and is the cyclically adjusted capacity output based on an initial capacity output of y_o^* and capacity growth rate of g^*.

In the case of Brazil, with long episodes of accelerating inflation, it is reasonable to assume that inflationary expectations for the next period are adjusted by the full amount of the divergence between the current period's actual and anticipated inflation rates:

$$\Delta\pi_t = \tau_{14}[\Delta lnP_{t-1} - \pi_{t-1}] \qquad where\ \tau_{14} = 1 \qquad (7)$$

This backward-looking (or adaptive) expectation formation process is somewhat institutionalized in Brazil by the traditional use of wage indexation schemes which correct nominal wages automatically for any unanticipated inflation.

The identities for the domestic sector include one for domestic credit which is a component of the money supply:

$$DC_t = \Delta CG_t + \Delta CP_t + DC_{t-1} \qquad (8)$$

where DC_t is total domestic credit

CP_t is private sector credit

CG_t is public sector credit

and $CG_t = G_t - T_t$ which is the public sector deficit

Since in an open economy foreign currency reserves are a component of the money supply:

$$M_t = R_t + DC_t \qquad (9)$$

To close the model, real balances can then be defined as:

$$m_t = \frac{M_t}{P_t} \qquad (10)$$

External Accounts

The domestic sector equations are defined as defined above are a block of simultaneous equations while the equations describing the paths of the components of the balance of payments constitute another block to be solved recursively with it. To solve for external accounts the values for real output growth, reserve levels and capacity growth rate for each year are initialized to the values computed by the domestic sector model. The external account equations are also recursive among themselves. Trade elasticities, which enter as parameters, have been estimated separately[13]. The recursive nature of the block of external account equations implies that while the domestic conditions influence the future paths of these accounts, there is no feedback effect of the balance of payments positions in a given year on the policy choices made in the following year. This reflects the assumption of a medium-term policy-making horizon in which authorities are expected to have a preference for adhering to an agenda rather than for responding to year-by-year variations in external positions.

In order to construct a current account balance, dollar value of oil exports (EXO) and imports (IMO) in period t are defined as:

$$EXO_t = EXO_1 \frac{PO_t}{PO_1} \qquad (1) \qquad \textit{and} \qquad IMO_t = IMO_1 \frac{PO_t}{PO_1} \qquad (2)$$

where PO is the world oil price and subscript 1 indicates the initial period values.

In the case of Brazil, exports are zero, and variations in volume of imports are ignored, due to the fact that in the 3-4 year simulation period

significant compression of oil imports is not feasible.

Non-oil exports (EXNO) and imports (IMNO), in dollars terms, are formulated as follows:

$$EXNO_t = EXNO_{t-1}[1 + E_1 g_t^f]\ [1 + E_2 \Delta g_t^f]\ [1 + E_3 \Delta g_{t-1}^f]\ [1 + \dot{P}_t]$$

$$\left[\frac{d_t}{d_{t-1}}\right]\left[1 + .5\,E_4\left(\frac{RE_t}{RE_{t-1}} - 1\right)\right] + EXNO_{t-2}\left[.5\,E_4\left(\frac{RE_{t-1}}{RE_{t-2}} - 1\right)\right] \qquad (3)$$

$$IMNO_t = IMNO_{t-1}\left[1 + E_5 g_t + E_6\left(\frac{\Delta g_t}{1 + g_{t-1}}\right)\right][1 + \dot{P}_t]\left[\frac{d_t}{d_{t-1}}\right]$$

$$\left\{\frac{1}{1 + .5\,E_7\left[\frac{RE_t}{RE_{t-1}} - 1\right]}\right\} - IMNO_{t-2}\left\{.5\,E_7\left[\frac{RE_{t-1}}{RE_{t-2}} - 1\right]\right\} \qquad (4)$$

where g_t^f and g_t are the growth rates of industrialized world and domestic economy, respectively

$\dot{P}_t$ *is the world inflation rate*

d_t is an index of the nominal exchange rate of the dollar vis-a-vis other major currencies

RE_t is the real exchange rate, cruz./$, with both currencies deflated by their respective price indices

Furthermore, E_1 is the export volume elasticity w.r.t. industrial world growth rate. E_2 and E_3 are measures of real export price responsiveness to

cyclical changes in industrial country growth rate in the current and lagged periods, respectively. E_4 captures the effects of a real depreciation of the domestic currency on real exports. Similarly, E_5 and E_6 are elasticities of real imports w.r.t. domestic growth rate and cyclical changes in this rate, respectively. E_7 is used to include the responsiveness of real imports to real devaluations of the national currency.

