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A Macroeconomic Model
for Debt Analysis
of the Latin America Region
and Debt Accounting
Models for the Highly
Indebted Countries

**Peter Dittus,
Paul S. O'Brien**

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OECD
DEPARTMENT
OF ECONOMICS AND STATISTICS

WORKING PAPERS

No. 93: A MACROECONOMIC MODEL FOR DEBT ANALYSIS OF THE LATIN AMERICA REGION
AND DEBT ACCOUNTING MODELS FOR THE HIGHLY INDEBTED COUNTRIES

by

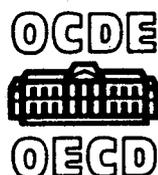
Peter Dittus

Central and Eastern Europe Division

Paul S. O'Brien

Country Studies Division II

February 1991



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Throughout the 1980s the problem of developing country debt was a recurring theme in international debate. Discussion was often hampered by the lack of an empirically-based modelling framework with which to discuss the interaction between developments and policies in OECD countries and those in debtor countries. This paper provides such a framework for Latin America, in the form of macro-economic models for the major countries in that region which are linked to the OECD's INTERLINK model of the industrialised countries. Using these models in combination it is possible to simulate the effects of, for example, fiscal policy tightening in OECD countries, on the output, trade and credit-worthiness of Latin American countries; in the same simulation INTERLINK provides details of the effects of the same policy change on OECD countries - both direct effects and via feedback to OECD countries from Latin America. This paper discusses the structure and estimation of the models for Latin America, describing the relationship with INTERLINK, and illustrates how the models can be used to analyse certain shocks and policy changes.

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Table of Contents	Page
I. INTRODUCTION	3
II. MODELLING	4
A. Modelling approach	4
B. DEMOD: macroeconomic models for Latin America	5
1. DEMOD structure	5
(a) The output block	6
(b) The trade block	8
(c) The debt block	9
2. DEMOD parameter estimation and tracking performance	10
(a) Parameter estimation	10
(b) Tracking behavior	11
(c) The baseline for simulations	13
C. The HIC debt models	14
1. Linkage to INTERLINK	14
2. Interest Debits	15
3. Estimation	15
4. Tracking performance of the investment income equations	17
III. SIMULATION PROPERTIES	18
A. Increase of the short term interest rate	18
B. Increase of OECD GDP by one per cent	19
C. Increase of net flows	20
E. Impact of the simulations on the HICs	21
F. The importance of feedback from Latin America for OECD economies	22
APPENDIX	26
Appendix A: Glossary of Acronyms	26
Appendix B: DEMOD Model Listings	30
Appendix C: Estimation	35
Appendix D: Simulation Results	41
Appendix E: HIC Models	44

I. INTRODUCTION

1. During the 1980s, following the Mexican payments crisis of August 1982, a number of debt "plans" and "strategies" have been introduced, but overall progress in resolving the situation has been slow. This paper results from a project to investigate the relationship between macroeconomic developments in OECD countries and those in debtor countries. The aim is to develop tools that can help to throw light on the importance of international linkages, including those between OECD and debtor countries, in order to understand better why many of the hopes and expectations of the various debt plans have not been realised.

2. This paper presents a set of models for Latin America (DEMOM) that can be used to analyze the impact of the world macroeconomy on the economies of Latin America; these have been designed to focus in particular on growth and debt servicing capacity and to trace the development of creditworthiness indicators¹. In addition, debt accounting models for the highly indebted countries (HICs) have been developed. The difference between this and many other debt models is its integration into a world macroeconomic model, the OECD's INTERLINK model. This assures consistency of macroeconomic policy assumptions in OECD countries and economic aggregates, and incorporates feedback between OECD and Latin America by model design.

3. Building on the strengths of INTERLINK - its global character, providing explicit modelling of international linkages of trade volumes and prices, as well as of interest and exchange rates - and based on estimated relationships, DEMOM also provides direct links between the debt burden and economic performance of Latin American countries, a feature less frequently observed in models of this kind. Its break-down into individual country modules allows a closer look to be taken at four countries of special interest: Brazil, Mexico, Argentina and Chile.

4. The paper is in three parts. Following the introduction, section II describes DEMOM and the HIC debt accounting models. This section presents choices that were made and the trade-offs involved; discusses the model structure and the key relationships that drive the model; introduces the determination of parameters and the establishment of a medium term baseline; and presents tracking capabilities of the models. The marginal properties of the model are explored in section III with the help of standard shocks. This section also contains an empirical evaluation of the importance of the feedback loop from Latin America to OECD countries by comparing a no-feedback situation against the INTERLINK trade equations and the DEMOM country modules. A complete model listing, including estimation results, is contained in the appendix.

II. MODELLING

A. Modelling approach

5. The major purpose of DEMOD is the analysis of the impact of OECD economic policies on middle-income debtors, and a quantification of the macroeconomic linkages. In particular, we wish (i) to extend the analysis of the impact of OECD economies upon non-OECD debtor countries beyond INTERLINK's restriction to group data and external indicators; (ii) to enhance the reliability of INTERLINK's feedback relationships by taking into account some explicit domestic considerations for non-OECD countries; (iii) to enhance the quality of the debt-accounting structure.

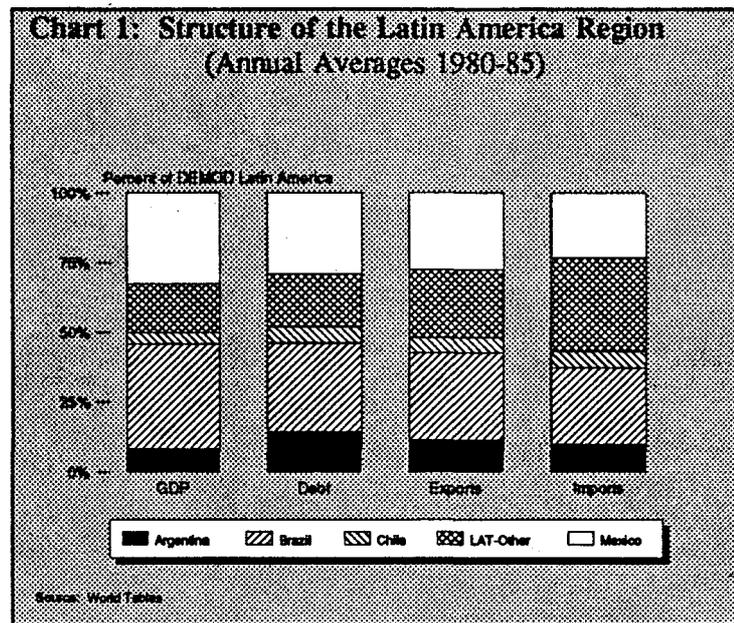
6. Given these aims, decisions on three key elements of modelling strategy are necessary. Should the models be "stand-alone" models, which would allow considerable freedom in specification and choice of data sources, or should they be linked to formally to a world model? Should we concentrate on individual country models, which may be time consuming, or use a regional aggregate which may allow more time for detailed specification? Should they be fully specified macroeconomic models or are reduced from relationships adequate?

7. Since the models are intended to be used to analyse interaction between debtor countries and the world economy, it is a clear advantage to design them from the beginning to interact with a world model, in this case INTERLINK. This immediately gives some constraints: the world environment variables used as external factors for the debtor countries must be available in the INTERLINK structure, and the DEMOD models must produce output that can be fed into INTERLINK. This decision also influences the choice of countries to be modelled.

8. INTERLINK treats non-OECD countries in highly aggregate form², using country groups defined on a geographical basis. No one group contains all the important debtor countries. The Latin America grouping contains several of the most important middle-income debtor countries and we have concentrated on this group for DEMOD. This group contains 30 countries; while it would be infeasible to model each one individually, some disaggregation is desirable. Focusing on some individual countries has some obvious advantages. It allows individual country differences - such as different countries' ability to transform additional external resources into output growth - to be taken into account. Differences between countries with respect to capital exports can also be of interest to policy-makers. This focus is also a prerequisite for linking country-specific information to the macroeconomic behaviour of Latin America as a whole, an advantage in the context of the OECD's periodic forecasting exercise. Individual country models also provide flexibility for changing country coverage or redefining regions³. While more costly in terms of resources, these have been kept down by using an identical structure for the different models.

9. Obvious countries to focus on are Brazil and Mexico, given their size and importance in the region; Argentina, a rather badly performing country, and Chile, a rather successful adjuster, were also chosen. The remainder of LAT⁴ is modelled as the aggregate of 15 other countries⁵. An overview

of the importance of different countries within LAT is provided in Chart 1. Brazil and Mexico alone account for about 70 per cent of LAT GDP, and almost 60 per cent of total debt outstanding and disbursed. Chile accounts for around 5 per cent, and Argentina for around 10 per cent, of LAT. The trade participation ratio (exports plus imports as a proportion of GDP) varies between 16 per cent for Brazil and 35 per cent for Chile; the overall LAT average is 21 per cent. Venezuela is not included, because it is part of the OPEC group in the INTERLINK country groupings.



10. The third key element is the degree of detailed structural modelling done for each country model. Our approach was to provide the minimum structure necessary to capture some of the essential aspects of the mechanisms by which external shocks affect domestic performance and creditworthiness. External capital flows and interest rates, the level of world activity, and of exchange rates and international trade prices are the variables whose influences we wish to trace, and the models have been designed with this in mind. Not all the major debtors are covered by DEMOD: therefore an additional set of debt-accounting models was constructed to cover the 17 "Highly Indebted Countries". The structure of these models is set out on pages 14 ff.

B. DEMOD: macroeconomic models for Latin America

1. DEMOD structure

11. DEMOD features endogenous output determination. However, the output block has been kept small, designed to capture just a few essential aspects of external shocks on domestic growth performance: external capital flows influence fixed investment; on the demand side investment has an important effect on actual output while on the supply side it influences the capital stock and potential output. Exports affect actual output via their effect on demand while imports are influenced directly by demand but also by the degree of capacity utilisation. The domestic financial sector has not been modelled.

12. DEMOD consists of five country modules - Brazil, Mexico, Chile, Argentina, and the aggregate of 15 smaller countries - each module having the same structural skeleton, presented in

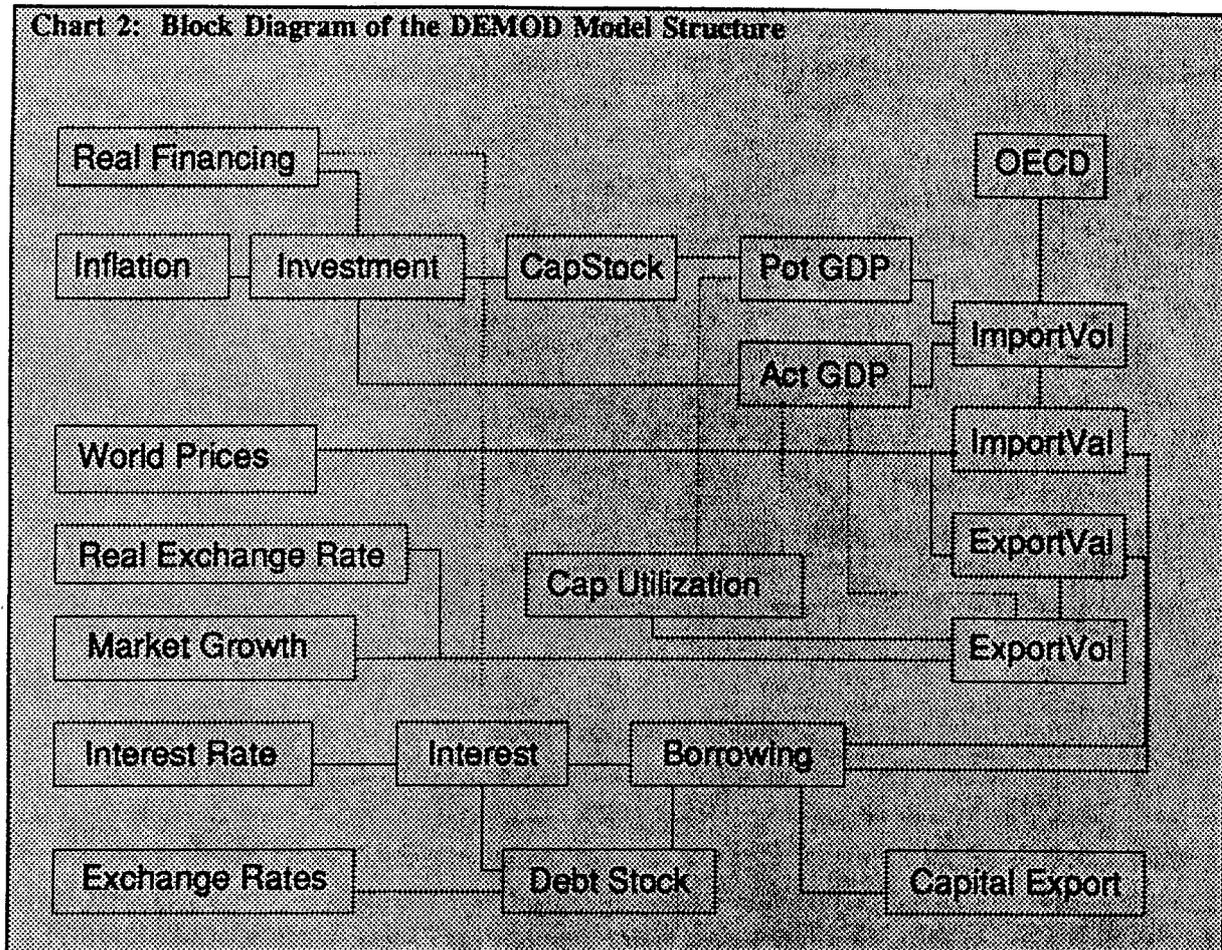


Chart 2. Variables that country models treat as exogenous are on the left hand side. These include the "economic environment" variables that DEMOD takes directly from INTERLINK: Prices for imports and exports, market growth for Latin America, the US short term interest rate, and the nominal effective US Dollar exchange rate. Additional exogenous variables are the inflation rate and the real exchange rate vis-a-vis the US Dollar. The DEMOD models consists of three blocks: the output block, the trade block and the debt block, which we discuss in turn.

(a) The output block

13. The output block calculates potential and actual output and it is here that the main domestic macroeconomic relationships referred to above are incorporated. Variations in potential output depend only on the capital stock; both increases in the labor force and technological progress are represented by a time trend. The functional form is log-linear in potential output, the capital stock and the time trend, with the elasticity of potential output with respect to the capital stock assumed⁶ to be 0.4. Capital stock data were not available and have been derived under the assumption, fairly common practice where reliable data is unavailable, that the capital stock was three times GDP in 1975, and

that it increases every year by gross domestic investment minus depreciation. The annual depreciation rate is assumed to be 5 per cent.

