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THE BALANCE OF PAYMENTS OF OIL-IMPORTING DEVELOPING COUNTRIES: AN AGGREGATE ECONOMETRIC ANALYSIS

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ABSTRACT

Using annual data drawn from 1963-1983 we estimate an econometric model of the balance of payments of oil-importing LDCs. The model consists of equations for the quantities of exports and imports, unit value indices for exports and imports, capital flows, reserves and the exchange rate. An important feature of the model is the way in which shortages of foreign exchange affect imports, external borrowing and the exchange rate. A number of simulation exercises are carried out to determine the model's properties.

JEL classification: 022, 431

Keywords: oil-importing LDCs, balance of payments, exchange rates, foreign exchange shortages, capital inflows

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NON-TECHNICAL SUMMARY

The balance of payments and external indebtedness of oil-importing developing countries have received much attention as a potential source of instability in the world economy. There have been many analyses of the balance of payments of individual developing countries, but models of the world economy have tended either to ignore the LDCs or to treat them in a superficial manner. Sachs and McKibbin and van Wijnbergen have, however, modelled the behaviour of the LDCs as a whole. In this paper I extend this approach by modelling how the components of the current and capital account of the balance of payments evolved over the period 1963-83 for the LDCs as a whole. I present econometric equations for exports, imports, capital flows, unit value indices for imports and exports, reserves and the exchange rate. The model I report provides a reasonable account of the behaviour of these variables. It takes account explicitly of the fact that in LDCs, shortages of foreign exchange are likely to influence the evolution of these variables, especially in the short run.

The central feature of the model is its assumption that LDC exchange rates are not perfectly flexible and that as a result their imports are constrained by the availability of central bank reserves. Some analyses of LDCs' balance of payments have assumed that external indebtedness reflects changes in the current account and central bank reserves, i.e. that net capital inflows are determined as a residual. Other analyses have modelled capital inflows, taking the current account and reserve changes as the residual. The model described in this paper attempts to explain these variables in a more satisfactory fashion. If the exchange rate is perfectly flexible, exchange rate movements clear the market, and render the capital and current accounts compatible for a given level of reserve changes. LDC exchange rates are not perfectly flexible in practice, and we therefore assume that capital flows to LDCs reflect developments in the market for sovereign loans. LDCs have a desired stock of external debt, but in the short run actual and desired debts

might differ. This might reflect adjustment costs or "distress" borrowing from external sources when foreign exchange is in short supply. Reserve movements are determined residually via the balance of payments identity in the short run, but in the longer term the authorities have a desired reserve position which can be achieved by restricting imports.

The authorities are assumed to have long-run objectives for their reserves, international debts and the exchange rate. LDC exports depend in the model on competitiveness as well as on rates of economic activity in the LDCs and elsewhere. The volume of imports varies directly with LDC economic activity and inversely with the price of imports relative to the price of domestic output. In addition, it is assumed that imports depend on the ratio of the actual to the government's desired level of reserves: imports are curtailed by LDC governments when reserves and foreign exchange are in short supply. Conversely, when reserves are abundant, imports are sucked in more rapidly.

The equilibrium real exchange rate varies directly with aid and capital inflows, relative price differences and the actual and desired reserves. The desired level of indebtedness reflects the "development cycle" theory of indebtedness, in which debt ratios are related to the stage of economic development. Distress borrowing from external sources occurs when foreign exchange is in short supply.

Although the model is essentially concerned with behavioural issues it is not devoid of normative significance. The main policy implications of the model simulations are as follows:-

1. Aid transfers and capital inflows to LDCs tend to raise their nominal and real exchange rates and reduce competitiveness. As their currency appreciates exports fall and imports rise. The additional aid pushes the trade balance into deficit, via a "crowding out" mechanism. Initially aid strengthens

reserves, but after four years the trade deficit is so large that reserves fall. Eventually the fall in reserves becomes so serious that import restrictions have to be imposed. The implications of this simulation are serious: reduced exports, reserve losses and growth of indebtedness can hardly be regarded as the objectives of official aid to developing countries. These adverse effects occur because the LDC exchange rate is not in general independent of aid flows. Exchange rate effects should therefore be taken into consideration when analysing the benefits and costs of aid transfers (and capital transfers).