Nominal exports and imports of services, EXS and IMS, are projected using the equations:

$$EXS_t = EXNO_t\left[\frac{EXS_1}{EXNO_1}\right] \quad (5) \qquad \textit{and} \qquad IMS_t = IMNO_t\left[\frac{IMS_1}{IMNO_1}\right] \quad (6)$$

Then, total exports (EX) and total imports (IM) can be calculated as:

$$EX_t = EXNO_t + EXS_t \quad (7)$$

$$IM_t = IMO_t + IMNO_t + IMS_t \quad (8)$$

The remainder of the current account is composed of the interest payments (INT) on foreign debt which is broken down into long-term (DBTLT) and short-term (DBTST) debt since the interest rates applied to each type of loan are different. Also, these payments are net of any earnings on non-gold dollar reserve holdings. Thus:

$$INT_t = i_t^{lt} DBTLT_{t-1} + i_t^{st} DBTST_{t-1} - f_t\left[\frac{R_{t-1}}{e_{t-1}}\right] \quad (9)$$

where i^{lt} is the average interest rate on long-term debt

i^{st} is the average interest rate on short-term debt

r' is the U.S. Treasury Bill rate (LIBOR minus 1%)

International transfer payments (TR) are assumed to increase 3% per annum in real terms and are inflated by the global inflation rate:

$$TR_T = TR_{t-1}(1.03)\,[1 + \dot{P}_t]\left[\frac{d_t}{d_{t-1}}\right] \qquad (10)$$

Now, the current account balance (CA) can be defined as:

$$CA_t = EX_t - IM_t - INT_t + TR_t \qquad (11)$$

The capital account will be represented by the flows of direct foreign investment (DFI), which is assumed to remain at the same level in real terms so that,

$$DFI_t = DFI_{t-1}\,(1 + \dot{P}_t)\left[\frac{d_t}{d_{t-1}}\right] \qquad (12)$$

The short-term flows are sensitive to the excess demand for cash balances and the inflation differential between Brazil and the rest of the world. Such transactions are assumed to be the primary source of reserve accumulations or decumulations in the medium term. Then, net new lending (NNL) needed by Brazil in any year t will be the sum of the current and capital account deficits net of reserve accumulations:

$$NNL_t = -CA_t - DFI_t - \Delta\left[\frac{R_t}{e_t}\right] \qquad (13)$$

For each year, total debt (DBT) is the sum of last year's debt and this year's new lending:

$$DBT_t = DBT_{t-1} + NNL_t \qquad (14)$$

Given the long- and short-term debt structure in the initial period, each component of total debt can be projected assuming this structure remains unchanged:

$$DBTLT_t = DBT_t\left[\frac{DBTLT_1}{DBT_1}\right] \quad (15) \quad and \quad DBTST_t = DBT_t - DBTLT_t \quad (16)$$

To arrive at a measure of indebtedness, the net new lending required in each year must be added to the amortization payments (AM) falling due that year. These payments are defined as a constant fraction (a) of long-term debt in the previous year so that

$$AM_t = a\,DBTLT_{t-1} \quad (17)$$

and the gross borrowing needs (GDBT) in a given year can thus be computed as:

$$GDBT_t = NNL_t + AM_t \quad (18)$$

II. Evaluating Simulation Performance:

The domestic sector equations were estimated, after appropriate substitutions, using data for the period 1967-1984. The OLS results, including corrections for autocorrelation where necessary, are reported in the length appendix. The estimated equations were used to simulate the endogenous variables for three different 7-year periods (same as for the final projections) for purposes of historical comparisons between the simulated and actual paths of these variables. These are "static" simulations, in the sense that the policy variables and external economic variables are initialized to their actual values for each year. Consequently, one can evaluate the ability of the model to generate endogenous variable paths close to their actual paths.

Table 1 shows the evaluation criteria for each endogenous variable in each of the three periods. Theil's inequality coefficient[14] (U) is used as a measure of simulation error (deviations between actual and simulated values) and is broken down into its three components. These are errors due to (i) bias (U^m) or systematic over- or under-simulation, (ii) differences in the variability in the actual and simulated series (U^s) and, (iii) unsystematic or random differences in the two series (U^c).

Taking U=.1 as a benchmark for acceptable performance, international reserves appears to be the only variable bordering on less than satisfactory performance. Predictably, as the simulation period is shifted to include the years of the first oil price shock (1974 and 1975), reserve levels become less trackable.

This volatility in reserve levels of a developing country, compounded by capital flight, has been the subject of research for some time and is beyond the scope of this paper. Therefore, we will explore the simulation results, keeping in mind that reserves will continue to be an unstable component of final borrowing levels.

III. Simulation Results and Implications

Simulations for the period 1984-90 were generated by first deriving the paths of domestic prices, reserve levels, public sector expenditures and revenues, real output and domestic credit from the domestic sector equations. To anchor the projections for the subsequent years more firmly to the actual initial conditions, private credit and nominal exchange rates were set equal to their actual values for 1984 and 1985 so that pure projection results start with those from 1986 onwards.