14. Actual output, rather than being derived - as for example in INTERLINK - from the sum of its expenditure components, is determined directly in a partially reduced form as a function of investment and exports. A structural formulation of the output block - with more detailed modelling of expenditure components, while desirable, goes beyond what was considered necessary and feasible for DEMOD.

15. Of domestic demand components, only investment is determined endogenously, permitting endogenous variation in the capital stock and potential output, as well as demand and actual output. We found no significant role for the real interest rate in the investment functions. This may have been for lack of an appropriate interest rate series and information on appropriate tax adjustments etc. But it seems more likely that, most of the time, interest rates are low on the list of factors taken into account in investment decisions in these countries. Much better results were obtained treating investment as savings constrained: investment is a function of activity (GDP and/or exports, proxying demand pressure and availability of internal finance) and real net external finance.

16. In addition to activity and net external flows, inflation is an important conditioning variable in the investment equations for Mexico and LAT-other, acting as a proxy for the macroeconomic framework. A major weakness of this version of DEMOD is the absence of any variable representing government policy, other than the rate of inflation. Lack of adequate and easily available data ruled out the use of a direct measure of fiscal or monetary policy at this stage⁷. The inflation rate was used, not in the expectation that one could use it to study the impact of changes in policy, but as a crude conditioning variable, in an attempt to improve estimates of other parameters in the equation.⁸

17. Real net external finance is defined as inflows of long term finance net of amortisation and interest payments, expressed in constant dollars. Thus investment depends on foreign interest rates indirectly, via their effect on available finance. Brazil is an exception here; it was not possible to identify a positive correlation between external finance and domestic investment. The debt:GDP ratio is quite strongly negatively correlated with investment in Brazil, however, and has been included in the equation.

18. The link between net real lending and investment is a key feature of the output block. Latin America is modelled as being finance constrained. But this constraint is a "soft constraint." DEMOD does not impose that additional exports or finance lead to an exactly equivalent rise in either investment or imports. Such additional finance will be used to increase imports, but part may also implicitly be used to increase reserve holdings or other assets abroad. The propensity of different countries with respect to these options is different, and embodied in the models' parameters. An additional variation compared with a strict finance-constrained model is that the reaction of imports to changes in exports may differ from the reaction to changes in external finance. Thus DEMOD retains the basic idea that Latin American countries are finance-constrained, but does not impose this strictly⁹.

19. In this context another choice in model design is of interest. There is agreement that the reduction in real lending that occurred in 1981/82 was a key factor in the decrease of investment and the ensuing slowing of growth. There is less agreement with regard to the mechanism by which this shock was transmitted. One possibility is that reduced net lending led to reduced imports, which in turn then caused declines in investment. The other possibility is that reduced net lending led to cancellations of investment projects, which in turn led to declining imports. While it is quite likely that both channels are at work simultaneously, the data do not offer the scope for incorporating both into the model at the same time. For DEMOD, using a real net lending variable to determine investment was the preferred solution, in particular because such a model tracks better. A model using the alternative approach gave roughly the same current account changes in response to a given shock to external finance.

(b) The trade block

20. DEMOD breaks trade into four categories: manufactures, raw materials and food, energy, and non-factor services. These categories match exactly the commodity breakdown of INTERLINK's trade sector (except that INTERLINK separates food and other raw materials). Export volumes depend basically on market growth, derived from INTERLINK modified by domestic capacity utilization - the ratio of actual to potential output. Increased capacity utilization means increased domestic demand for goods - both as inputs for domestic production and for direct consumption - and hence reduced supply for exports¹⁰.

21. In standard export functions, as in INTERLINK, competitiveness is a key variable determining trade patterns. Here it was only in the case of Brazil that we succeeded in establishing a statistically significant competitive effect on exports, in the form of a real exchange rate variable. The volume of Mexico's oil exports appears to have little to do with market growth, but more with supply potential and possibly strategic considerations. The value of oil exports varies with oil prices but volume is taken to be exogenous.

22. Imports are separated into the same commodity categories as exports. In each category, import volumes are determined by domestic activity variables and capacity utilization. Domestic activity variables are one or several of the following: actual output, potential output, the difference between actual and potential output, and investment. Again, as for exports, we did not find a significant competitiveness variable, and there are therefore no price terms in the import equations.

23. As discussed above, DEMOD treats Latin American countries as finance constrained; but this constraint is "soft": imports are not directly determined by the amount of export revenue and capital flows available. Rather these latter variables affect other expenditures (via the investment and output equations) which in turn have an important impact on import behaviour.

24. Trade prices determined in INTERLINK, and therefore the same (in each category of trade) for each of the DEMOD countries, are used to calculate the dollar value of imports and exports.

(c) The debt block

25. The debt block is a standard debt accounting module. It calculates debt and asset stocks dynamically over time, and uses them to determine factor service payments. Creditworthiness indicators like the debt to GDP ratio, the debt to export ratio, and the interest to export ratio are also calculated in this block.

26. Changes in debt stocks depend on two factors: net borrowing, and valuation adjustments. Valuation adjustments are necessary because part of the external liabilities are not in US dollars, but DEMOD measures debt in US dollars. Changes in the effective nominal rate (EXCHE from INTERLINK) of the US dollar vis-a-vis other currencies are used, together with an assumed non-dollar share of debt, to derive valuation adjustments to the US dollar stock of debt.

27. Capital exports are (mostly) unobserved but can be calculated ex post as a residual, given the valuation adjusted change in debt stocks, net direct foreign investment, reserve changes and the current account balance. This follows from the identity for net borrowing, that is total borrowing less amortization payments, defined as:

$$\begin{aligned} \text{Net borrowing} = & \text{Reserve Change} \\ & + \text{Current Account Deficit} \\ & + \text{Capital Exports} \\ & - \text{Net (inward) Direct Foreign Investment} \end{aligned}$$

DEMOD links reserve changes to imports and the current account through standard equations that assume a certain - country specific - reserve cover for imports. The current account deficit is calculated as the sum of the trade balance, non-factor service balance, and investment income and transfer balance.

28. When adjusted for valuation changes, the change in the total debt stock is equal to net borrowing given by this equation. Capital exports can thus be calculated for the historical period. It would not be appropriate to view the derived capital exports figures as only capital flight. Inter alia, it includes errors and omissions of the balance of payments, "legal" capital exports including trade finance, and errors in the estimation of the non dollar debt share. Nevertheless, the capital export variable bears a certain resemblance to patterns of capital flight analyzed in other studies.

29. Investment income payments and receipts are calculated as multiples of estimated payments on the basis of identified stocks of assets and liabilities. This part of DEMOD is almost identical to the debt modules used for the remaining HICs; for further detail, see below, see page 14 ff.

30. This structure - despite its simple form and a number of shortcomings - allows the state of the world macroeconomy to directly influence economic performance of debtor countries. The key variables in this linkage are (i) the US short term interest rate; (ii) OECD output growth; (iii) net flows to debtor countries. The response to variations in these exogenous variables is discussed on pages 18 ff.

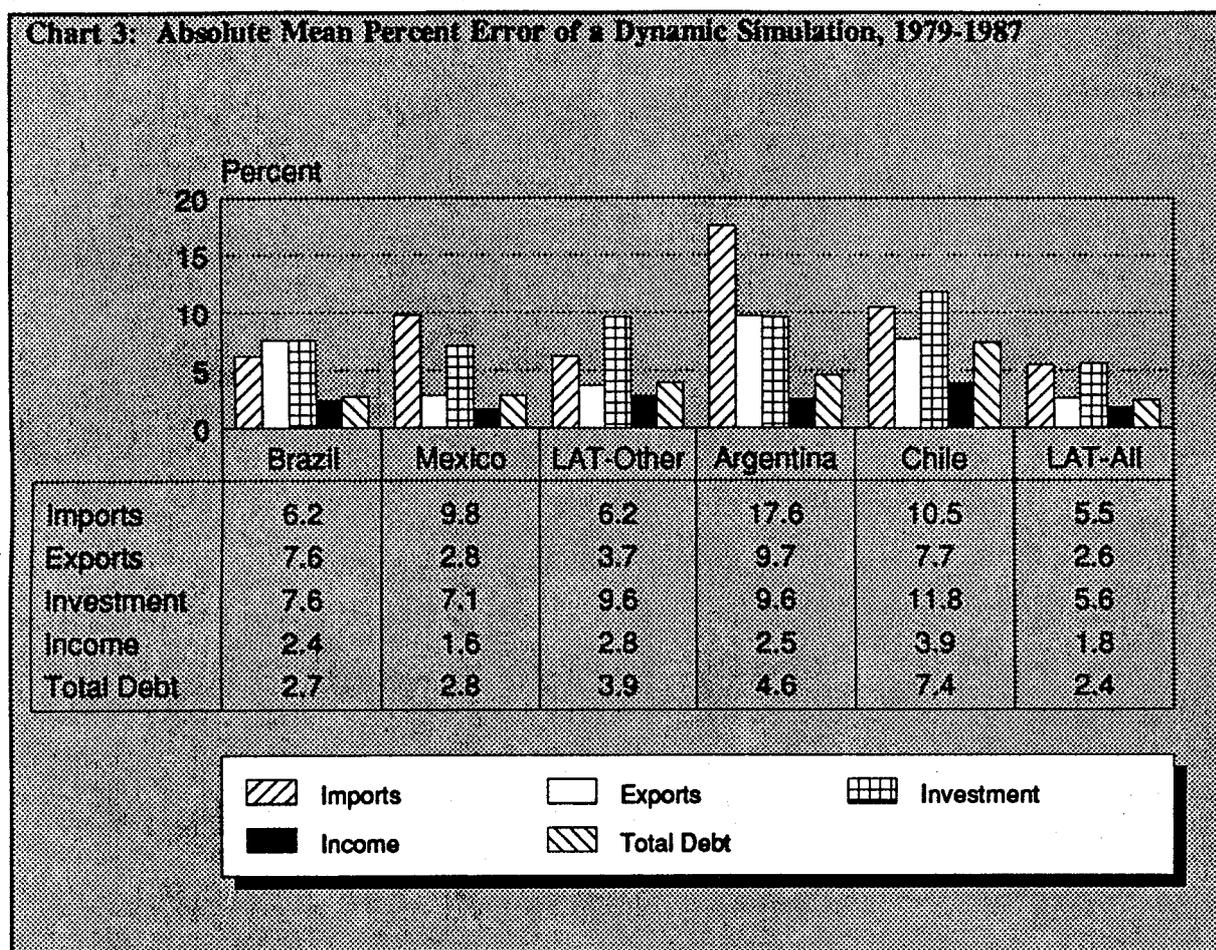
2. DEMOD parameter estimation and tracking performance

(a) Parameter estimation

31. The data used for the estimation are from OECD sources for historical series of OECD variables, and from the World Bank's World Tables for data on Latin American countries. Some variables had to be assumed or estimated. This is the case of the capital stock: the capital-output ratio was simply assumed to be 3.0 in 1975. The exponent on capital in the potential output equation is assumed to be 0.4, combining the assumption of Cobb-Douglas technology, competitive markets and an income distribution assumption; the proportion of non dollar debt in the total was estimated to be between 0.3 and 0.4; the ratio of variable to fixed rate debt was estimated on the basis of World Debt Tables data. Data problems were encountered for a number of smaller LAT countries, especially with data availability for 1986 and 1987. Missing data were estimated on the basis of average ratios. Some ad hoc adjustments were required to trade data. Exchange rates and deflators are used to express all variables in constant US 1980 dollars.

32. The equations were estimated with time series data from 1975 to 1987. The year 1975 is after the second oil price shock, and is about the time when large scale lending to Latin America started; also, some time series from INTERLINK are not available for earlier years. This gives 13 observations, which is rather few for econometric work, and especially for testing. Behavioral equations of DEMOD were estimated by simple ordinary least squares, using Micro TSP and MICRO-FIT. In the output block especially, simultaneity is present and leads to biased and inconsistent parameter estimates. In this case, one can improve on OLS by using two-stage least squares which are biased, too, but they are consistent. With a sample of 13 observations, it is not clear - on the basis of large sample theory - that much is gained by using consistent estimators, especially since 2SLS estimates have a larger variance than OLS. Nevertheless, "diagnostic" 2SLS were performed; as a rule, results were almost identical to OLS. With 3SLS, specification errors in one equation would influence the parameter estimates of all other equations in the system. "Diagnostic" 3SLS for Mexico yielded results that were not statistically different from OLS. Within the structural framework laid out above, slightly different functional forms and activity variables were tried.

33. The relatively few observations do not permit an extensive use of diagnostic statistics. In the first stage, the DW statistic was used as an indicator of functional misspecification and serial correlation. In a second stage, a number of equations were subjected to more rigorous testing,

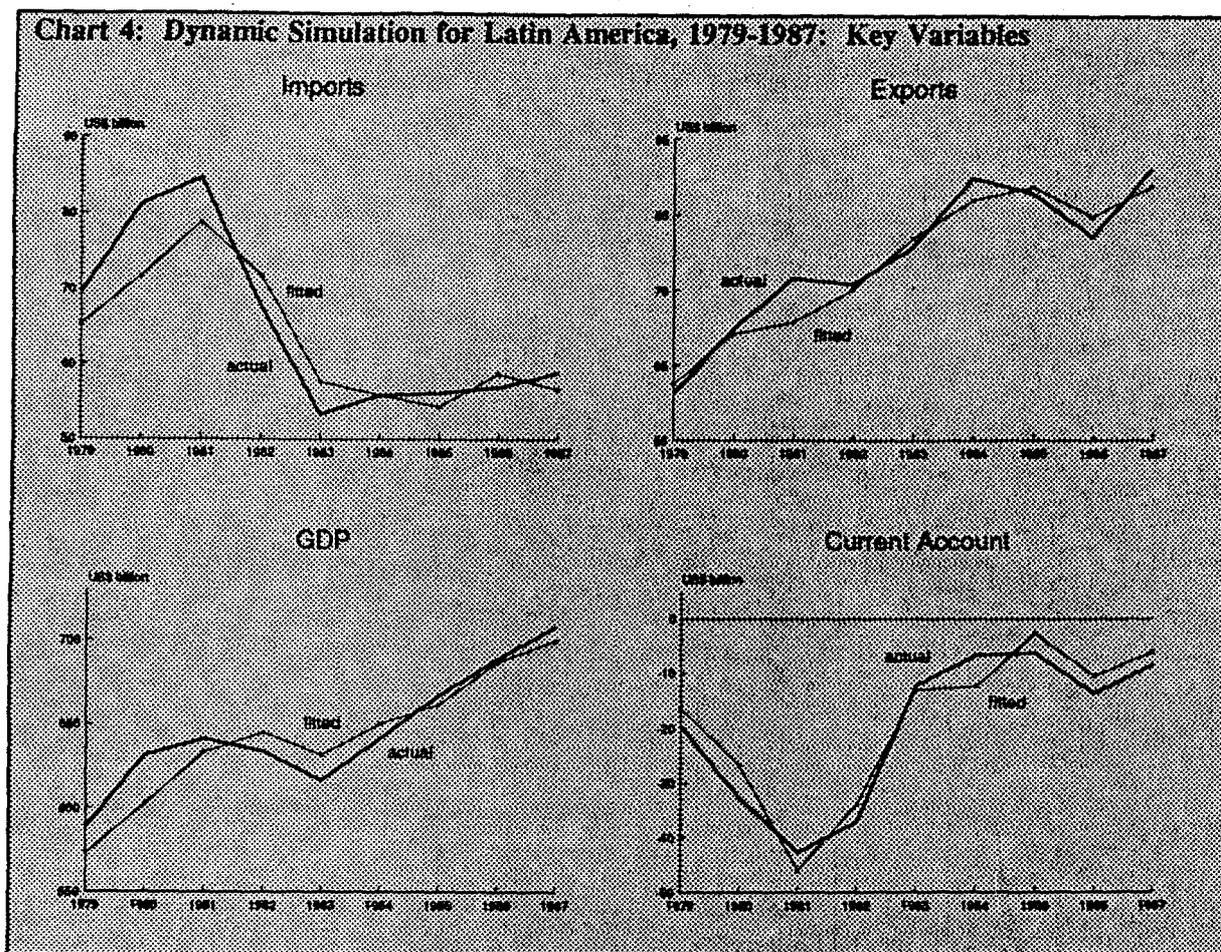


including for heteroskedasticity and misspecification of functional form. CUSUM and CUSUMSQ plots were used to check for structural breaks. Detailed regression results are reported in the appendix. Final selection of an equation was made on the basis of its simulation properties with the RMS error as selection criterion.