2. While individual developing countries have operated fixed but adjustable exchange rates, the aggregate exchange rate between LDC and non-LDC currencies has displayed a surprisingly high degree of flexibility. The index of the real exchange rates of the oil-importing LDCs has been volatile, but has displayed no apparent trend. This indicates that the (aggregate) LDC real exchange rate has moved to offset the difference in inflation rates between the LDCs and the industrial economies. The simulations suggest that an increase in LDC inflation initially increases the price of LDC exports and in turn induces a currency depreciation. The short-run fall in the exchange rate is not much smaller than its long-run counterpart, suggesting that the exchange rate moves quite rapidly to reflect relative price movements.

3. The simulations indicate that the balance of payments process seems to be stable, i.e. benign and adverse shocks tend to die out over time rather than reinforce themselves.

4. External indebtedness tends to reflect long-run patterns of economic development rather than responses to balance of payments crises.

The research that I report forms part of a research project into the interdependence between rich and poor countries. In subsequent work I intend to use this model in conjunction with a model of the industrial economies, described in Discussion Paper No. 164, to explore the economic interdependence between the industrialized and the developing countries.

I. Introduction

There have been numerous analyses of the balance of payments of individual developing countries. In this paper, however, we carry out an econometric analysis of the aggregate balance of payments of (oil importing) developing countries as a whole. This complements previous research in two ways. In models of the world economy the developing countries have either been ignored, e.g. INTERLINK at the OECD, or they have been treated in a superficial way. For example, in the latter case, Beenstock and Minford (1976) explained LDC exports in terms of rates of economic activity in the industrialised countries, while LDC imports were explained by their foreign exchange earnings. Here, we try to build upon these previous efforts by providing a more detailed empirical account of not only LDC exports and imports, but also their reserves of gold and foreign exchange, capital account transactions and exchange rates.

Secondly, the aggregation of LDCs as a whole has recently been made by e.g. Sachs and McKibbin (1985) and Wijnbergen (1985). The former present a model in which the parameters are not estimated empirically, while the latter assumes that the capital account is driven by the current account. Here we seek to develop further this empirical tradition which may provide a productive platform for the study of the world economy.

In section II we describe our theoretical premises. The central insight is that because LDC exchange rates are not perfectly flexible, imports are constrained by central bank reserves. The authorities are assumed to have long term objectives for their

reserves , international debts and the exchange rate, while LDC exports depend upon domestic considerations, the state of world demand and price competitiveness. The model solves for exports and imports, capital flows, the exchange rate and the reserves and is estimated from annual data over the period 1963-1983.

Empirical estimates of the model are described in section III and the empirical properties of the estimated model are analysed in section IV. Section V concludes.

II. Theory

Accounting Framework

The balance of payments of LDCs reflects current account and capital account transactions, i.e.

$$\Delta RES \equiv XP_x - MP_m + AID + IPD + \Delta D \qquad (1)$$

where

- RES holdings of gold and foreign exchange (foreign currency)
- X volume of exports
- P_x price of exports (foreign currency)
- M volume of imports
- P_m price of imports (foreign currency)
- AID aid (foreign currency)
- IPD net interest profit and dividend payments (foreign currency)
- ΔD net inward capital flows (foreign currency)

Below we assume that aid is exogenously determined by policies in the industrialised countries, while IPD largely reflects LDCs' international debt position and the world rate of interest, i.e.

$$IPD_t = {}_{t-1}D_t R_t$$

where R denotes the world rate of interest. Beenstock (1987) has indicated how world interest rates might be determined in a way that reflects LDC indebtedness among other factors. The 'real' rate of interest on LDC debt is defined as

$$R^* = R - \Delta \ln P - \Delta \ln E$$

where

P LDC price level (domestic currency)

E LDC effective exchange rate index (foreign currency per unit of domestic currency)

Table 1 records the main balance of payments aggregates for the oil importing developing countries over the bulk of our observation period. It also shows the juxtaposition between the aggregates for this bloc of countries and similar aggregates for other country blocs, namely, the industrial countries and the oil exporting countries. While individual developing countries operate fixed but adjustable exchange rates (some more fixed and less adjustable than others) the aggregate exchange rate between LDC currency and non-LDC currency has, on the whole, varied continuously over our obseration period (see figure 1). These data reflect the composition of our currency index in which individual countries adjust their rates and generate what appears to be a continuous movement in the aggregate LDC exhange rate index.