The projections assumed a baseline set of external conditions predicted for this period as shown in table 2. As for domestic policies, three different paths of private credit expansion (denoted as I, II and III) and nominal exchange rate (indicated by A, B and C) were combined into the nine possible policy strategies. The yearly magnitudes along with annual percentage changes in the policy variables are shown in table 3.

Each of the policy combinations were fed into the model with the same set of (baseline) external variable values, to generate the corresponding output growth and inflation paths. The results are summarized in table 4 in which each box shows the projected results of one policy strategy. In terms of inflation and real growth, the policy trade-offs are quite apparent in these figures.

More specifically, it was assumed that private credit expansion would have to accelerate at least one more year after 1985. Scenario II shows a moderate acceleration (from the actual 262% in 1985) followed by an equally moderate deceleration. In scenario I, the initial boost to private credit is larger, leading to higher nominal levels of credit despite a somewhat faster deceleration. Finally, scenario III displays a more pronounced initial boost followed by lower credit levels than in the middle scenario. Therefore, given any exchange rate path, say A, prices rise by 281% in 1986 (up from 230% as reported by the IMF in 1985). Inflation then begins to slow down but does so less in scenario I and much more in scenario III compared to the "moderate" scenario II. The same comparisons are valid for the remaining exchange rate paths.

While these results confirm the role of restrictive credit policies in controlling inflation through their contractionary effect on aggregate demand, they also illustrate the price to be paid in terms of output growth. Again, comparing the moderate credit scenario to the others under exchange rate path

A, the growth rate rises significantly following the initial acceleration of credit expansion. More specifically, since credit expansion rate exceeds the inflation rates in the first few years, there is indeed, a real expansion of credit which stimulates growth. But as the rate of credit expansion and inflation rate approach each other (even though both are declining), real credit expansion slows down, contributing less and less to higher growth of output. In fact, in the most restrictive credit scenario (III) by 1990, inflation rate is higher than the rate of credit expansion in that year, which is the only case in which there is an actual decline in output growth (under exchange rate path A).

Moving the comparison of credit policies to a more rapid devaluation path (B), output growth with the moderate credit policy (BII) is steady throughout the period of projection, primarily owing to the stimulation of exports. However, the added export demand causes inflation to remain slightly higher compared to AII with the exception of 1990 in which there is a small revaluation of the cruzeiro, relieving the inflationary pressure significantly. Output growth continues for one more year in BI (compared to AI) and inflation rate does not show much of an improvement until 1990 for the same reasons. In policy combination BIII, while the most dramatic improvement in inflation is attained, the growth rate inevitably suffers in light of the fact that real credit expansion is negative throughout the period. Output stimulation by rapid devaluation of the currency has only limited potential in offsetting the contraction of credit. Similar comparisons of credit policies under the most rapid devaluation path (C) (especially BII with CII and BIII with CIII) confirm the conclusion that the policy trade-offs between restricting credit and devaluing the national currency are extremely limited.

At this juncture, it is possible to see the sources of friction between Brazil and the IMF in the post 1982 period. While demand management policies, including credit restriction, has been at the top of the list of recommendations by the IMF, Brazil's own social and political agenda has focused on real growth. With a population growth of 2.1% in recent years, a net increase in income per capita means real growth rates below 2.5%-3% in any year makes it politically unacceptable. Given the average long-term growth rates of 6.4% (over 1964-1984), anything less, especially when prescribed by an external entity such as the IMF, is perceived as an unpalatable retrenchment. Viewed in this light, one might be more inclined to suggest policy combination BII as the best attainable compromise and consider combinations AI and BIII as two more variations, one stressing growth at the expense of inflation (AI) and the other abdicating growth for the sake of price stability (BIII).

Using the inflation and output paths in these three strategies the external accounts and debt levels were projected as presented in table 5. All of these policies indicate that debt levels (DBT) decline starting in 1986. As would

be expected, this decline is most pronounced if the moderate strategy were to be adopted (BII). It also allows a real depreciation of the cruzeiro (RE) for an additional year (relative to the other strategies), letting the exports support the debt reduction effort. The policy combination that accomplishes the least is BIII. While growth rates are lower, debt only declines to $88.746 billion. Even then, it is a dramatic reduction in debt by 1990.

The discussion so far has focused on the domestic policy choices. There is, undoubtedly, much that can happen beyond the control of Brazilian policy makers (but not of their counterparts elsewhere) that will bear heavily upon these results. Therefore, the final part of the empirical work in this study will be on the impact of changes in external conditions on the debt projections. For the sake of brevity, strategy AI is the only one that was simulated under new external scenarios, since Brazil's preference for high growth rates is likely to continue.

The effects of more rapid growth in the industrial world (an accelerated output expansion) are shown in table 6. The debt level in 1990 is projected to be $82 million less with strategy AI and the new foreign growth path (g^f), with all other external conditions maintained on their baseline paths (table 2). If, instead, the baseline growth path is raised by a full 1% in each year, Brazil's final debt projection is $359 million below what it was under the baseline external scenario. The combination of a 1% higher and accelerated foreign growth path results in a $420 million improvement in debt projections.