34. The equation for the long term interest rate, INTLT (see also page 15 where the HIC debt modules are described), was fitted by a manual grid search. The ratio of floating to fixed rate debt, the spread over the short term US interest rate, and the long term interest rate were experimented with to arrive at a reasonable fit with actual interest payments. No attempt was made to fine-tune the fit. A complete listing of the models for Argentina, Brazil, Chile, Mexico, and LAT-other is in the appendix. The appendix also contains a complete list of exogenous and endogenous variables, explanation of acronyms, and sources of data with concordance to the World Tables.

(b) Tracking behavior

35. While the statistical results for individual equations are of interest, the complete models are equally importantly evaluated by their simulation and tracking properties. Of such a simple model as



DEMODO, one would not expect great forecasting accuracy; but it is important that the model track satisfactorily the pattern exhibited by the data, including turning points. To check this, dynamic simulations were carried out over a nine year period from 1979 to 1987. Generally, tracking performance appears satisfactory. The model is stable; residuals are not unreasonable for this kind of model; and turning points are well traced. Chart 3 shows absolute mean per cent errors for a dynamic simulation from 1979 to 1987 for key variables. Simulation errors for Brazil, Mexico, and LAT-Other, which account for most of Latin America, appear reasonable; the models for Argentina and Chile are less satisfactory. The Latin America region taken as a whole has smaller simulation errors than any of the individual country models, of the order of five per cent or less.

36. Error statistics alone do not describe a simulation model very well, since one of the more important criteria is how well turning points are traced. Actual versus predicted values for some variables for the Latin America region are graphed in Chart 4. Turning points are reasonably well identified. DEMODO captures correctly the downturn in investment, income, and imports in 1981-83; it traces the decrease in exports during 1985/86 and the following upturn in 1987. Overall, while some residuals are large, and would render use as a forecasting tool difficult, the model structure DEMODO imposes on the data seems quite capable of reproducing the historical pattern of key variables.

37. For the analysis of debt related questions, it is important that the model be able to simulate the stock of debt reasonably well; because the compound interest effects tends to increase small errors over time. The actual versus the predicted path of debt is shown in ?. Debt is simulated fairly well, which can partly be attributed to the use of exogenous capital export variable. With the knowledge of this variable, and a decent simulation for the current account, one would expect good tracking for the debt stock. Underestimation of capital exports was one reason for the unsatisfactory debt projections produced in the early eighties.

(c) The baseline for simulations

38. For scenario analysis in the medium term future, a baseline is needed. The broad features of the baseline that form the basis for the simulations can be described as follows. Growth in the OECD area is smooth, and projected at 2.9 per cent between 1990 and 1994 - the same as during the eighties. Capacity utilization in the OECD area remains at high levels, but inflation peaks in 1990 and declines thereafter to 3.6 in 1994. This development is mirrored by the short term interest rate, which peaks at 9.2% in 1990 and thereafter declines to 7.6% in 1994. The trilateral current imbalances between the United States, Japan, and Germany remain roughly constant, and some additional imbalances develop within Europe. Thus there is little adjustment, but there is also no crisis. The assumption is that these imbalances can be smoothly financed, without major changes in exchange rates or interest rates.

39. Based on this external environment, baselines for Argentina, Brazil, Chile, Mexico, and LAT-Other have been constructed. These DEMOD baselines take a cautiously optimistic view of the world. To the generally favourable external environment, slowly increasing net flows and low capital exports are added. This assumes that Latin American countries make some progress with macro-economic stabilization as well as structural reforms. Latin America's current account deficit remains at about \$10 billion, which seems able to be financed. Taken together with satisfactory export growth, this would appear to allow growth to resume. Most DEMOD baseline figures have been projected by using the model itself. Output growth has been checked for consistency with Project LINK and World Bank projections, and achieved mainly through add factors in the investment equations. Key variables are shown in Table 1. Output growth for Latin America is assumed to be 4.1 per cent per annum. Imports grow at 9.6 per cent, which implies an import elasticity of 2.3. Relatively rapid export and GDP growth improve debt indicators over time, though not dramatically. Total debt is projected to increase by \$90 billion to almost \$500 billion by 1994.

40. It should be pointed out that this scenario could be considered optimistic on two counts. First, there are risks in the baseline for OECD countries. Current account imbalances may not prove as sustainable as assumed therein; sudden adjustment could involve much reduced OECD growth and possibly higher US interest rates. Such a development would cloud considerably the outlook for Latin America. Second, macroeconomic policies in Latin America may not improve very much, and reform efforts under way could be derailed easily by political developments. In such a case, much higher

Table 1
DEMODO: The Baseline for Latin America

	<i>Brazil</i>	<i>Mexico</i>	<i>LAT-Other</i>	<i>Argentina</i>	<i>Chile</i>	<i>Total</i>
Output Growth (Annual Average 89-94)	4.7	4.1	3.5	1.1	5.2	4.1
Goods Import Growth (Annual Average 89-94)	11.5	12.4	4.0	12.3	7.8	9.6
Goods Export Growth (Annual Average 89-94)	6.3	6.8	4.6	6.4	8.9	6.3
Current Account (Average 89-94, \$ bn)	2.8	-3.7	-7.7	-1.3	-0.9	-10.0
Total Debt (89/94, \$ bn)	112/112	103/125	100/141	59/77	25/32	398/488
Debt to GDP Ratio (89/94)	26/16	62/48	66/61	75/73	101/79	46/37
Debt to Export Ratio (89/94)	315/191	293/202	299/273	417/323	297/206	315/231

capital exports, and lower investment and growth could be expected. The baseline may be best viewed as a fair weather scenario, particularly from the point of view of domestic policies in debtor countries.

C. The HIC debt models

41. While the main modelling effort has been concentrated on the major Latin American debtors, simple debt accounting models have been constructed for each of the 17 Highly Indebted Countries (HICs) (see Appendix E. for a list of the HICs). Equations are provided linking the main balance of payments flows for each of these countries to INTERLINK simulations so that the impact of various scenarios on the evolution of total debt and debt servicing can be traced for the HICs as a whole. Unlike the main DEMODO models, these debt accounting models provide no feed-back to INTERLINK.

1. Linkage to INTERLINK

42. The HIC models take no account of the likely diversity of response of individual HICs to external shocks; only debt interest payments are given country-by-country treatment. Each HIC belongs to one or other of the regional groupings which INTERLINK uses to represent non-OECD countries (see Appendix E.). Simple equations link each of exports and imports of goods and services to the corresponding regional total; deviations from baseline are allocated to individual countries using baseline proportions, thus for exports of goods and (non-factor) services in country *i* in region *R*:

$$XGS_i = a_i * XGS_R \quad (1)$$

$$\text{with } a_i = XGS_i (\text{baseline}) / XGS_R (\text{baseline})$$

where XGS_R is exports of goods and services for the relevant region in a particular INTERLINK simulation; a_i will of course vary through time though fixed in simulation. A similar equation is used for imports of goods and services.

43. Other items in the current account are transfers, which are taken as exogenous, and credits and debits on factor services. Credits on this item are not very important for most HICs; a simplifying assumption is used: all credits are assumed to be interest payments on reserves which are assumed to be held in dollars and to earn interest at a rate of interest directly proportional to LIBOR. Hence

$$XSI_i = IRSUS * XSI_i (\text{baseline}) / IRSUS (\text{baseline}) \quad (2)$$

where IRSUS is the US short term interest rate. The spread between this interest rate and LIBOR is assumed to be constant.

2. Interest Debits

44. The structure of the equations for debt interest flows described here is also used in DEMOD. Debits on factor services consist mainly of interest payments on foreign debt. Two equations are used to model this item. One takes World Bank data on payments of interest on long term debt and models this in terms of the stock of long term debt and United States treasury bill rate. A second equation uses an implicit equation for interest payments on short-term debt (for which explicit data are not available) and, taking this together with payments on long-term debt, models factor services debits.

The resulting equations are of the following form for all countries:

$$IIDEBL = LTD * \{ SFX * RFX + (1-SFX) * DD * IRSUS / 100 \} \quad (3)$$

$$IIDEBS = STD * (IRSUS + MK) / 100 \quad (4)$$

$$MSI = EA * \{ EE * IIDEBL + (2-EE) * IIDEBS \} + AD \quad (5)$$

where: IIDEBL, IIDEBS	interest payments on long and short debt respectively
LTD, STD	stock of long and short debt, respectively
SFX	share of fixed interest rate debt
IRSUS	United States treasury bill rate
MSI	Factor income debits
RFX	rate of interest on fixed rate debt
DD, MK, EA, EE, AD	coefficients

3. Estimation

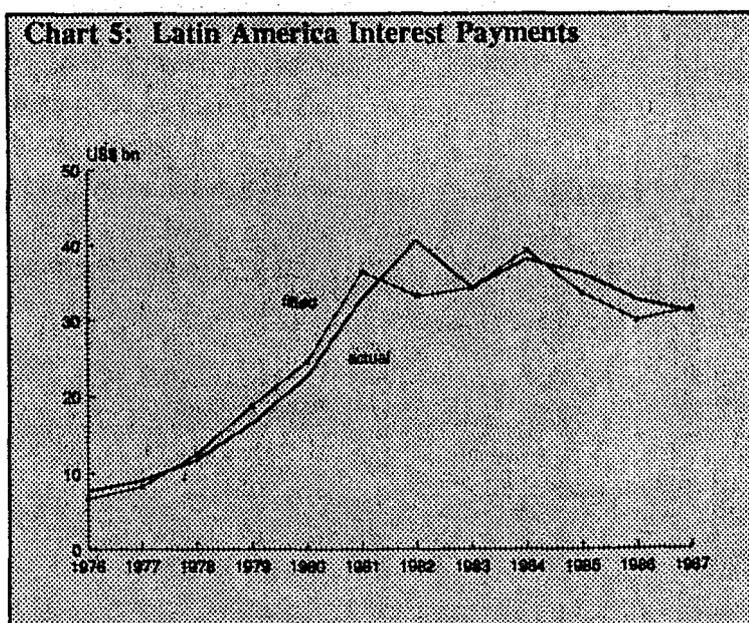
45. DD, MK, EA, EE and AD are all coefficients to be estimated. For each country their estimated values are tabulated in Appendix E. RFX was set to a constant 6 per cent in almost all

cases, corresponding to OECD estimates of the average interest rate paid on fixed interest debt for all developing countries, which have shown very little variation outside a range close to 6 per cent over the whole period since 1975.

46. The data on long-term interest are on a *payments* basis whereas the current account item for debits on factor services (denoted MSI) is measured on an *accruals* basis. Hence, if the model for interest payments fitted the data exactly, the model for MSI would fit badly during periods when arrears are being accumulated or paid off. Since the focus here is not on modelling *payments* but on *accruals* we did not attempt to produce well-fitting equations for payments; rather equations that satisfy some a priori conditions and produced a "reasonable" fit were produced for long term interest payments (denoted IIDEBL), and the predictions from these equations were then used to model MSI. In both cases the functional form was over-parameterised (more coefficients than variables) to allow flexibility, and coefficients were estimated by grid-search and graph-plotting rather than by regression.

47. Equation (3) was estimated directly but equation (4) was estimated indirectly by substituting for IIDEBS in equation (5); equation (5) itself was estimated using *fitted* values for IIDEBL on the right-hand side, not actual values. Fitted rather than actual values for interest payments on long term debt were taken to be a more accurate representation of *accruals* than data on actual payments would be. It may be noted that the final result is to produce an equation for MSI which is a complicated function of IRSUS and the stock of debt; three equations are probably not necessary for this. However, a priori there is no good reason why such an approach suffices for MSI (which may contain other flows than pure debt interest); estimating initially equation (3), where it is known that the data for stocks and flows match exactly (with the sole exception of the difference between payments and accruals) is a useful check of the plausibility of the specification.