Out of interest we plot on figure 2 the real exchange rate index for the oil importing developing countries. This shows that

Table 1

Summary of Balances of International Transactions

(In billions of SDRs)

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	
−1.2	—	−3.4	−1.6	2.9	9.8	6.4	−12.0	−15.6	−18.4	−21.2	−15.4	−28.1	−59.3	−97.2	−76.2	**A. Current Account, n.i.e.**
4.5	5.5	6.7	10.0	6.9	10.8	−18.7	7.5	−8.7	−12.7	13.7	−18.7	−46.7	−15.5	−20.8	−18.3	Industrial Countries
1.3	.9	1.3	2.3	3.2	5.5	53.6	23.2	28.4	19.9	−2.4	42.9	78.2	38.9	−13.5	−17.2	Oil Exporting Countries
−6.1	−5.4	−10.4	−12.9	−6.2	−5.5	−24.5	−32.8	−21.4	−19.7	−25.5	−37.6	−56.5	−79.7	−62.9	−41.7	Non-Oil Developing Ctys.
−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−4.0	−10.0	−14.0	−7.0	−7.0	−2.0	−3.0	−3.0	—	1.0	Other Countries
5.7	6.7	6.5	5.7	10.1	14.6	18.3	8.9	8.3	11.3	9.8	16.3	22.9	20.6	−.2	11.2	**A-1. Trade Balance**
5.5	5.7	9.6	11.5	9.6	8.2	−19.2	8.1	−11.2	−14.9	7.4	−28.9	−50.8	−15.4	−12.9	−6.1	Industrial Countries
7.6	7.5	7.9	8.8	9.8	16.1	69.1	44.1	55.2	53.0	34.7	83.7	128.9	102.4	55.5	39.6	Oil Exporting Countries
−6.4	−5.5	−10.0	−13.7	−8.3	−8.7	−27.6	−33.2	−21.7	−20.8	−27.3	−38.6	−54.2	−66.4	−45.9	−26.3	Non-Oil Developing Ctys.
−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−4.0	−10.0	−14.0	−6.0	−5.0	—	−1.0	—	3.0	4.0	Other Countries
−4.9	−5.2	−7.6	−4.5	−3.4	−3.4	−5.5	−11.5	−15.2	−20.9	−19.9	−23.0	−39.7	−67.6	−98.3	−80.6	**A-2. Oth. Gds., Serv., & Inc.**
4.9	5.6	4.5	7.6	8.0	13.1	15.1	13.8	17.5	18.4	25.4	32.1	28.7	25.9	20.7	18.8	Industrial Countries
−5.7	−6.0	−6.1	−6.0	−5.8	−9.4	−10.7	−13.2	−18.3	−22.1	−25.6	−29.2	−34.8	−44.7	−57.7	−48.1	Oil Exporting Countries
−4.2	−4.8	−6.0	−6.1	−5.5	−7.1	−9.9	−12.2	−14.4	−16.2	−17.7	−23.9	−31.6	−45.8	−50.3	−48.3	Non-Oil Developing Ctys.
—	—	—	—	—	—	—	—	—	−1.0	−2.0	−2.0	−2.0	−3.0	−3.0	−3.0	Other Countries
−2.0	−1.5	−2.4	−2.8	−3.8	−1.3	−6.3	−9.3	−8.7	−9.9	−11.1	−8.7	−11.2	−12.2	−8.6	−6.8	**A-3. Unrequited Transfers**
−5.9	−5.8	−7.4	−9.1	−10.7	−10.4	−14.6	−14.3	−14.9	−16.2	−19.2	−21.9	−24.6	−25.9	−28.6	−31.0	Industrial Countries
−.6	−.6	−.6	−.5	−.8	−1.2	−4.8	−7.7	−8.5	−11.0	−11.5	−11.6	−15.9	−18.8	−11.3	−8.7	Oil Exporting Countries