The impact of favorable external conditions does not seem symmetric to that of adverse external factors. For instance, a 1% higher path for dollar devaluation (and a corresponding revaluation of the cruzeiro) result in higher final debt position by $3.14 billion. Similarly, a 1% higher short-term interest rate pattern adds another $1.23 billion to Brazilian debt in 1990. Finally, a 1% increase in long-term interest rates produces the worst damage to the projected Brazilian debt, raising it by $6.17 billion. Punctuating the importance of trade as a means of bringing down debt levels, a 1% higher inflation in the industrialized countries (relative to domestic prices) improves debt levels by $7.69 billion.

IV. Conclusions

In interpreting the results one should not focus so much on absolute figures generated by these simulations as on the relative impact of the various strategies. While it is clear that inflation is more responsive to monetary contraction, austerity measures based on monetary control are likely to hurt long-term growth, thereby precipitating a more severe debt crisis in the future. By the same token, liberalization of exchange rate determination has an

immediate and adverse effect on domestic inflation which threatens to undo the benefits of a conservative monetary policy. In this study, some compromise between the goals of output growth and price stability were suggested.

There is every evidence at this writing that Brazilian authorities have not revised their growth ambitions. In spite of the rising debt levels, GDP growth has risen to 5.7% in 1986 and 1987 and is estimated to reach 7.4% in 1988[15]. This performance has been primarily due to credit expansion at rates surpassing those used in our projections. Consequently, inflation has topped 680% in 1988.

An important part of the explanation, however, may lie in an attempt, on the part of the policy makers, to insulate their economy from the adverse conditions developing abroad. Among these are the lackluster growth rates and the rise of protectionist pressures globally. Given that Brazil obtains 42.6% of its imports from the U.S. and the EEC countries and exports 58.1% of its exportables to the same group, its ability to earn the foreign exchange with which to serve its debt is extremely sensitive to protectionist barriers. This paper has shown that while an improvement in the competitiveness of Brazilian exports (a 1% higher relative inflation abroad) results in the most significant reduction in debt, adverse changes, such as a 1% faster devaluation of the dollar (a natural barrier to Brazilian imports into the U.S.), results in the worst possible debt position. Thus, in searching for a gradual and relatively less destabilizing resolution to the debt crisis, at least in the case of Brazil, there is much to be gained from sharing the burden.

Endnotes

[1]McDonald, Donogh C., "Debt Capacity and Developing Country Borrowing: A Survey of the Literature," IMF Staff Papers, December 1982, Vol. 29, No. 4, pp. 603-46.

[2]See, McDonald, Donogh, "The Determinants of Savings Behavior in Latin America," IMF Research Department, DM/83/26, 1983.

[3]Solomon, R., "A Quantitative Perspective on the Debt of Developing Countries," Brookings Papers on Economic Activity, No. 2, pp. 479-501, The Brookings Institution, 1977; the IMF, "International Capital Markets: Recent Developments and Short-Term Prospects," Occasional Paper #1, Washington D.C., 1980.

[4]For further discussion of the factors that precipitated the debt crisis, see, Killick, Tony and Sutton, Mary, "An Overview," p. 5; Nowzad, Bahram, "Some Issues and Questions Regarding Debt of Developing Countries," p. 156; Killick, Tony and Sutton, Mary, "Disequilibria, Financing and Adjustment in Developing Countries," p. 61 in *Adjustment and Financing in the Developing World: The Role of the IMF*, Tony Killick (ed.), IMF and the Overseas Development Institute, London., 1982. Also, Enders, Thomas O. and Mattione, Richard P., *Latin America: The Crisis of Debt and Growth*, the Brookings Institute, Washington D.C., 1984; Cline, William R., *International Debt and the Stability of the World Economy*, pp. 13-30, Institute for International Economics, Washington D.C., 1983; Cline, William R., *International Debt: Systemic Risk and Policy Response*, pp. 1-18, Institute for International Economics, Washington D.C., 1984; Balassa, Bela, et al., *Toward Renewed Economic Growth in Latin America*, pp. 17-20, Institute for International Economics, Washington D.C., 1986.

[5]A distinction drawn by Cline. See, Op. Cit., Chp. 3. Guitian's definition of "sustainable" debt level is "..a current account deficit that can be financed, on a sustainable basis, by net capital inflows on terms that are compatible with the development and growth prospects of the country, and therefore, with its debt carrying capacity." This definition contrasts that of "liquidity" in Cline's perspective in that the access to credit markets is tied to the existing current account balance, rather than the projected position. See: Guitian, Manuel, "Economic Management and IMF Conditionality," in *Adjustment and Financing in the Developing World: The Role of the IMF*, Tony Killick (ed.), IMF and the Overseas Development Institute, London 1982, p. 75.