48. To complete the modelling of the balance of payments and debt consequences of an external shock on each HIC, a pair of equations for updating the debt stocks is added. Data on both short-term and long-term debt is required. In simulations it is assumed that variations in the current balance from baseline will be entirely financed through changes in debt, and not through changes in reserves, and that in any given period the proportion of short and long-term debt will remain as in the baseline. Data were available for all variables up to 1987; some estimates were used for 1988 and values for 1989

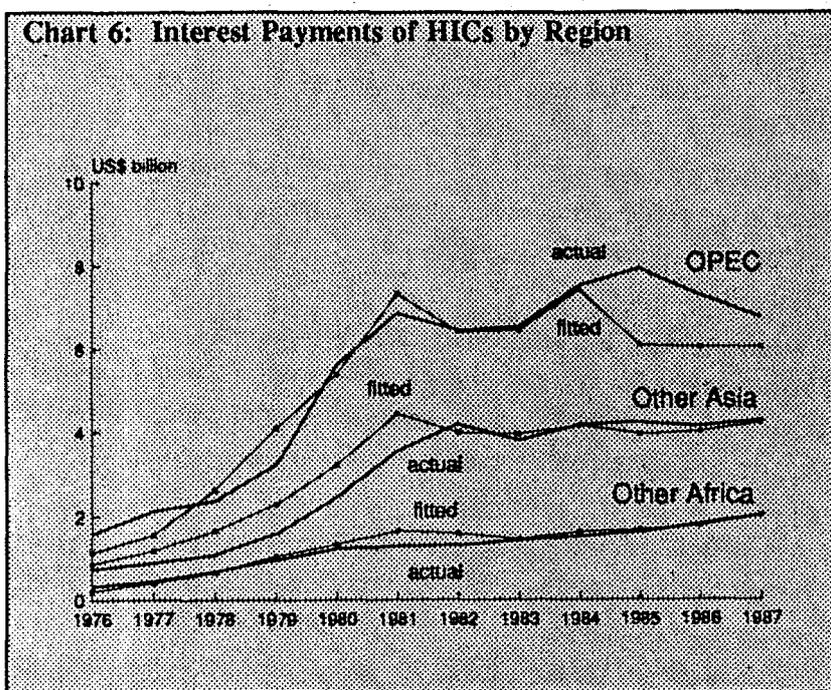


onwards were calculated by applying the above equations to the baseline, with all share-type variables fixed at their 1988 levels. Unlike in the DEMOD models, there is no account taken of valuation effects resulting from exchange rate movements¹¹.

4. Tracking performance of the investment income equations

49. In many cases the naive modelling approach used worked well. In particular the shift variables used (DD EA and AD) rarely needed to be substantially different from unity (for DD and EA) or zero (for AD). In some cases

high values were used for EE in equation (5), implying an exaggerated weight for long-term debt interest in factor payments, and some values of MK are not very plausible estimates of borrowing margins over LIBOR for the countries concerned. Certain countries produced rather badly fitting models (in particular those for Ecuador, Bolivia and Yugoslavia). But on the whole the tracking performance for MSI is very respectable. Following successful estimation for



HICs this type of formulation for MSI was incorporated into the DEMOD structure.

50. The main systematic error across countries is that the models tend to predict that the peak in the average interest rate occur in 1980, when US short term rates peaked, rather than in 1981, when the average apparent interest rate (calculated by dividing factor debits by total debt) peaked. Given that this was the only obvious error of timing, and that the model tracked very well the rising factor payments trend of the 1975-1979 period, no attempt was made to experiment with more refined specifications. Chart 5 and Chart 6 show fitted and actual values of MSI for HICs grouped according to which INTERLINK region they belong.

III. SIMULATION PROPERTIES

51. An important performance criterion of a model is its reaction to shocks. A model may have small residuals and track historical data, especially within the sample, reasonably well, but may have implausible marginal properties. In this section, the results of standard shocks on DEMOD are reported. All simulations have been done in combined mode with INTERLINK. The results of the simulations therefore incorporate the direct impact of, e.g., an increase in the US short term interest rate, as well as the indirect effect through slower GDP growth in the OECD area and lower raw materials prices, etc. Exchange rates are exogenous; OECD government consumption and investment are constant in real terms. The shocks are:

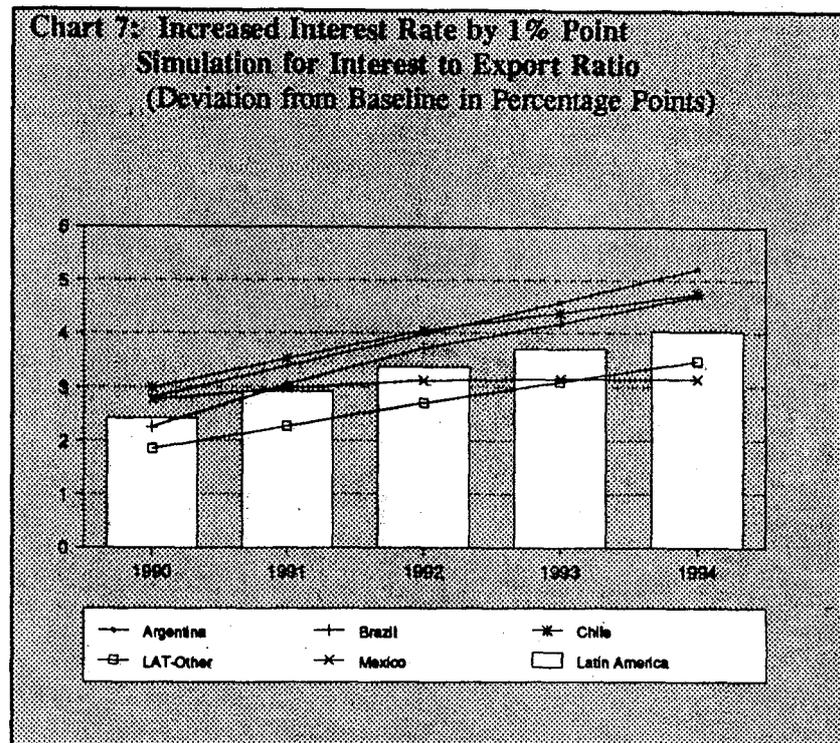
- (i) The US short term interest rate is increased by one percentage point. This increases interest payments and tends to worsen the current account. At the same time, however, it reduces net real lending, which reduces domestic output growth and tends to reduce imports.
- (ii) OECD GDP is increased by one per cent over baseline. This increases demand for Latin American imports and hence tends to improve the current account and increase growth. OECD short term nominal interest rates are held constant.
- (iii) Real net flows is increased by 10% of baseline imports. This increases investment and growth, and leads to higher imports. The negative effect on the current account is somewhat softened by the feedback effect from the OECD area: increased import demand from Latin America increases OECD growth and hence demand for Latin American products.

Detailed tables for these simulations are in the appendix. The following sections highlight important features of the simulations and present them in simple graphs. It should be noted that these simulations are baseline-dependent. If the shocks were introduced in different years, DEMOD would show slightly different changes. This is due to the stocks that are in the model: capital and debt. Measures and flows derived from these stocks will obviously differ if these stocks differ, as they do between different years.

A. Increase of the short term interest rate

52. An increase of one percentage point of the US short term interest rate increases Latin American factor service payments by 4.9 billion dollars. The current account worsens by less, however, because higher interest payments translate into reduced foreign finance for investment, leading to lower investment and GDP and hence to lower import demand. The current account deterioration is \$3.4 billion in 1990, increasing to \$10.7 billion after five years due to the compound interest effect. Much of this current account deterioration is due to higher interest payments, but there

are also indirect effects at work. Most important, higher interest rates in the United States reduce economic activity and hence import demand, leading to export losses for Latin America. The combined effects of the interest rate increase on Latin America's GDP is not negligible. In 1990, GDP is reduced by 0.4 per cent against the baseline; in 1994, GDP is 2.8 per cent lower than in the baseline. Lower GDP, higher debt, and increased interest all tend to worsen indicators of creditworthiness. Chart 7



shows the change of the interest to export ratio in percentage points against the baseline. For the Latin America region as a whole, the interest to export ratio increases by 4 percentage points after five years; lowest is Mexico (3.1 percentage points), highest Argentina (5.2 percentage points). Country differences depend on the debt stock, the ratio of floating rate debt, the influence of foreign finance on investment, and the influence of investment on GDP.

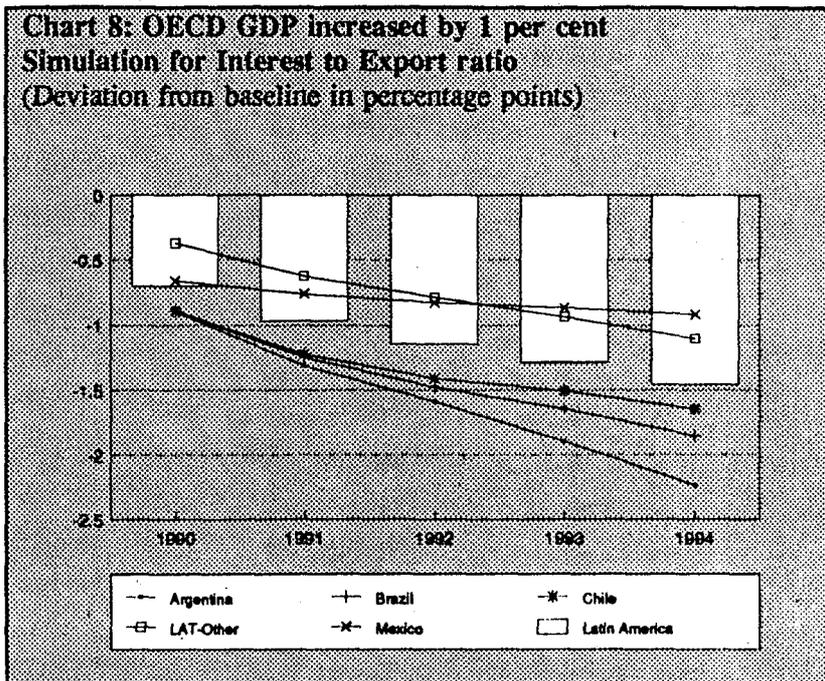
B. Increase of OECD GDP by one per cent

53. An increase in the level of OECD GDP by one per cent increases the market growth variables for Latin America and hence leads to higher exports. The increased OECD GDP has been achieved in this simulation by targetting total domestic demand (TDDV) with private consumption (CPV). Monetary policy in OECD countries is assumed to accommodate the increase of consumption; OECD short term interest rates remain constant. As a result of increased exports, the Latin American current account improves by \$2 billion in the first year. By 1994, partly due to the compound interest effect, the improvement in the current account has increased to \$6 billion. The simulated change of the interest to export ratio from baseline in percentage points is shown in Chart 8. The ratio improves for Latin America by 0.7 percentage points in 1990 increasing to 1.5 percentage points in 1994. This is due to a combination of three factors. First, increased exports increase GDP directly. Second, higher exports reduce the current account deficit and the stock of debt. Third, lower debt stocks lead to lower

interest payments after the first year, thereby increasing foreign finance available for investment, leading to higher investment and GDP. Latin America's GDP increases by 1.2 per cent in 1990; by 1994, the change is 1.8 per cent.

54. Within the Latin America region, there are considerable differences in the reaction to increased OECD GDP. Argentina's GDP does not change, reflecting the absence of

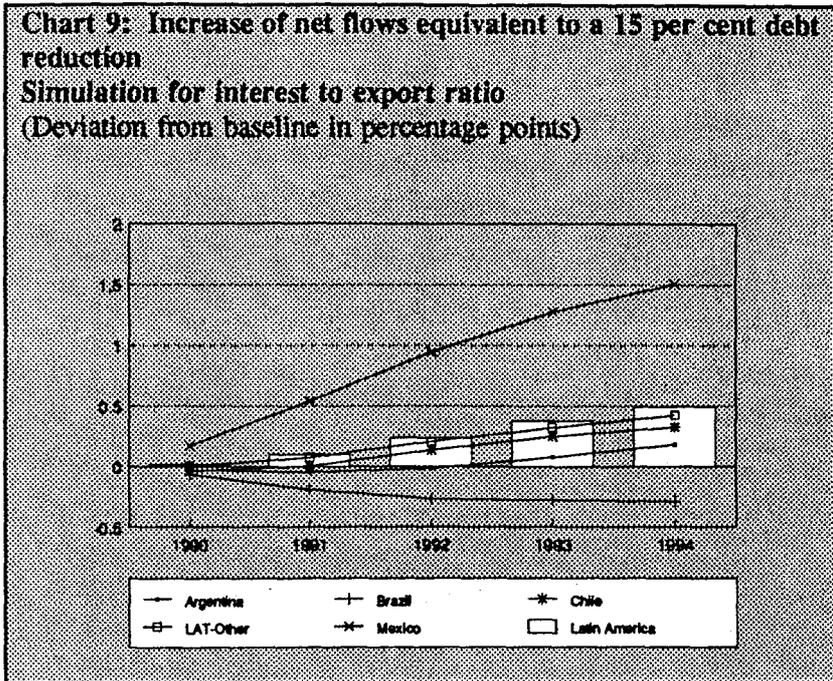
exports in Argentina's GDP equation. Brazil and Mexico are best at transforming higher OECD GDP into domestic growth. By 1994, Brazil's GDP has increased by 2.5 per cent over baseline, Mexico's by 1.8 per cent. The figure for LAT-Other is 0.9 per cent.



C. Increase of net flows equivalent to debt reduction of 15 per cent

55. Net flows in the simulations are increased by an amount equal to interest savings that would result from a reduction of the debt stock of 15 per cent (assuming that debt is being serviced). This is an interesting simulation. It indicates whether in DEMOD "new money" can be expected to improve the debt situation. New money makes increased investment possible, but it also adds to the debt stock. In DEMOD, new money leads to higher investment and GDP; increased domestic absorption leads to higher imports, worsening the current account. As a result, debt accumulates faster than before, an effect strengthened over time by the compound interest effect. The change of Latin America's GDP from baseline is modest. Chile shows the largest deviation from baseline: its GDP increases by 1.2 per cent over baseline. At the other end of the spectrum are Argentina and Brazil. The DEMOD country model for Argentina describes it as generally inefficient at transforming foreign finance into investment. Argentina's GDP increases by 0.3 per cent, Brazil's by 0.5 per cent after five years. This corresponds to a change in the *growth rate* of less than 0.1 per cent per annum.

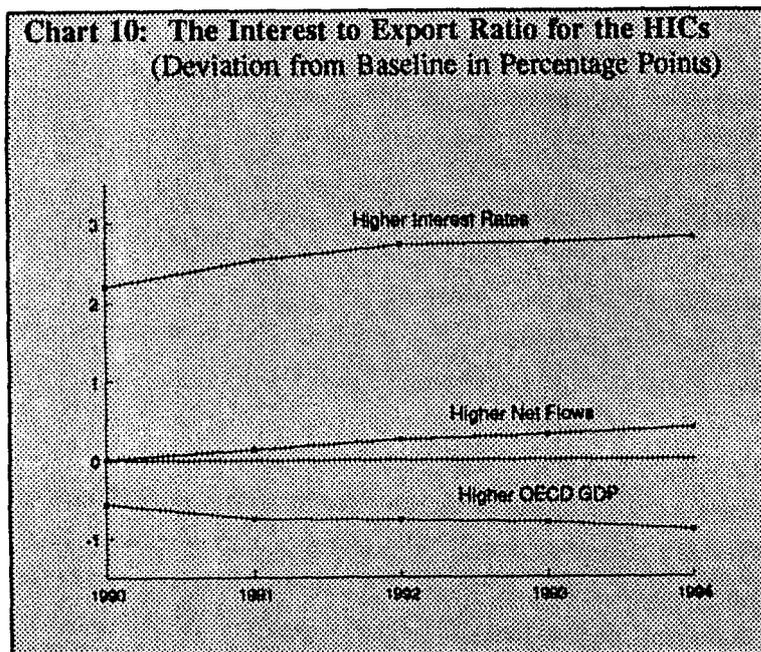
56. While the impact on growth is small, indicators of creditworthiness deteriorate. The current account deficit increases by \$5 billion over five years. The interest to export ratio of Latin America increases by 0.5 percentage points over baseline by 1994, as shown in Chart 9. New money thus leads to a worsening debt situation, although it does increase GDP growth.