4.5	4.9	5.6	6.9	7.7	10.3	13.0	12.6	14.7	17.3	19.6	24.8	29.3	32.5	33.3	32.9	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries
1.8	−2.0	3.5	5.2	5.8	−1.3	4.1	−1.7	13.5	23.2	20.6	1.2	13.2	35.5	31.2	44.6	**B. Long-Term Capital, n.i.e.**
−5.3	−10.0	−5.9	−6.1	−7.8	−15.0	−6.6	−18.8	−10.1	−4.9	−25.4	−37.1	−13.3	−14.5	−32.7	−32.1	Industrial Countries
.9	.9	.7	.9	.8	.7	−7.4	−4.8	−3.6	1.5	11.5	2.2	−18.1	−19.3	5.5	25.1	Oil Exporting Countries
6.2	7.1	8.7	10.4	12.8	12.9	18.1	21.9	27.1	26.6	34.5	36.0	44.5	69.3	58.3	51.6	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries
.6	−2.0	.1	3.6	8.7	8.6	10.5	−13.7	−2.2	3.8	−.6	−14.2	−14.9	−23.8	−66.0	−31.6	**Total A Plus B**
−.8	−4.6	.8	3.9	−.9	−4.1	−25.3	−11.3	−18.7	−17.6	−11.7	−55.7	−60.0	−29.9	−53.4	−50.5	Industrial Countries
2.2	1.8	2.0	3.3	4.0	6.2	46.2	18.4	24.8	21.5	9.1	45.1	60.1	19.6	−7.9	7.9	Oil Exporting Countries
.2	1.8	−1.7	−2.6	6.6	7.5	−6.4	−10.8	5.7	6.9	9.0	−1.6	−12.0	−10.4	−4.6	10.0	Non-Oil Developing Ctys.
−1.0	−1.0	−1.0	−1.0	−1.0	−1.0	−4.0	−10.0	−14.0	−7.0	−7.0	−2.0	−3.0	−3.0	—	1.0	Other Countries
−.1	6.8	1.2	1.8	1.7	−2.5	−1.4	−1.2	−4.0	2.6	−12.9	.4	21.6	1.3	−11.8	27.2	**C. Short-Term Capital, n.i.e.**
.6	8.3	1.6	1.3	4.1	1.6	4.7	−4.3	—	4.9	−5.1	9.0	22.1	9.5	4.7	47.9	Industrial Countries
−1.8	−1.5	−1.7	−1.5	−2.4	−3.9	−11.3	−3.7	−7.9	−3.8	−10.9	−15.2	−16.7	−19.9	−15.6	−9.6	Oil Exporting Countries
1.1	.1	1.3	2.0	.1	−.3	5.1	6.8	3.9	1.5	3.2	6.6	16.2	11.7	−.9	−11.1	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries
.5	−4.8	5.8	−2.4	.4	−3.8	1.8	16.3	21.1	10.2	22.8	24.3	19.7	5.4	29.4	−2.6	**D. Net Errors and Omissions**
−1.3	−4.9	3.3	−5.1	−1.5	−4.2	−.8	9.8	10.6	5.3	16.9	22.5	26.2	13.2	44.2	—	Industrial Countries
—	−.1	.1	−.1	.6	−.5	−.4	.1	1.5	1.8	1.3	—	−2.0	−3.4	−3.6	−2.2	Oil Exporting Countries
.8	−.1	1.4	1.7	.3	−.1	−1.0	−3.7	−4.9	−3.9	−3.2	−.1	−7.5	−7.4	−11.2	.6	Non-Oil Developing Ctys.
1.0	1.0	1.0	1.0	1.0	1.0	4.0	10.0	14.0	7.0	7.0	2.0	3.0	3.0	—	−1.0	Other Countries
.9	.8	7.2	3.0	10.8	2.3	10.9	1.4	14.9	16.6	8.5	10.5	26.4	−17.0	−48.4	−7.0	**Total A through D**
−1.6	−1.1	5.7	.2	1.7	−6.7	−21.3	−5.7	−8.1	−7.4	.1	−24.2	−11.7	−7.2	−4.5	−2.6	Industrial Countries
.5	.2	.5	1.6	2.1	1.9	34.5	14.9	18.4	19.5	−.6	29.9	41.4	−3.7	−27.2	−3.9	Oil Exporting Countries