[6]See; Cline, William R., *International Debt: Systemic Risk and Policy Response*, Institute for International Economics, Washington D.C., 1984; Morgan Guaranty Trust Co. of New York, "Global Debt: Assessment and Long-Term Strategy," World Financial Markets, June 1983 and "The LDC Debt Problem: At the Mid-point?," World Financial Markets, Oct/Nov. 1984; Enders, Thomas O. and Mattione, Richard P., *Latin America: the Crisis of Debt and Growth*, the Brookings Institution, Washington D.C., 1984; Leven, Ronald and Roberts, David L., "Latin America's Prospects for Recovery," Federal Reserve Bank of New York Quarterly Review, Autumn 1983, Vol. 8, no. 3.

[7]Much literature on structural adjustment advocating demand management and restriction of domestic absorption has come forth from the IMF since the onset of the debt crisis. See, for instance, Khan, Mohsin S. and Knight, Malcolm D., "Stabilization Policies in Developing Countries: A Formal

Framework," IMF Staff Papers, Vol. 28, No. 1, March 1981, Washington D.C., pp. 1-59.

[8]In all developing countries but especially in Latin America, capital flight (recorded as a debit on the balance of payments) is a significant factor in reducing the capital account surplus. Unlike other debtor countries, Latin American governments have resisted breaking with tradition and imposing controls on capital flows. At the same time, however, interest rate ceilings and preannouncement of large devaluations of their national currencies have contributed to the willingness of domestic investors to go abroad. For further discussion of capital flight, see: Khan, Mohsin S. and Ul-Hague, Nadeem, "Foreign Borrowing and Capital Flight: A Formal Analysis," IMF Staff Papers, Dec. 1985, Vol. 32, No. 4, pp. 606-28; Ender, Thomas O. and Mattione, Richard P., "*Latin America: The Crisis of Debt and Growth*, the Brookings Institution, Washington D.C., 1987.

[9]For in depth discussions of the changing maturity structure and public/private mix of debt and how it contributed to the growing debt service burden, see; Nowzad, Bahram, "Some Issues and Questions Regarding Debt of Developing Countries," in *Adjustment and Financing in the Developing World: The Role of the IMF*, Tony Killick (ed.), IMF and the Overseas Development Institute, London, 1982, p. 157; Enders, Thomas O. and Mattione, Richard P., Op. Cit.

[10]See footnote 5.

[11]Op. cit.

[12]The specification of these relationships is primarily inspired by the Khan and Knight paper. However, they have been modified to account for the characteristics of the Brazilian economy, such as the appropriate lag structures, which were formulated by preliminary research.

[13]The specification of these equations are borrowed from Cline's work with some substantial modifications in the way the growth rate enters some of the equations. The basic assumptions, including that the structure of debt is assumed to remain unchanged for the duration, have been left intact. See, Cline, William R., Op. Cit.

[14]For a discussion of this coefficient and its components, see: Pindyck, Robert S. and Rubinfeld, Daniel L., *Econometric Models and Economic Forecasts*, 2nd Ed., McGraw-Hill, 1981, pp. 359.

[15]These and subsequent figures are taken from: Index, Quarterly Economic Review, Banque Indosuez, No. 13, 2nd quarter, 1989, Paris.

APPENDIX: Estimated Equations of the Domestic Sector

$$\Delta \ln P_t = \underset{(-.2145)}{-.1278} + \underset{(4.1211)}{.3404 \ln m_{t-1}} - \underset{(-3.0968)}{.2729 \ln y_t} + \underset{(6.8875)}{.5292 \pi_t}$$

$$\underset{(-4.9143)}{-.4911\left[\ln P_{t-1} - \ln(e_{t-1} p^f_{t-1})\right]} + \underset{(5.0650)}{.311 \Delta \ln(e_t P^f_t)}$$

$R^2 = .99$
Adj.$R^2 = .99$
F-stat = 259.11
D-W = 1.57

$$\ln R_t = \underset{(-6.6623)}{-.73.0354} + \underset{(3.5975)}{5.5452 \ln y_t} - \underset{(-4.9875)}{5.7506 \pi_t} - \underset{(-1.8114)}{1.9081 \ln m_{t-1}}$$

$$\underset{(-3.0141)}{-7.0746\left[\ln P_{t-1} - \ln(e_{t-1} P^f_{t-1}) - \ln \beta_t\right]} - \underset{(-2.7623)}{6.2613 \ln e_t}$$

$R^2 = .99$
Adj.$R^2 = .98$
F-stat = 98.11
D-W = 1.40

$$\ln G_t = \underset{(-7.0368)}{-4.6501} + \underset{(7.0314)}{.6394 \ln y_t} + \underset{(4.3589)}{.4208 \ln G_{t-1}}$$