E. Impact of the simulations on the HICs

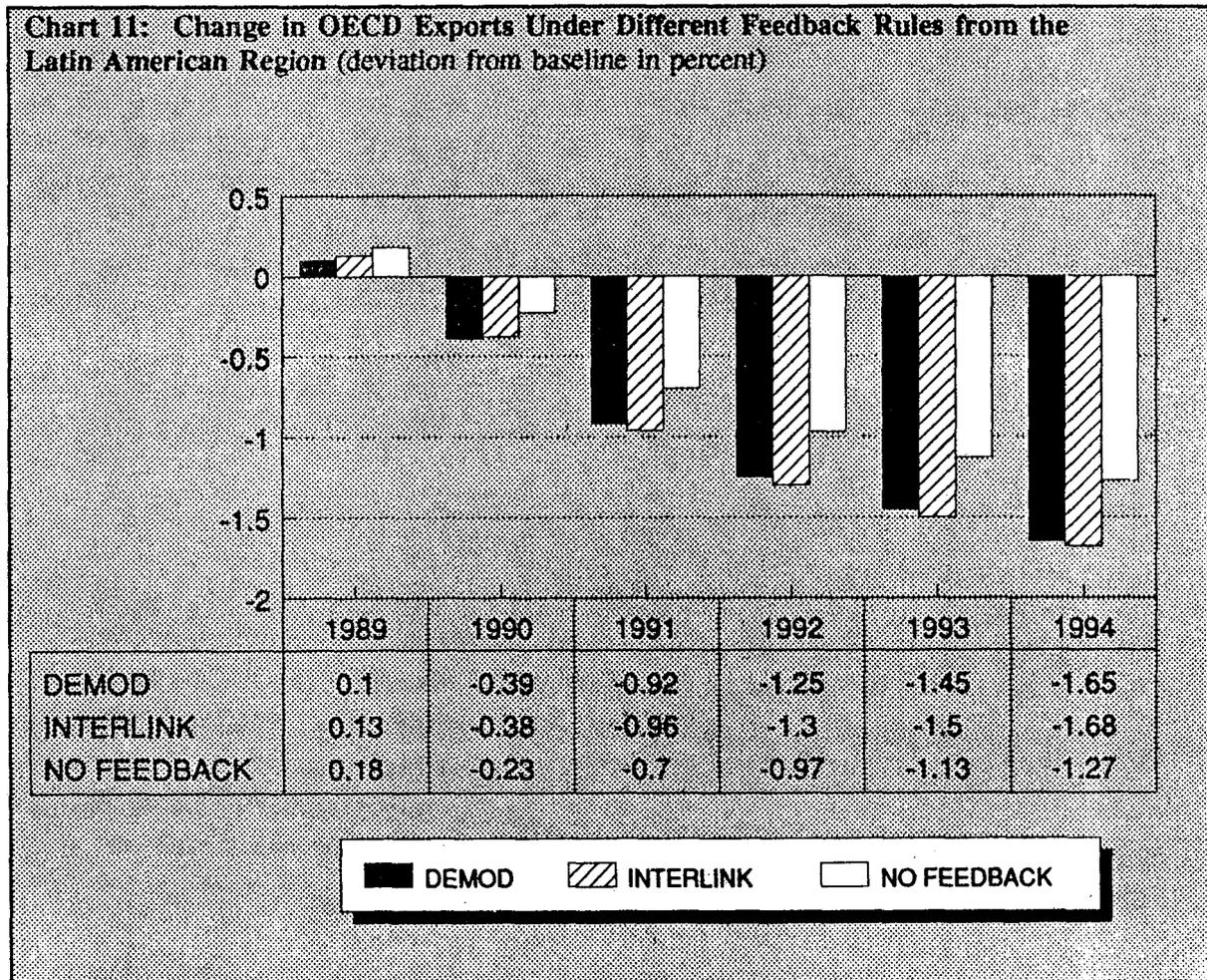
57. The preceding paragraphs have shown the reaction to standard shocks of key variables of the Latin America region. Based on the joint runs of INTERLINK and DEMOD, the HIC models calculate the changes from baseline of the interest to export ratio for the 17 highly indebted middle

income countries. These changes are graphed in Chart 10. Of particular interest is the comparison of changes in the interest to export ratio for HICs with the corresponding changes for the Latin America region (see Appendix D). The changes for the Latin America region and for the HICs are rather similar.



F. The importance of feedback from Latin America for OECD economies

58. DEMOD and the HIC accounting models have been developed for analyzing the interaction between OECD economic policies and the debt situation of Latin America and of highly indebted middle-income countries. It is also interesting to analyze the strength of the feedback loop between



the OECD area and Latin America. This is possible since DEMOD is designed to be able to replace the INTERLINK Latin America region. Such an exercise can provide some quantitative insight into how important Latin America is to the OECD economies. A comparison between the feedback loop of INTERLINK and of DEMOD can give some indication of the possible value of modelling non-OECD areas in more detail than is done in the current version of INTERLINK.

59. For a quantitative assessment of the importance of feedback from Latin America for OECD economies, the simulation with an increase in the US short term interest rate of one percentage point has been taken as an example (see page 18f.). Three variants of this simulation are presented below. First, INTERLINK and DEMOD are run in combined mode; the DEMOD models replace the equation for Latin America. In this variant, increased interest rates and lower demand for Latin American exports from the OECD area lead to lower GDP growth in Latin America; as a result, Latin American

import demand is reduced, which is then fed back to the OECD economies. Second, INTERLINK is run "as is": Latin America is represented by a finance-constrained import demand equation. Higher interest rates reduce available financing and hence Latin American import demand. Third, Latin American import demand is exogenized and kept at baseline levels. Thus, there is no feedback from the Latin American region to OECD economies. The deviation of OECD exports of goods and services under different feedback rules from Latin America is shown in Chart 11.

60. Two points are noteworthy in this comparison. First, the feedback from the Latin American region matters. In 1994, five years after the increase of the US short term interest rate by one percentage point, OECD exports are reduced by 1.27 per cent in the simulation without feedback; this contrasts with a reduction of OECD exports by 1.68 per cent for the feedback from the INTERLINK import equation for Latin America. This is not an insignificant difference. If the reduced demand from Latin America is not taken into account, the magnitude of the effect on OECD exports is understated by as much as one quarter.

61. Second, the feedback between the INTERLINK import equation for Latin America and the more detailed DEMOD models is similar. The differential impact of these two feedback rules on OECD exports is 0.05 percentage points or less; the differential impact on the OECD current account is \$0.8 billion or less.

62. Two preliminary conclusions may be drawn from these simulations. First, the feedback from Latin America to the OECD area makes a significant difference to economic aggregates of the OECD economies. Second, it would appear that the modelling of Latin American imports in INTERLINK as being finance constrained is appropriate for a macroeconomic model that focuses on the OECD area. Despite its simplicity, this approach gives very similar answers to the more detailed modelling of Latin America in DEMOD.

NOTES

1. Cline (1983) is probably the best-known example of this type of modelling approach to analyse the debt crisis.
2. A description of INTERLINK and its simulation properties can be found in Pete Richardson (1988). See O'Brien, Meuro and Camilleri (1989) for details on the non-OECD regional aggregates used by Interlink.
3. DEMOD builds on earlier work on debt models carried out at the OECD. See Saunders and Dean (1986).
4. "LAT" is the mnemonic in Interlink used to identify the Latin American region, which excludes, as mentioned above, Venezuela, which INTERLINK treats as part of a group of OPEC members. Venezuela is included in the list of HICs for which debt accounting models have been developed.
5. Bolivia, Colombia, Costa Rica, Dominican Republic, San Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Trinidad & Tobago, Uruguay. Excluded due to data problems have been Barbados, Guyana, Antigua & Bermudas, Belize, Dominica, St. Kitts and Nevis, St. Lucie, St. Vincent & Grenadins, Surinam, Bahamas, Grenada. The excluded countries account for less than 5% of relevant economic aggregates of Latin America.
6. In the case of Argentina, 0.6 has been used. By using .4, changes in potential output would have been small compared to the large output changes that actually occurred. To attribute these large output changes only to changes in actual output appeared not very plausible (Another possibility would have been to allow for faster depreciation due to insufficient maintenance).
7. Recently, Srinivasan and Vines (1990) have built a macroeconomic model for Latin America that has fiscal and monetary policy instruments. Many resources were necessary to build an analytical database for Latin America.
8. Other analysts have found the use of a proxy for government policy useful. Kormendi and McGuire (1985) find that the rate of inflation is negatively correlated with GDP growth in a sample of 46 countries.
9. In practice, constraints are often "on/off" rather than "soft." Regime switching models might therefore be more appropriate. In this context, with only 13 annual observations to play with, such modelling would be over-ambitious.
10. In some equations, usually rather badly-fitting ones, capacity utilisation appears with a positive sign. Further estimation work must address this counter-intuitive result.
11. In this exercise, no attempt was made to take into account either already-agreed or possible debt reduction agreements reached between HICs and creditor banks or governments.

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APPENDIX

Appendix A: Glossary of Acronyms

1. Glossary of Calculated Series

Imports

MEDV	Energy import volume
MMDV	Manufacture import volume
MRDV	Raw materials imports volume
MSNIV	Non-factor service income volume
MGV	Goods imports volume
MG	Goods imports value \$
MGS	Imports of goods and non-factor services, value, \$
PMG	Import unit value of goods

Exports

XMDV	Manufactures export volume
XRDV	Raw materials export volume
XEDV	Energy export volume
XSNIV	Non-factor services export volume
XGV	Export of goods volume
XG	Export of goods, value, \$
XGS	Export of goods and non-factor services, value, \$
PXG	Export unit value of goods

Income

INFL	Inflation rate
GDIVD	Gross domestic investment, volume, \$ terms
GDPVD	Gross domestic product, volume, \$ terms
KKD	Capital stock in constant \$
GDPVDP	Potential GDP in constant \$
DIFGDP	Actual minus potential GDP, constant \$
GDSVD	Gross domestic savings in constant \$
RTRANS	Real net long term lending

Debt

CHEXUS	Rate of change of \$ effective exchange rate
RATDEB	Ratio of non-\$ debt
TBD	Trade balance, \$ value
CBNI	Non-interest current account in \$
CBD	Current account, \$
NBORR	Net borrowing requirements in \$
DOD	Total debt outstanding and disbursed
IIDEBL	Interest payments on long term debt
IIDEBS	Interest payments on short term debt
DE	Debt to export ratio
DG	Debt to GDP ratio
IE	Interest to export ratio
NBG	Net borrowing to GDP ratio

2. Glossary of Input Variables

<i>Acronym</i>	<i>Explanation</i>	<i>Concordance to WT</i>
INTERLINK		
IRSUS	Short term US interest rate	
EXCHUS	Effective US exchange rate	
PMRD	Import price of raw materials (1980=100)	
PMM	Import price of manufactures	
PMFD	Import price of food	
PMED	Import price of energy	
PMS	Import price of services	
PXRD	Export price of raw materials (1980=100)	
PXM	Export price of manufactures	
PXFD	Export price of food	
PXED	Export price of energy	
PXS	Export price of services	
XRVMKT	Market growth of raw material	
XFVMKT	Market growth of food	
XMVMKT	Market growth of manufactures	
XEVMKT	Market growth of energy	
XSVMKT	Market growth of services	
World Tables		
DEFUS	GDP deflator for US	DEFL.GDP
MRD	\$ imports of non-fuel primary products	CP.IMP.NFP
MMD	\$ imports of manufactures	CP.IMP.MAN
MED	\$ imports of energy	CP.IMP.FUEL
MSNI	\$ imports of non-factor services	DR.IMP.NFS
MSI	\$ factor service payments	DR.FCTINC
XRD	\$ exports of non-fuel primary products	CP.EXP.NFP
XMD	\$ exports of manufactures	CP.EXP.MAN
XED	\$ exports of energy	CP.EXP.FUEL
XSNI	\$ exports of non-factor services	CR.EXP.NFS
XSI	\$ factor service payments	CR.FCTINC
GDIV	Gross domestic investment in 1980 prices	KP.L.INV.GDI
GDPV	Gross domestic product in 1980 prices	KP.L.GDP.MP
GDPDEF	GDP deflator	DEFL.GDP
PCV	Private Consumption in 1980 prices	KP.L.CON.PRIV
GCV	Government Consumption in 1980 prices	KP.L.CON.GOV
LTINT	Long-term interest payments per DRS	BOP.IMP.LTINTRTST
LTAMOR	Amortization payments on long term debt	LT.CAP.REPYMT
LTDIS	Disbursements of long term debt	LT.CAP.DISBUR
RES	International reserves excluding gold	INTL.RES.EXGOLD
NDFI	Net direct foreign investment	NET.INVEST.DIRECT
NTOFF	Official net transfers	NET.TRANSF.OFFCAP
NTPRIV	Private net transfers	BOP.NET.CURTRANS
DODPNG	Private non-guaranteed debt outstanding/disbursed	PRV.LLOAN
DODPPG	Public and publicly guaranteed long term debt	PUB.LLOAN
DODST	Identified short term debt	SHORT.DEBT

IMF	Purchases from the IMF	USE.FUND
EXRATE	Exchange rate	PR.EXRATE

Manual Input

RATDEB	Ratio of \$ debt in 1975 (typically assumed .6 to .7)
RATFOB	Ratio of FOB to CIF imports calculated from WT
RATVAR	Ratio of variable to fixed interest debt. From World debt tables.
TIME	Time trend with TIME(1967)=1
KKD	$KKD(1975)=GDPV/EXRATE(1980)*3$

3. Variables in Alphabetical Order

CBD	Current account, \$	
CBNI	Non-interest current account in \$	
CHEXUS	Rate of change of \$ effective exchange rate	
DE	Debt to export ratio debt tables.	
DEFUS	GDP deflator for US	DEFL.GDP
DG	Debt to GDP ratio	
DIFGDP	Actual minus potential GDP, constant \$	
DOD	Total debt outstanding and disbursed	
DODPNG	Private non-guaranteed debt outstanding/disbursed	PRV.LLOAN
DODPPG	Public and publicly guaranteed long term debt	PUB.LLOAN
DODST	Identified short term debt	SHORT.DEBT
EXCHUS	Effective US exchange rate	
EXRATE	Exchange rate	PR.EXRATE
EX80	EXRATE(1980)	
GCV	Government Consumption in 1980 prices	KP.L.CON.GOV
GDIV	Gross domestic investment in 1980 prices	KP.L.INV.GDI
GDIVD	Gross domestic investment, volume, \$ terms.	
GDPDEF	GDP deflator	DEFL.GDP
GDPV	Gross domestic product in 1980 prices	KP.L.GDP.MP
GDPVD	Gross domestic product, volume, \$ terms	
GDPVDP	Potential GDP in constant \$	
GDSVD	Gross domestic savings in constant \$	
IE	Interest to export ratio	
IIDEBL	Interest payments on long term debt	
IIDEBS	Interest payments on short term debt	
IMF	Purchases from the IMF	USE.FUND
INFL	Inflation rate	
IRSUS	Short term US interest rate	
KKD	Capital stock in constant \$	
LTAMOR	Amortization payments on long term debt	LT.CAP.REPYMT
LTDIS	Disbursements of long term debt	LT.CAP.DISBUR
LTINT	Long-term interest payments per DRS	BOP.IMP.LTINTRTST
MED	\$ imports of energy	CP.IMP.FUEL
MEDV	Energy import volume	
MG	Goods imports value \$	
MGS	Imports of goods and non-factor services, value, \$	
MGV	Goods imports volume	
MMD	\$ imports of manufactures	CP.IMP.MAN

MMDV	Manufacture import volume	
MRD	\$ imports of non-fuel primary products	CP.IMP.NFP
MRDV	Raw materials imports volume	
MSI	\$ factor service payments	DR.FCTINC
MSNI	\$ imports of non-factor services	DR.IMP.NFS
MSNIV	Non-factor service income volume	
NBG	Net borrowing to GDP ratio	
NBORR	Net borrowing requirements in \$	
NDFI	Net direct foreign investment	NET.INVEST.DIRECT
NTOFF	Official net transfers	NET.TRANSF.OFFCAP
NTPRIV	Private net transfers	BOP.NET.CURTRANS
PCV	Private Consumption in 1980 prices	KP.L.CON.PRIV
PMED	Import price of energy	
PMFD	Import price of food	
PMG	Import unit value of goods	
PMM	Import price of manufactures	
PMRD	Import price of raw materials (1980=100)	
PMS	Import price of services	
PXED	Export price of energy	
PXFD	Export price of food	
PXG	Export unit value of goods	
PXM	Export price of manufactures	
PXRD	Export price of raw materials (1980=100)	
PXS	Export price of services	
RATDEB	Ratio of \$ debt in 1975 (typically assumed .6 to .7)	
RATFOB	Ratio of FOB to CIF imports calculated from WT	
RATVAR	Ratio of variable to fixed interest debt. From World Debt Tables	
RES	International reserves excluding gold	INTL.RES.EXGOLD
RTRANS	Real net long term lending	
TBD	Trade balance, \$ value	
TIME	Time trend with TIME(1967)=1	
XED	\$ exports of energy	CP.EXP.FUEL
XEDV	Energy export volume	
XEVMKT	Market growth of energy	
XFVMKT	Market growth of food	
XG	Export of goods, value, \$	
XGS	Export of goods and non-factor services, value, \$	
XGV	Export of goods volume	
XMD	\$ exports of manufactures	CP.EXP.MAN
XMDV	Manufactures export volume	
XMVMKT	Market growth of manufactures	
XRD	\$ exports of non-fuel primary products	CP.EXP.NFP
XRDV	Raw materials export volume	
XRVMKT	Market growth of raw material	
XSI	\$ factor service payments	CR.FCTINC
XSNi	\$ exports of non-factor services	CR.EXP.NFS
XSNIV	Non-factor services export volume	
XSVMKT	Market growth of services	

Appendix B: DEMOD Model Listings**1. Argentina**Imports

$MMDV = -3.244771D + 10 + .6327095 * GDPVD + .7632478 * MMDV(-1) + ADFMM$
 $MEDV = -4.8D + 09 - 56531441 * TIME + 6.6D + 09 * (GDPVD / GDPVDP) + ADFME$
 $MRDV = -3.7D + 09 + 8.84D - 02 * GDPVD + ADFMR$
 $MSNIV = -3.296D + 10 + .466 * GDPVDP + 1.08D + 10 * (GDPVD / GDPVDP) + ADFMSN$
 $MGV = MEDV + MMDV + MRDV$
 $MG = MEDV * PMED + MMDV * PMM + MRDV * (PMRD / 2 + PMFD / 2)$
 $MSNI = MSNIV * PMS$
 $MGS = MG + MSNI$
 $PMG = MG / (MMDV + MEDV + MRDV)$

Exports

$XMDV = EXP(21.285 + 0.281 * LOG(XMVMKT) + 2.7 * LOG(REER)) + ADFXM$
 $XRDV = EXP(22.5185 + 1.59 * LOG(XFVMKT / 2 + XRVMKT / 2)) + ADFXR$
 $XEDV = -4.004548D + 08 + 47515375 * TIME + ADFXE$
 $XSNIV = EXP(21.324 + 2.309 * LOG(XSVMKT)) + ADFXSN$
 $XGV = XMDV + XRDV + XEDV$
 $XG = XMDV * PXM + XRDV * (PXR / 2 + PXFD / 2) + XEDV * PXED$
 $XSNI = XSNIV * PXS$
 $XGS = XG + XSNI$
 $PXG = XG / (XMDV + XRDV + XEDV)$

Income

$KKD = 0.95 * KKD(-1) + GDIVD$
 $DIFGDP = GDPVD - GDPVDP$
 $GDPVDP = EXP(9.216443 - 0.0016 * TIME + 0.6 * LOG(KKD))$
 $GDPVD = 2.582586D + 10 + .6311223 * GDIVD + 2.923915 * GCVD + ADFGDP$
 $RTRANS = NETFLOW - (IIDEBL + ADFIIL) / DEFUS$
 $GDIVD = 1.559568D + 10 + .3955471 * RTRANS - 4.583803D + 08 * TIME + ADFGDI$

Debt

$CHEXUS = LOG(1 / EXCHUS) - LOG(1 / EXCHUS(-1))$
 $RATDEB = RATDEB(-1) / (1 + (1 - RATDEB(-1)) * CHEXUS)$
 $INTLT = (RATVAR - .3) * 1.3 * IRSUS / 100 + (1 - (RATVAR - .3)) * .09$
 $IIDEBL = RATLT * (DOD(-1) + DOD) / 2 * INTLT$
 $IIDEBS = (1 - RATLT) * (DOD(-1) + DOD) / 2 * 1.1 * IRSUS / 100$
 $MSI = IIDEBL * 1.18 + IIDEBS * 1.20 + ADFMS$
 $XSI = IRSUS / 100 * (RES / 2 + RES(-1) / 2) * 1.12 + 6.63D + 06 * TIME + ADFXS$
 $TBD = XG - MG$
 $CBNI = TBD + XSNI - MSNI + NTPRIV + NTOFF$
 $CBD = CBNI + XSI - MSI$
 $RES = .7395928 * MGS + .6064293 * CBD + .6051025 * CBD(-1) + ADFRES$
 $NBORR = RES - RES(-1) - CBD - NDFI + ADFDEB$
 $DOD = DOD(-1) * (1 + (1 - RATDEB(-1)) * CHEXUS) + NBORR$
 $DE = DOD / (XG + XSNI + XSI)$
 $DG = DOD / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$
 $IE = IIDEBL / (XG + XSNI + XSI)$
 $NBG = NBORR / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$

2. Brazil

Imports

$MEDV=1.01D+10+.377*MEDV(-1)-4.06D+09*REER+ADFME$
 $MMDV=-3.5D+09+0.61*MMDV(-1)+0.1346*GDIVD+ADFMM$
 $MRDV=1.49D+09+6.298D-03*GDPVDP+5.68D-02*DIFGDP+ADFMR$
 $MSNIV=4.335D+09+ADFMSN$
 $MGV=MEDV+MMDV+MRDV$
 $MG=MEDV*PMED+MMDV*PMM+MRDV*(PMRD/2+PMFD/2)$
 $MSNI=MSNIV*PMS$
 $MGS=MG+MSNI$
 $PMG=MG/(MMDV+MEDV+MRDV)$

Exports

$XMDV=EXP(22.6118+1.386*(LOG(REER)-LOG(REER(-1))))+1.511*LOG(XMVMKT))+ADFXM$
 $XRDV=EXP(23.2355+1.024*LOG(XFVMKT/2+XRVMKT/2)+0.427*LOG(REER))+ADFXR$
 $XEDV=EXP(20.4362+2.811*LOG(REER))+ADFXE$
 $XSNIV=EXP(21.33+1.565*LOG(XSVMKT))+ADFXSN$
 $XGV=XMDV+XRDV+XEDV$
 $XG=XMDV*PXM+XRDV*(PXR/2+PXFD/2)+XEDV*PXED$
 $XSNI=XSNIV*PXS$
 $XGS=XG+XSNI$
 $PXG=XG/(XMDV+XRDV+XEDV)$

Income

$KKD=0.95*KKD(-1)+GDIVD$
 $GDPVDP=EXP(14.86551+0.02852*TIME+.4*LOG(KKD))$
 $DIFGDP=GDPVD-GDPVDP$
 $GDPVD=1.431072*GDIVD+2.635898*GCVD(-1)+3.945696*GCVD+3.558787*XGV-5.517994D+10+ADFGDP$
 $GDIVD=3.584205D+10-6.750889D+10*DG+.1405752*GDPVD+ADFGDI$

Debt

$CHEXUS=LOG(1/EXCHUS)-LOG(1/EXCHUS(-1))$
 $RATDEB=RATDEB(-1)/(1+(1-RATDEB(-1))*CHEXUS)$
 $INTLT=0.7*1.1*IRSUS/100+0.3*0.08$
 $IIDEBL=RATLT*(DOD(-1)+DOD)/2*INTLT$
 $IIDEBS=(1-RATLT)*(DOD(-1)+DOD)/2*1.1*IRSUS/100$
 $MSI=IIDEBL*1.65+ADFMS$
 $XSI=70163652*IRSUS+.731306*(IRSUS/100*RES(-1))+ADFXS$
 $TBD=XG-MG$
 $CBNI=TBD+XSNI-MSNI+NTPRIV+NTOFF$
 $CBD=CBNI+XSI-MSI$
 $RES=0.34*MGS+ADFRES$
 $NBRR=RES-RES(-1)-CBD-NDFI+ADFDEB$
 $DOD=DOD(-1)*(1+(1-RATDEB(-1))*CHEXUS)+NBRR$
 $DE=DOD/(XG+XSNI+XSI)$
 $DG=DOD/(GDPVD*EX80*(GDPDEF/100)/EXRATE)$
 $IE=IIDEBL/(XG+XSNI+XSI)$
 $NBG=NBRR/(GDPVD*EX80*(GDPDEF/100)/EXRATE)$

3. Chile

Imports

$MMDV = -3.326968D+09 + 1.1682045 * GDIVD + 4.17279D+09 * (GDPVD / GDPVDP) + .3812264 * MMDV(-1) + AD$
 FMM
 $MEDV = -0.052 * GDPVDP + 2.093D+09 * (GDPVD / GDPVDP) + ADFME$
 $MRDV = 7.0254D+08 + 7.38D-02 * DIFGDP + ADFMR$
 $MSNIV = 5.077D-02 * GDPVDP + 8.29D-02 * DIFGDP + ADFMSN$
 $MGV = MEDV + MMDV + MRDV$
 $MG = MEDV * PMED + MMDV * PMM + MRDV * (PMRD / 2 + PMFD / 2)$
 $MSNI = MSNIV * PMS$
 $MGS = MG + MSNI$
 $PMG = MG / (MMDV + MEDV + MRDV)$

Exports

$XMDV = 3.284D+08 * (GDPVD / GDPVDP) + ADFXM$
 $XRDV = EXP(22.03596 + 2.36 * LOG(XRVMKT / 2 + XFVMKT / 2)) + ADFXR$
 $XEDV = EXP(18.1807 + 1.14 * LOG(XEVMKT)) + ADFXE$
 $XSNIV = EXP(20.54723 + 2.438981 * LOG(XSVMKT) + 2.004583 * LOG(GDPVD / GDPVDP)) + ADFXSN$
 $XGV = XMDV + XRDV + XEDV$
 $XG = XMDV * PXM + XRDV * (PXR / 2 + PXFD / 2) + XEDV * PXED$
 $XSNI = XSNIV * PXS$
 $XGS = XG + XSNI$
 $PXG = XG / (XMDV + XRDV + XEDV)$

Income

$KKD = 0.95 * KKD(-1) + GDIVD$
 $DIFGDP = GDPVD - GDPVDP$
 $GDPVDP = EXP(13.629 + 0.0251 * TIME + 0.4 * LOG(KKD))$
 $RTRANS = NETFLOW - (IIDEBL + ADFIIL) / DEFUS$
 $GDIVD = 1.485898 * RTRANS + .85459 * XGV + ADFGDI$
 $GDPVD = 1.787061D+10 + .7429465 * GDIVD + 1.470854 * XGV - 3.361646D+09 * INFL + ADFGDP$

Debt

$CHEXUS = LOG(1 / EXCHUS) - LOG(1 / EXCHUS(-1))$
 $RATDEB = RATDEB(-1) / (1 + (1 - RATDEB(-1)) * CHEXUS)$
 $INTLT = RATVAR * 1.3 * IRSUS / 100 + (1 - RATVAR) * .07$
 $IIDEBL = RATLT * (DOD(-1) + DOD) / 2 * INTLT$
 $IIDEBS = (1 - RATLT) * (DOD(-1) + DOD) / 2 * 1.1 * IRSUS / 100$
 $MSI = IIDEBL * 1.44 + ADFMS$
 $XSI = IRSUS / 100 * (RES / 2 + RES(-1) / 2) * 1.36 + ADFXS$
 $TBD = XG - MG$
 $CBNI = TBD + XSNI - MSNI + NTPRIV + NTOFF$
 $CBD = CBNI + XSI - MSI$
 $RES = -6.6D+08 + 0.56 * MGS + ADFRES$
 $NBORR = RES - RES(-1) - CBD - NDFI + ADFDEB$
 $DOD = DOD(-1) * (1 + (1 - RATDEB(-1)) * CHEXUS) + NBORR$
 $DE = DOD / (XG + XSNI + XSI)$
 $DG = DOD / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$
 $IE = IIDEBL / (XG + XSNI + XSI)$
 $NBG = NBORR / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$