$R^2 = .99$
Adj.$R^2 = .99$
D-W = 2.18
F-stat = 8226.078

$$\ln T_t = \underset{(-6.4956)}{-3.7002} + \underset{(6.5744)}{.5049(\ln y_t + \ln P_t)} + \underset{(7.1184)}{.5681 \ln T_{t-1}}$$

$R^2 = .99$
Adj.$R^2 = .99$
F-stat = 6390.643

$$\ln y_t = \underset{(.2328)}{.1894} + \underset{(1.6169)}{.1801 \ln m_{t-1}} - \underset{(-2.4706)}{.2285 \pi_t} + \underset{(2.9623)}{.5918 \ln y_t^*} + \underset{(1.7328)}{.3619 \ln y_{t-1}}$$

$R^2 = .99$
Adj.$R^2 = .99$
D-W = 1.97
F-stat = 618.86

Equations of the External Sector

$$EXO_t = EXO_1\left[\frac{PT_t}{PO_1}\right]$$

$$IMO_t = IMO_1\left[\frac{PO_t}{PO_1}\right]$$

$$EXNO_t = IXNO_{t-1}[1 + E_1 g\text{-}t^f][1 + E_2\Delta g_t^f][1 + E_3\Delta g_{t-1}^f][1 + P_t]\left[\frac{d_t}{d_{t-1}}\right]$$

$$\left[1 + .5E_4\left(\frac{RE_t}{RE_{t-1}} - 1\right)\right] + EXNO_{t-2}\left[.5E_4\left(\frac{RE_{t-1}}{RE_{t-2}} - 1\right)\right]$$

$$IMNO_t = IMNO_{t-1}\left[1 + E_5 g_t + E_6\left(\Delta\frac{g_t}{1} + g_{t-1}\right)\right][1 + P_t]\left[\frac{d_t}{d_{t-1}}\right]$$

$$\left\{\frac{1}{1 + 1\left[\frac{RE_t}{RE_{t-1}} - 1\right]}\right\} - IMNO_{t-2}\left\{.5E_7\left[\frac{RE_{t-1}}{RE_{t-2}} - 1\right]\right\}$$

$$EXS_t = EXNO_t\left[\frac{EXS_1}{EXNO_1}\right]$$

$$IMS_t = IMNO_t \left[\frac{IMS_1}{IMNO_1} \right]$$

$$EX_t = EXO_t + EXNO_t + EXS_t$$

$$IM_t = IMO_t + IMNO_t + IMS_t$$

$$INT_t = i_t^f DBTLT_{t-1} + r_t DBTST_{t-1} - r_t \delta_4 \left[\frac{R_{t-1}}{\epsilon_{t-1}} \right]$$

$$TR_t = TR_{t-1} (1.03) (1 + P_t) \left[\frac{d_t}{d_{t-1}} \right]$$

$$CA_t = EX_t - IM_t - INT_t + TR_t$$

$$DFI_t = DFI_{t-1}(1 + P_t) \left[\frac{d_t}{d_{t-1}} \right]$$

$$DBT_t = DBT_{t-1} + NNL_t$$

$$DBTLT_t = DBT_t \left[\frac{DBTLT_1}{DBT_1} \right]$$

$$DBTST_t = DBT_t - DBTLT_t$$

$$AM_t = a\, DBTLT_{t-1}$$

$$GDBT_t = NNL_t + AM_t$$

Table 1: Theil's Coefficients for Simulated Domestic Variables

Variable	Theil's Coefficients		
	Simulation Period 67-73	Simulation Period 68-74	Simulation Period 69-75
Consumer Price Index (CPI)	.056	.055	.053
International Reserves (RVS)	.153	.258	.065
Public Sector Spending (GEXP)	.017	.012	.050
Public Sector Revenue (TAX)	.016	.023	.048
Gross Domestic Product (GDP)	.023	.023	.014
Domestic Credit (DCR)	.029	.024	.019

Table 2: Baseline External Economic Conditions

Year	Foreign Output Growth (%)	Foreign Inflation (%)	Trade Weighted Dollar (1980=100)	Oil Price ($/Barrel)	Long-Term Interest Rate (%)	Short-Term Interest Rate (%)	U.S. Treasury Bill Rate (%)
1984	4.4	4.75	149.24	28.55	11.80	13.80	9.49
1985	3.0	5.00	150.00	28.30	11.95	11.11	11.95
1986	4.0	5.00	160.00	14.60	10.25	11.20	10.77
1987	4.5	6.00	164.00	17.50	9.75	11.50	10.50
1988	4.5	5.30	162.00	18.38	9.50	11.20	10.60
1989	5.0	4.00	160.00	18.50	10.25	11.60	11.00
1990	5.0	3.77	162.00	18.00	10.50	12.00	11.25