4. LAT-Other

Imports

$MMDV = 2.166D + 10 - 2.426D + 10 * (GDPVD / GDPVDP) + .743 * GDIVD + ADFMM$
 $MEDV = 1.923D + 10 - .135 * GDPVDP + ADFME$
 $MRDV = 4.876D - 02 * GDPVDP - 6.749D + 09 * (GDPVD / GDPVDP) + .238 * GDIVD + ADFMR$
 $MSNIV = 1.775D + 09 + 4.365D - 02 * GDPVD + ADFMSN$
 $MGV = MEDV + MMDV + MRDV$
 $MG = MEDV * PMED + MMDV * PMM + MRDV * (PMRD / 2 + PMFD / 2)$
 $MSNI = MSNIV * PMS$
 $MGS = MG + MSNI$
 $PMG = MG / (MMDV + MEDV + MRDV)$

Exports

$XMDV = EXP(21.9727 + 2.129 * LOG(GDPVD / GDPVDP) + .309 * LOG(XMVMKT)) + ADFXM$
 $XRDV = EXP(23.1588 + .615 * LOG(XFVMKT / 2 + XRVMKT / 2)) + ADFXR$
 $XEDV = EXP(22.377 + .831 * LOG(XEVMKT)) + ADFXE$
 $XSNIV = EXP(22.48704 + 1.511419 * LOG(XSVMKT)) + ADFXSN$
 $XGV = XMDV + XRDV + XEDV$
 $XG = XMDV * PXM + XRDV * (PXR / 2 + PXFD / 2) + XEDV * PXED$
 $XSNI = XSNIV * PXS$
 $XGS = XG + XSNI$
 $PXG = XG / (XMDV + XRDV + XEDV)$

Income

$KKD = 0.95 * KKD(-1) + GDIVD$
 $DIFGDP = GDPVD - GDPVDP$
 $GDPVDP = EXP(14.631455 + 0.0129 * TIME + 0.4 * LOG(KKD))$
 $RTRANS = NETFLOW - (IIDEBL + ADFIIL) / DEFUS$
 $GDIVD = 1.27641 * RTRANS + 1.038389 * XGV(-1) - 3.274274D + 09 * INFL + ADFGDI$
 $GDPVD = 1.032499 * GDIVD + 1.335243 * XGV + .8467255 * GDPVDP - 3.20513D + 10 + ADFGDP$

Debt

$CHEXUS = LOG(1 / EXCHUS) - LOG(1 / EXCHUS(-1))$
 $RATDEB = RATDEB(-1) / (1 + (1 - RATDEB(-1)) * CHEXUS)$
 $INTLT = 0.6 * 1.0 * IRSUS / 100 + 0.4 * .04$
 $IIDEBL = RATLT * (DOD(-1) + DOD) / 2 * INTLT$
 $IIDEBS = (1 - RATLT) * (DOD(-1) + DOD) / 2 * 1.0 * IRSUS / 100$
 $MSI = 1.58 * IIDEBL + 4.34 * IIDEBS + ADFMS$
 $XSI = (IRSUS / 100 + IRSUS(-1) / 100) / 2 * RES(-1) * 5.35 + ADFXS$
 $TBD = XG - MG$
 $CBNI = TBD + XSNI - MSNI + NTPRIV + NTOFF$
 $CBD = CBNI + XSI - MSI$
 $RES = 0.326 * MGS + ADFRES$
 $NBORR = RES - RES(-1) - CBD - NDFI + ADFDEB$
 $DOD = DOD(-1) * (1 + (1 - RATDEB(-1)) * CHEXUS) + NBORR$
 $DE = DOD / (XG + XSNI + XSI)$
 $DG = DOD / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$
 $IE = IIDEBL / (XG + XSNI + XSI)$
 $NBG = NBORR / (GDPVD * (GDPDEF / 100) / EXRATE)$

5. Mexico

Imports

$MMDV = .498 * GDIVD + 2.13D - 02 * GDPVDP - 1.397D + 10 * (GDPVD / GDPVDP) + ADFMM$
 $MEDV = 1.061D + 09 - 4.081D + 07 * TIME + ADFME$
 $MRDV = .099 * GDIVD + 2.29D - 02 * GDPVDP - 5.625D + 09 * (GDPVD / GDPVDP) + ADFMR$
 $MSNIV = 5.275D + 09 + 0.1 * DIFGDP + ADFMSN$
 $MGV = MEDV + MMDV + MRDV$
 $MG = MEDV * PMED + MMDV * PMM + MRDV * (PMRD / 2 + PMFD / 2)$
 $MSNI = MSNIV * PMS$
 $MGS = MG + MSNI$
 $PMG = MG / (MMDV + MEDV + MRDV)$

Exports

$XMDV = EXP(21.6735 + 2.2 * LOG(XMVMKT) - 2.35 * LOG(GDPVD / GDPVDP)) + ADFXM$
 $XRDV = EXP(21.94 + 1.39 * LOG(XRVMKT / 2 + XFVMKT / 2)) + ADFXR$
 $XEDV = XEDV + ADFXE$
 $XSNIV = EXP(22.552 + 1.055 * LOG(XSVMKT)) + ADFXSN$
 $XGV = XMDV + XRDV + XEDV$
 $XG = XMDV * PXM + XRDV * (PXR / 2 + PXFD / 2) + XEDV * PXED$
 $XSNI = XSNIV * PXS$
 $XGS = XG + XSNI$
 $PXG = XG / (XMDV + XRDV + XEDV)$

Income

$KKD = 0.95 * KKD(-1) + GDIVD$
 $DIFGDP = GDPVD - GDPVDP$
 $GDPVDP = EXP(14.8185 + 0.0226 * TIME + 0.4 * LOG(KKD))$
 $GDIVD = -3.207825D + 10 + .4317696 * GDPVD + 1.449748 * RTRANS - 2.534538D + 10 * INFL + ADFGDI$
 $GDPVD = 9.922875D + 10 + .9411593 * GDIVD + 3.047393 * XGV + ADFGDP$

Debt

$CHEXUS = LOG(1 / EXCHUS) - LOG(1 / EXCHUS(-1))$
 $RATDEB = RATDEB(-1) / (1 + (1 - RATDEB(-1)) * CHEXUS)$
 $INTLT = 0.8 * 1.3 * IRSUS / 100 + 0.2 * .09$
 $IIDEBL = RATLT * (DOD(-1) + DOD) / 2 * INTLT$
 $IIDEBS = (1 - RATLT) * (DOD(-1) + DOD) / 2 * 1.1 * IRSUS / 100$
 $MSI = IIDEBL * 1.2 + IIDEBS * 1.1 + ADFMS$
 $XSI = -1.041D + 09 + 1.368D + 08 * TIME + .89 * (RES * IRSUS / 100) + ADFXS$
 $RTRANS = NETFLOW - (IIDEBL + ADFIIL) / DEFUS$
 $TBD = XG - MG$
 $CBNI = TBD + XSNI - MSNI + NTPRIV + NTOFF$
 $CBD = CBNI + XSI - MSI$
 $RES = RES(-1) + .575 * (CBD - CBD(-1)) + .46 * (MGS - MGS(-1)) + ADFRES$
 $NBORR = RES - RES(-1) - CBD - NDFI + ADFDEB$
 $DOD = DOD(-1) * (1 + (1 - RATDEB(-1)) * CHEXUS) + NBORR$
 $DE = DOD / (XG + XSNI + XSI)$
 $DG = DOD / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$
 $IE = IIDEBL / (XG + XSNI + XSI)$
 $NBG = NBORR / (GDPVD * EX80 * (GDPDEF / 100) / EXRATE)$

Appendix C: Estimation**Glossary of Variables Referred to in Tables**

CAPUT	Capacity utilization (GDPVD/GDPVDP)
CBD	Current account balance in current \$
CONST	Intercept
DG	Debt to GDP ratio
DIFGDP	Difference between actual and potential production
GCVD	Government consumption in constant \$
GDIVD	Gross domestic investment in constant \$
GDPVD	Gross domestic product in constant \$
GDPVDP	Potential production in constant \$
IIDEBL	Scheduled interest payments on long-term debt
IIDEBS	Scheduled (estimated) interest payments on short-term debt
INFL	Domestic inflation measured by the GDP deflator
IRSUS	Short term US interest rate
MEDV	Imports of Energy in constant \$
MGS	Imports of goods and services in current \$
MMDV	Imports of Manufactures in constant \$
REER	Real exchange rate (dREER>0 indicates depreciation)
RES	Reserves in current \$
RTRANS	Real net long-term lending (disbursement-amortization-interest payments in constant \$)
TIME	Time trend
XEVMKT	Market growth for Latin America for energy exports
XGV	Exports of goods and services in constant \$
XMVMKT	Market growth for Latin America for manufactures exports
XRAMKT	Market growth for Latin America for raw materials/food exports
X SVMKT	Market growth for Latin America for services exports

Table 1
Imports of Manufactured Goods

	CONST	GDIVD	GDPVD	GDPVDP	CAPUT	MMDV(-1)	\bar{R}^2	DW'	F
Argentina	-3.24E+10 (-5.27)		0.63 (5.59)			0.76 (5.47)	0.81	-0.32/0.52	24.2
Brazil	-3.50E+09 (-3.87)	0.13 (6.27)				0.61 (11.55)	0.96	0.62/0.09	137.1
Chile	-3.33E+09 (-2.95)	0.17 (2.53)			4.17E+09 (3.17)	0.38 (5.97)	0.95	-0.01/0.07	78.3
Mexico		0.50 (17.16)		0.02 (2.97)	-1.39E+10 (-6.72)		0.97	2.12	207.7
Lat-Other	2.16E+10 (5.09)	0.74 (9.55)			-2.42+10 (-4.34)		0.92	1.35	72.1

* For equations with lagged independent variables, the Durbin h/the F(1,8) Lagrange multiplier statistic are provided instead of the DW statistic (Chile F(1,7)).

Table 2
Imports of Raw Materials

	CONST	GDIVD	GDPVD	GDPVDP	CAPUT	DIFGDP	\bar{R}^2	DW	F
Argentina	-3.70E+9 (-2.06)		0.09 (2.59)				0.32	0.99	6.75
Brazil	1.49E+9 (2.36)		0.006 (2.31)			0.057 (5.89)	0.76	2.69	20.36
Chile	2.75E+7 (25.47)					0.074 (4.72)	0.63	2.96	22.3
Mexico		0.10 (6.52)		0.023 (6.08)	-5.62E+9 (-5.15)		0.85	1.84	35.4
Lat-Other		0.24 (10.14)		0.049 (10.9)	-6.75E+9 (-9.18)		0.95	2.11	111.9

Table 3
Imports of Energy

	CONST	TIME	GDIVD	GDPVDP	REER	CAPUT	MEDV(-1)	\bar{R}^2	DW'	F
Argentina	-4.8E+9 (-3.56)	-5.65E+7 (-4.19)				6.61E+09 (4.96)		0.76	2.29	20.5
Brazil	1.01E+10 (4.26)				-4.06E+9 (4.41)		0.38 (2.23)	0.86	-1.03/5.38	35.2
Chile				-0.052 (-3.08)		2.09E+9 (4.87)		0.53	1.66	14.83
Mexico	1.06E+9 (5.07)	-4.08E+7 (-3.02)						0.40	1.60	9.1
Lat-Other	1.92E+10 (15.29)			-0.13 (-11.77)				0.92	1.71	138.5

* For Brazil, the Durbin h/Lagrange multiplier statistic F(1,8) for serial correlation.

Table 4
Imports of Non-Factor Services

	CONST	GDPVD	GDPVDP	CAPUT	DIFGDP	\bar{R}^2	DW	F
Argentina	-3.29E+10 (-4.44)		0.47 (4.05)	1.08E+10 (3.45)		0.63	1.39	11.52
Brazil	4.33E+9 (24.8)							
Chile			0.051 (35.56)		0.083 (4.04)	0.71	1.63	30.7
Mexico	5.27E+9 (19.84)				0.10 (4.16)	0.57	1.53	17.3
Lat-Other	1.77E+9 (2.86)	0.044 (7.73)				0.83	1.61	59.8

Table 5
Exports of Manufactures
(All variables in logarithmic form)

	CONST	XMVMKT	REER	δ REER	CAPUT	\bar{R}^2	DW	F
Argentina	21.28 (416.8)	0.28 (1.45)	2.70 (3.35)			0.43	1.66	5.7
Brazil	22.61 (516.8)	1.51 (7.67)		1.39 (3.68)		0.85	1.65	33.3
Chile					3.28E+8 (26.5)	0.19	2.34	
Mexico	21.67 (613.4)	2.2 (14.73)			-2.35 (-3.80)	0.95	2.68	113.4
Lat-Other	21.97 (831.0)	0.31 (2.76)			2.13 (2.61)	0.54	0.84	7.96

Independent and dependent variables for Chile without logarithmic transformation.

Table 6
Exports of Raw Materials
(All variables in logarithmic form)

	CONST	XRAMKT	REER	\bar{R}^2	DW	F
Argentina	22.52 (540.1)	1.59 (4.26)		0.59	1.05	18.1
Brazil	23.23 (742.3)	1.02 (2.97)	0.43 (2.18)	0.80	1.98	25.5
Chile	22.03 (723.5)	2.36 (8.61)		0.85	1.37	74.1
Mexico	21.94 (692.6)	1.39 (4.89)		0.65	2.82	23.9
Lat-Other	23.16 (1185.7)	0.61 (3.5)		0.48	1.86	12.2

Table 7
Exports of Energy
 (All variables in logarithmic form)

	CONST	XEVMKT	REER	TIME	\bar{R}^2	DW	F
Argentina*	-4.0E+8 (-2.53)			4.75E+7 (4.65)	0.63	1.98	21.6
Brazil	20.43 (177.1)		2.81 (5.06)		0.67	1.75	25.5
Chile	18.18 (244.78)	1.14 (2.58)			0.32	1.12	6.7
Lat-Other	22.38 (610.3)	0.83 (3.80)			0.53	0.68	14.4

* Variables without logarithmic transformation

Table 8
Exports of Non-Factor Services
 (All variables in logarithmic form)

	CONST	XSVMT	CAPUT	\bar{R}^2	DW	F
Argentina	21.32 (461.6)	2.31 (5.07)		0.69	1.56	25.7
Brazil	21.33 (846.9)	1.56 (6.31)		0.78	2.11	39.8
Chile	20.55 (543.3)	2.44 (6.58)	2.00 (3.65)	0.84	1.97	29.2
Mexico	22.55 (431.1)	1.05 (2.05)		0.22	1.85	4.2
Lat-Other	22.49 (917.9)	1.51 (6.26)		0.78	1.05	39.2

Table 9
Gross Domestic Investment

	CONST	GDPVD	RTRANS	INFL	DG	XGV	\bar{R}^2	DW	F
Argentina	1.56E+10 (8.73)		0.39 (1.98)			-4.5E+8 (-4.0)	0.68	1.80	14.0
Brazil	3.58E+10 (6.11)	0.14 (4.06)			-6.75E+10 (-5.77)		0.77	1.88	16.7
Chile			1.49 (6.27)			0.85 (19.4)	0.81	2.22	46.5
Mexico	-3.21E+10 (-4.79)	0.43 (11.6)	1.45 (6.97)	-2.53E+10 (-5.95)			0.94	2.66	58.0
Lat-Other			1.28 (4.16)	-3.27E+9 (-2.24)		1.04 (47.6)	0.82	1.02	26.2

* TIME instead of XGV for Argentina, XGV(-1) instead of XGV for Lat-Other

Table 10
Gross Domestic Product

	CONST	GDIVD	XGV	GDPVDP	GCVD	GCVD(-1)	INFL	\bar{R}^2	DW	F
Argentina	2.58E+10 (5.27)	0.63 (4.79)			2.92 (4.89)			0.72	2.12	17.1
Brazil	-5.52E+10 (-3.25)	1.43 (4.59)	3.56 (9.56)		3.94 (5.93)	2.64 (4.22)		0.97	1.37	133.9
Chile	1.79E+10 (14.2)	0.74 (5.62)	1.47 (6.36)				-3.36E+9	0.96	1.54	93.0
Mexico	9.92E+10 (18.9)	0.94 (7.39)	3.05 (22.04)					0.97	1.73	284.4
Lat-Other	-3.20E+10 (-7.57)	1.03 (8.44)	1.33 (5.98)	0.85 (25.2)				0.99	2.47	418.6

Table 11
Factor Services Imports

	IIDEBL	IIDEBS	\bar{R}^2	DW	F
Argentina	1.18 (17.42)	1.20 (6.74)	0.97	1.01	399.8
Brazil	1.65 (27.22)		0.89	1.78	-
Chile	1.44 (36.16)		0.96	1.65	-
Mexico	1.20 (14.43)	1.10 (3.13)	0.94	2.45	183.7
Lat-Other	1.58 (4.61)	4.34 (4.50)	0.94	1.81	183.3

Table 12
Exports of Factor Services

	CONST	Reserves*Interest Rate	IRSUS	TIME	R ²	DW	F
Argentina		1.12 (13.15)		6.63E+6 (2.92)	0.93	1.76	149.2
Brazil		0.73 (2.53)	7.01E+7 (3.15)		0.69	1.36	25.9
Chile		1.36 (15.90)			0.89	1.88	-
Mexico	-1.02E+9 (-3.46)	0.89 (2.40)		1.36E+8 (5.73)	0.91	1.80	59.6
Lat-Other		5.35 (28.18)			0.94	0.39	-

* Defined as $IRSUS/100*(RES+RES(-1))/1$ for Argentina and Chile; $IRSUS/100*RES(-1)$ for Brazil; $IRSUS/100*RES$ for Mexico; and $(IRSUS+IRSUS(-1))/2*RES(-1)$ for Lat-Other.

Table 13
Reserve Holdings

	CONST	MGS	CBD	CBD(-1)	ΔCBD	ΔMGS	R ²	DW	F
Argentina		0.74 (10.31)	0.61 (2.45)	0.61 (3.02)			0.79	2.30	21.2
Brazil		0.34 (7.04)					-0.65	1.15	-
Chile	-6.6E+8 (-1.72)	0.56 (6.86)					0.79	0.75	47.3
Mexico*					0.57 (3.29)	0.46 (3.22)	0.43	1.74	9.5
Lat-Other		0.33 (17.55)					0.63	0.52	-

* Independent variable ΔRES

Appendix D: Simulation Results

Table 14
OCED GDP Increases by One Percentage Point

	1990	1991	1992	1993	1994
GDP					
Percentage Change from Baseline					
Argentina	0.0	0.0	0.0	0.0	0.0
Brazil	1.7	1.9	2.1	2.3	2.5
Chile	1.2	1.5	1.8	1.9	2.1
Latin America Other	0.3	0.6	0.7	0.8	0.9
Mexico	1.2	1.4	1.5	1.6	1.8
Latin America Total	1.2	1.3	1.5	1.7	1.8
Investment Ratio					
Percentage Point Change from Baseline					
Argentina	0.0	0.0	0.0	0.0	0.0
Brazil	0.2	0.2	0.2	0.3	0.3
Chile	0.3	0.3	0.4	0.4	0.5
Latin America Other	0.0	0.1	0.2	0.2	0.2
Mexico	0.3	0.3	0.3	0.3	0.3
Latin America Total	0.2	0.2	0.2	0.3	0.3
Current Account					
Change from Baseline (\$ million)					
Argentina	395	606	774	974	1231
Brazil	1110	1434	1717	2188	2836
Chile	150	214	260	352	479
Latin America Other	653	648	767	919	1139
Mexico	-68	-64	-108	-99	-32
Latin America Total	2241	2837	3410	4334	5653
Debt to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	-11.4	-16.4	-20.4	-25.0	-30.1
Brazil	-13.4	-18.3	-21.2	-24.4	-28.6
Chile	-11.2	-15.3	-17.4	-19.5	-22.2
Latin America Other	-6.9	-10.6	-13.7	-17.0	-20.8
Mexico	-1.2	-7.3	-7.9	-8.7	-9.7
Latin America Total	-9.4	-13.0	-15.4	-18.1	-21.3
Interest to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	-0.9	-1.3	-1.6	-1.9	-2.2
Brazil	-0.9	-1.2	-1.5	-1.6	-1.9
Chile	-0.9	-1.2	-1.4	-1.5	-1.6
Latin America Other	-0.4	-0.6	-0.8	-0.9	-1.1
Mexico	-0.7	-0.8	-0.8	-0.9	-0.9
Latin America Total	-0.7	-1.0	-1.1	-1.3	-1.5
Debt to GDP Ratio					
Change from Baseline in Percentage Points					
Argentina	-0.2	-0.4	-0.8	-1.4	-2.1
Brazil	-0.6	-0.8	-1.0	-1.3	-1.6
Chile	-1.3	-1.9	-2.5	-3.1	-3.9
Latin America Other	-0.6	-1.0	-1.3	-1.6	-2.0
Mexico	-0.4	-0.3	-0.3	-0.1	0.0
Latin America Total	-0.7	-0.9	-1.1	-1.3	-1.6

Table 15
Increase of US Short Term Interest Rate by One Percentage Point

	1990	1991	1992	1993	1994
GDP					
Percentage Change from Baseline					
Argentina	-0.1	-0.1	-0.1	-0.1	-0.1
Brazil	-0.4	-1.4	-2.3	-3.0	-3.7
Chile	-0.7	-1.3	-1.9	-2.3	-2.8
Latin America Other	-0.4	-0.7	-1.1	-1.4	-1.7
Mexico	-0.6	-1.3	-2.0	-2.4	-2.9
Latin America Total	-0.4	-1.1	-1.8	-2.3	-2.8
Investment Ratio					
Change from Baseline in Percentage Points					
Argentina	-0.1	-0.1	-0.1	-0.2	-0.2
Brazil	-0.1	-0.2	-0.3	-0.5	-0.6
Chile	-0.6	-0.7	-0.9	-1.0	-1.2
Latin America Other	-0.2	-0.3	-0.4	-0.5	-0.5
Mexico	-0.5	-0.7	-0.8	-0.9	-0.9
Latin America Total	-0.3	-0.4	-0.5	-0.6	-0.7
Current Account					
Change from Baseline (\$ million)					
Argentina	-569	-859	-1198	-1561	-1981
Brazil	-1381	-2268	-3145	-4006	-5012
Chile	-254	-378	-525	-700	-912
Latin America Other	-1155	-1483	-1959	-2407	-2931
Mexico	-50	-22	49	100	101
Latin America Total	-3409	-5011	-6778	-8574	-10734
Debt to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	3.2	11.6	21.3	30.8	40.5
Brazil	5.2	17.5	28.4	37.9	48.2
Chile	4.0	12.5	20.5	27.5	34.6
Latin America Other	2.6	8.0	15.5	23.3	31.5
Mexico	1.2	3.0	6.2	8.6	10.5
Latin America Total	2.4	10.0	17.7	24.7	31.7
Interest to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	2.8	3.4	4.0	4.6	5.2
Brazil	2.3	3.0	3.7	4.2	4.7
Chile	3.0	3.5	4.1	4.4	4.7
Latin America Other	1.9	2.3	2.7	3.1	3.5
Mexico	2.8	3.0	3.1	3.1	3.1
Latin America Total	2.4	2.9	3.4	3.7	4.0
Debt to GDP Ratio					
Change from Baseline in Percentage Points					
Argentina	0.3	0.6	1.3	2.3	3.4
Brazil	0.4	1.0	1.6	2.2	2.8
Chile	1.3	2.8	4.4	6.0	7.8
Latin America Other	0.9	1.8	2.9	3.9	5.0
Mexico	0.0	0.3	0.4	0.4	0.3
Latin America Total	0.4	1.1	1.8	2.4	3.1

Table 16
Increase in Net Flows Equivalent to Debt Reduction of 15 per cent

	1990	1991	1992	1993	1994
GDP					
Percentage Change from Baseline					
Argentina	0.1	0.3	0.3	0.3	0.3
Brazil	0.2	0.4	0.5	0.5	0.5
Chile	0.6	1.2	1.3	1.3	1.2
Latin America Other	0.4	1.0	1.1	1.1	1.1
Mexico	0.5	1.1	1.1	1.0	1.0
Latin America Total	0.3	0.7	0.8	0.8	0.8
Investment Ratio					
Change from Baseline in Percentage Points					
Argentina	0.2	0.4	0.4	0.4	0.4
Brazil	0.0	0.0	0.0	0.1	0.1
Chile	0.6	1.1	1.0	0.9	0.9
Latin America Other	0.3	0.5	0.5	0.5	0.4
Mexico	0.5	0.9	0.8	0.7	0.6
Latin America Total	0.3	0.5	0.4	0.4	0.4
Current Account					
Change from Baseline (\$ million)					
Argentina	-81	-217	-317	-434	-547
Brazil	77	231	346	375	407
Chile	-83	-200	-235	-248	-251
Latin America Other	-419	-1010	-1148	-1341	-1542
Mexico	-1321	-2778	-2997	-3190	-3386
Latin America Total	-1827	-3975	-4351	-4837	-5319
Debt to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	0.0	0.1	0.6	2.0	3.3
Brazil	-1.0	-2.8	-3.9	-4.1	-4.5
Chile	0.2	1.2	2.3	3.7	4.6
Latin America Other	0.9	2.5	4.0	6.2	8.4
Mexico	3.4	8.8	13.0	16.8	19.6
Latin America Total	0.9	2.4	3.8	5.6	7.2
Interest to Export Ratio					
Change from Baseline in Percentage Points					
Argentina	0.0	0.0	0.0	0.1	0.2
Brazil	-0.1	-0.2	-0.3	-0.3	-0.3
Chile	0.0	0.0	0.1	0.3	0.3
Latin America Other	0.0	0.1	0.2	0.3	0.4
Mexico	0.2	0.5	0.9	1.3	1.5
Latin America Total	0.0	0.1	0.2	0.4	0.5
Debt to GDP Ratio					
Change from Baseline in Percentage Points					
Argentina	0.0	0.2	0.4	0.8	1.2
Brazil	0.0	-0.1	-0.2	-0.2	-0.3
Chile	0.0	0.4	1.0	1.6	2.0
Latin America Other	0.1	0.4	0.8	1.3	1.8
Mexico	0.3	1.2	2.4	3.5	4.4
Latin America Total	0.1	0.3	0.6	0.9	1.2

Appendix E: HIC Models

The 17 HICs grouped by Interlink region

Region:	Latin America	OPEC	Other Asia	Other Africa
	Argentina	Nigeria	Philippines	Ivory Coast
	Brazil	Ecuador	Yugoslavia	Morocco
	Mexico	Venezuela		
	Chile			
	Bolivia			
	Colombia			
	Costa Rica			
	Jamaica			
	Peru			
	Uruguay			

The equations:

$$XGS_i = a_i * XGS_R$$

$$a_i \equiv XGS_i \text{ (baseline)} / XGS_R \text{ (baseline)}$$

$$MGS_i = b_i * MGS_R$$

$$b_i \equiv MGS_i \text{ (baseline)} / MGS_R \text{ (baseline)}$$

$$XSI_i = IRSUS * XSI_i \text{ (baseline)} / IRSUS \text{ (baseline)}$$

$$IIDEBL = LTD * \{SFX * RFX + (1 - SFX) * DD * IRSUS / 100\}$$

$$IIDEBS = STD * (IRSUS + MK) / 100$$

$$MSI = EA * \{EE * IIDEBL + (2 - EE) * IIDEBS\} + AD$$

$$LTD = LTD_{-1} - CBD * LTD_{-1} / (STD_{-1} + LTD_{-1})$$

$$STD = STD_{-1} - CBD * STD_{-1} / (STD_{-1} + LTD_{-1})$$

(variable names are the same as in DEMOD; subscripts i and R refer to corresponding countries and regions as in the table above; debt stocks and interest payment flows are measured in millions of US dollars).

Coefficient values	DD	MK	EA	EE	AD	RFX
Argentina	1.0	1.0	1.0	1.6	0	0.06
Brazil	1.1	1.0	1.0	1.6	0	0.06
Chile	1.1	1.0	1.0	1.4	0	0.06
Mexico	1.2	1.0	0.9	1.6	0	0.055
Bolivia	1.2	1.0	1.2	1.6	0	0.04
Colombia	1.1	1.0	1.0	2.0	0	0.06
Costa Rica	1.0	1.0	1.0	1.2	0	0.06
Jamaica	1.2	1.0	2.0	1.0	0	0.06
Peru	1.0	1.0	1.0	1.5	0	0.06
Uruguay	1.4	2.0	1.0	1.6	0	0.06
Nigeria	1.0	1.0	1.0	1.0	500	0.06
Ecuador	1.5	1.0	1.0	1.0	100	0.035
Venezuela	1.0	2.0	1.0	1.4	200	0.06
Philippines	0.95	0.0	1.0	1.6	200	0.06
Yugoslavia	1.3	1.0	1.0	1.4	-300	0.06
Ivory Coast	1.3	2.0	1.0	1.0	0	0.06
Morocco	1.1	3.0	0.85	1.5	0	0.04

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