Table 3: Domestic Policy Scenarios

Year	I		II		III	
	Private Credit (Bill. Cruzeiros)	Change (%)	Private Credit (Bill. Cruzeiros)	Change (%)	Private Credit (Bill. Cruzeiros)	Change (%)
1984	69,150	205	69,150	205	69,150	205
1985	250,586	262	250,586	262	250,586	262
1986	977,285	290	960,520	283	1,052,461	320
1987	3,518,227	260	3,523,240	267	3,367,867	220
1988	10,554,680	200	8,826,639	151	6,735,751	100
1989	26,386,710	150	21,066,598	139	10,103,628	50
1990	52,773,408	100	45,546,516	116	12,124,354	20

Year	A		B		C	
	Nominal Exchange Rate (Cruzeiros/$)	Change (%)	Nominal Exchange Rate (Cruzeiros/$)	Change (%)	Nominal Exchange Rate (Cruzeiros/$)	Change (%)
1984	1,848.03	220	1,848.03	220	1,848.03	220
1985	6,200.00	235	6,200.00	235	6,200.00	235
1986	17,340.00	180	17,980.00	190	18,600.00	200
1987	47,685.00	175	50,344.00	180	54,870.00	195
1988	128,750.00	170	135,929.00	170	159,123.00	190
1989	341,186.00	165	353,415.00	160	453,501.00	185
1990	887,084.00	160	883,539.00	150	1,269,802.00	180

Table 4: Growth and Inflation Paths under Nine Policy Combinations

	A					B					C				
	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
	Growth (%)					Growth (%)					Growth (%)				
I	-1.3	2.4	7.4	11.4	11.1	-1.3	1.8	7.0	11.0	11.4	-1.3	1.2	6.1	9.3	8.8
	Inflation (%)					Inflation (%)					Inflation (%)				
	281	233	181	151	140	285	239	186	151	135	289	249	201	170	154
	Growth (%)					Growth (%)					Growth (%)				
II	-1.3	2.3	7.6	9.2	10.4	-1.3	1.6	7.2	8.9	10.7	-1.3	1.0	6.3	7.2	8.0
	Inflation (%)					Inflation (%)					Inflation (%)				
	281	232	181	143	131	285	238	186	144	125	289	248	201	162	144
	Growth (%)					Growth (%)					Growth (%)				
III	-1.3	3.2	6.1	6.5	5.1	-1.3	2.5	5.7	6.2	5.5	-1.3	1.9	4.8	4.5	2.5
	Inflation (%)					Inflation (%)					Inflation (%)				
	281	237	178	130	101	285	243	183	130	96	289	253	199	147	111

Table 5: External Account Simulations
for Three Policy Combinations
(Millions of U.S. $)

AI

OBS.	EXNO	IMNO	INT	CA	NNL	DBT	R	RE
1984	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80	11559.51	82.26
1985	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30	11961.56	76.82
1986	31616.25	11443.74	12534.09	1286.78	-3832.59	122763.70	13536.24	59.25
1987	33306.50	12027.04	11619.83	2343.19	-2927.30	119836.40	6530.80	51.84
1988	34672.02	12526.66	11380.67	3102.55	-6017.64	113818.80	8182.63	52.53
1989	35685.17	12921.62	11474.59	3524.74	-9370.73	104448.10	20977.83	57.75
1990	37590.32	13634.34	10050.32	6174.55	-18534.78	85913.33	58959.65	64.79

BII

OBS.	EXNO	IMNO	INT	CA	NNL	DBT	R	RE
1984	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80	11559.51	82.26
1985	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30	11961.56	76.82
1986	31619.47	11446.59	12534.09	1286.35	-3268.14	123328.20	11280.17	60.75
1987	33313.08	12028.17	11794.97	2173.50	-3200.99	120127.20	6048.30	53.29
1988	34675.99	12527.67	11434.70	3051.35	-6116.05	114011.20	8298.57	53.03
1989	35688.17	12908.54	11488.37	3531.65	-8845.48	105165.70	18965.11	58.89
1990	37601.29	13635.15	10240.70	5994.68	-20381.67	84784.03	65054.01	67.82

BIII

OBS.	EXNO	IMNO	INT	CA	NNL	DBT	R	RE
1984	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80	11559.51	82.26
1985	27389.42	9961.32	13712.54	-6536.03	4626.47	126595.30	11961.56	76.82
1986	31619.47	11446.59	12534.09	1286.35	-3268.14	123328.20	11280.17	60.75
1987	33310.85	12031.41	11794.97	2166.79	-3289.22	120039.00	6428.02	52.51
1988	34673.02	12517.86	11405.94	3090.13	-5834.89	114204.10	7398.55	52.68
1989	35698.65	12900.92	11558.09	3483.23	-8115.09	106089.00	15337.20	61.94
1990	37657.46	13646.69	10544.04	5735.21	-17342.58	88746.41	50307.64	81.87

Table 6: Effects of Changing External Conditions on Debt (Millions of U.S. $ or %)

Accelerated Foreign Growth

OBS	g^f	EXNO	IMNO	INT	CA	NNL	DBT
1984	0.044	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	0.030	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30
1986	0.045	31622.80	11443.74	12534.09	1293.70	-3839.51	122756.80
1987	0.048	33318.42	12027.04	11619.13	2356.49	-2940.59	119816.20
1988	0.048	34684.71	12526.66	11378.69	3117.93	-6033.02	113783.20
1989	0.053	35700.64	12921.62	11470.86	3544.81	-9390.80	104392.40
1990	0.053	37609.15	13634.34	10044.44	6200.44	-18560.66	85831.73

1% Higher Foreign Growth

OBS	g^f	EXNO	IMNO	INT	CA	NNL	DBT
1984	0.044	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	0.040	27400.76	9961.32	13712.54	-6524.06	4614.49	126584.30
1986	0.050	31645.42	11443.74	12532.84	1318.85	-3864.66	122719.60
1987	0.055	33346.24	12027.04	11615.40	2389.62	-2973.72	119745.90
1988	0.055	34722.76	12526.66	11371.81	3165.02	-6080.11	113665.80
1989	0.060	35747.03	12921.62	11458.56	3606.13	-9452.12	104213.70
1990	0.060	37665.63	13634.34	10025.12	6279.33	-18639.55	85574.16

1% Higher and More Accelerated Foreign Growth

OBS	g^f	EXNO	IMNO	INT	CA	NNL	DBT
1984	0.044	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	0.040	27400.76	9961.32	13712.54	-6524.06	4614.49	126584.30
1986	0.055	31651.98	11443.74	12532.84	1325.78	-3871.59	122712.70
1987	0.058	33358.18	12027.04	11614.70	2402.93	-2987.03	119725.70
1988	0.058	34735.47	12526.66	11369.83	3180.43	-6095.51	113630.20
1989	0.063	35762.52	12921.62	11454.83	3626.22	-9472.21	104158.00
1990	0.063	37684.48	13634.34	10019.13	6305.24	-18665.46	85492.54

Table 6: (continued)

1% Higher Dollar Devaluation

OBS	d	EXNO	IMNO	INT	CA	NNL	DBT
1984	149.24	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	150.00	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30
1986	165.00	31616.25	11443.74	12534.09	1286.78	-3832.59	122763.70
1987	162.36	32973.11	11906.48	11619.83	2150.74	-2711.49	120052.20
1988	158.79	33983.86	12277.64	11401.79	2684.29	-5549.77	114502.40
1989	155.30	34635.04	12540.98	11546.21	2847.75	-8615.90	105886.50
1990	151.80	35223.73	12775.97	10204.98	4656.04	-16835.90	89050.60

1% Higher Short-Term Interest Rates

OBS	i_{st}	EXNO	IMNO	INT	CA	NNL	DBT
1984	0.138	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	0.111	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30
1986	0.122	31616.25	11443.74	12746.83	1074.04	-3619.85	122976.40
1987	0.125	33306.50	12027.04	11847.85	2115.17	-2699.27	120277.10
1988	0.122	34672.02	12526.66	11625.91	2857.31	-5772.40	114504.70
1989	0.126	35685.17	12921.62	11738.87	3260.45	-9106.45	105398.30
1990	0.130	37590.32	13634.34	10329.60	5895.27	-18255.50	87142.80

1% Higher Long-Term Interest Rates

OBS	i_{lt}	EXNO	IMNO	INT	CA	NNL	DBT
1984	0.118	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80
1985	0.120	27389.42	9961.32	13712.54	-6536.03	4626.47	126596.30
1986	0.113	31616.25	11443.74	13587.31	233.56	-2779.36	123816.90
1987	0.108	33306.50	12027.04	12755.72	1207.31	-1791.41	122025.50
1988	0.105	34672.02	12526.66	12610.08	1873.14	-4788.23	117237.30
1989	0.113	35685.17	12921.62	12808.10	2191.22	-8037.22	109200.10
1990	0.115	37590.32	13634.34	11469.76	4755.12	-17115.34	92084.76

1% Higher Foreign Inflation

OBS	EXNO	IMNO	INT	CA	NNL	DBT	$\dot{p}^f$
1984	25895.93	9408.44	14067.85	-7814.98	4349.61	121969.80	0.048
1985	27390.30	9962.11	13712.54	-6536.16	4620.06	126589.90	0.050
1986	31919.56	11554.18	12532.02	1462.87	-4246.49	122343.40	0.060
1987	33943.76	12257.88	11530.61	2799.74	-3386.91	118956.50	0.070
1988	35670.91	12886.78	11255.89	3805.58	-6861.42	112095.10	0.063
1989	37066.50	13421.23	11238.71	4558.30	-11074.58	101020.50	0.050
1990	39421.81	14299.73	9497.43	7781.41	-22794.45	78226.05	0.048