2.1	1.7	1.0	1.2	7.0	7.1	−2.2	−7.7	4.7	4.4	9.0	4.8	−3.3	−6.1	−16.7	−.5	Non-Oil Developing Ctys.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Other Countries
−.8	.6	2.9	−.3	1.0	−8.3	.1	4.0	1.3	−5.5	−13.9	6.9	14.4	14.3	8.8	11.9	**E. Counterpart Items**
−.7	.4	2.1	−.4	.4	−6.5	.1	2.3	1.2	−3.5	−6.8	5.8	9.4	6.4	1.9	5.7	Industrial Countries
—	.1	.1	.1	.1	—	−.3	1.1	.2	−1.5	−5.5	.2	1.6	2.8	2.6	2.3	Oil Exporting Countries
−.1	.2	.8	—	.4	−1.8	.3	.6	−.1	−.6	−1.6	.9	3.4	5.2	4.3	3.1	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries
.1	1.4	10.1	2.7	11.8	−8.0	11.0	5.4	16.2	11.1	−5.3	17.4	40.8	−2.7	−39.6	4.1	**Total A through E**
−2.3	−.7	7.8	−.2	2.1	−13.2	−21.3	−3.5	−7.0	−10.8	−6.6	−18.5	−2.2	−.9	−2.7	3.1	Industrial Countries
.5	.3	.5	1.7	2.2	1.9	34.2	16.0	18.6	18.1	−6.1	30.1	43.0	−.9	−24.5	−1.6	Oil Exporting Countries
1.9	1.9	1.8	1.2	7.4	5.3	−1.9	−7.1	4.5	3.8	7.4	5.8	.1	−1.0	−12.4	2.6	Non-Oil Developing Ctys.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Other Countries
—	.2	.3	.4	2.2	7.4	10.5	8.2	8.4	9.8	8.7	9.8	11.4	7.9	15.5	13.1	**F. Exceptional Financing**
—	.1	—	.2	1.7	6.4	8.8	2.6	4.1	4.6	5.2	6.8	6.8	3.4	7.3	9.5	Industrial Countries
.1	.1	.1	.1	−.2	.1	−.2	1.0	.2	—	—	—	—	—	3.7	3.1	Oil Exporting Countries
—	—	.2	.2	.7	.9	1.9	4.6	4.0	5.2	3.6	2.2	4.6	4.5	4.5	.5	Non-Oil Developing Ctys.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Other Countries
2.4	−.7	4.4	28.2	18.5	5.2	11.7	4.7	11.1	33.1	27.8	7.1	18.5	−1.2	.3	5.9	**G. Liab. Cent. Fa. Auth. Res.**
2.3	−.7	4.4	28.1	10.6	5.1	11.6	4.5	10.0	32.8	27.5	7.0	17.7	−2.0	−3.2	5.9	Industrial Countries
—	—	—	.1	−.1	—	—	—	—	—	—	—	—	—	—	—	Oil Exporting Countries
—	—	—	—	—	.1	.1	.2	1.0	.3	.1	—	.8	.7	3.5	−.8	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries
−2.5	−.9	−14.8	−31.3	−24.5	−6.6	−33.2	−18.3	−35.7	−53.9	−31.0	−33.4	−70.6	−4.0	23.8	−22.2	**H. Total Change in Reserves**
—	1.3	−12.2	−28.1	−14.4	1.6	.9	−3.5	−7.2	−26.5	−26.0	4.7	−22.3	−.6	−1.5	−18.4	Industrial Countries
−.5	−.3	−.6	−1.9	−2.0	−2.0	−34.0	−17.0	−18.8	−18.1	6.1	−30.1	−43.0	.9	20.8	−1.5	Oil Exporting Countries
−1.9	−1.9	−2.0	−1.4	−8.1	−6.3	−.1	2.2	−9.6	−9.4	−11.1	−8.0	−5.4	−4.3	4.4	−2.2	Non-Oil Developing Ctys.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Other Countries

Source: IMF Annual Report, 1984

Figure 1 LDC Exchange Rate Index (1962-83) (1980 = 100)

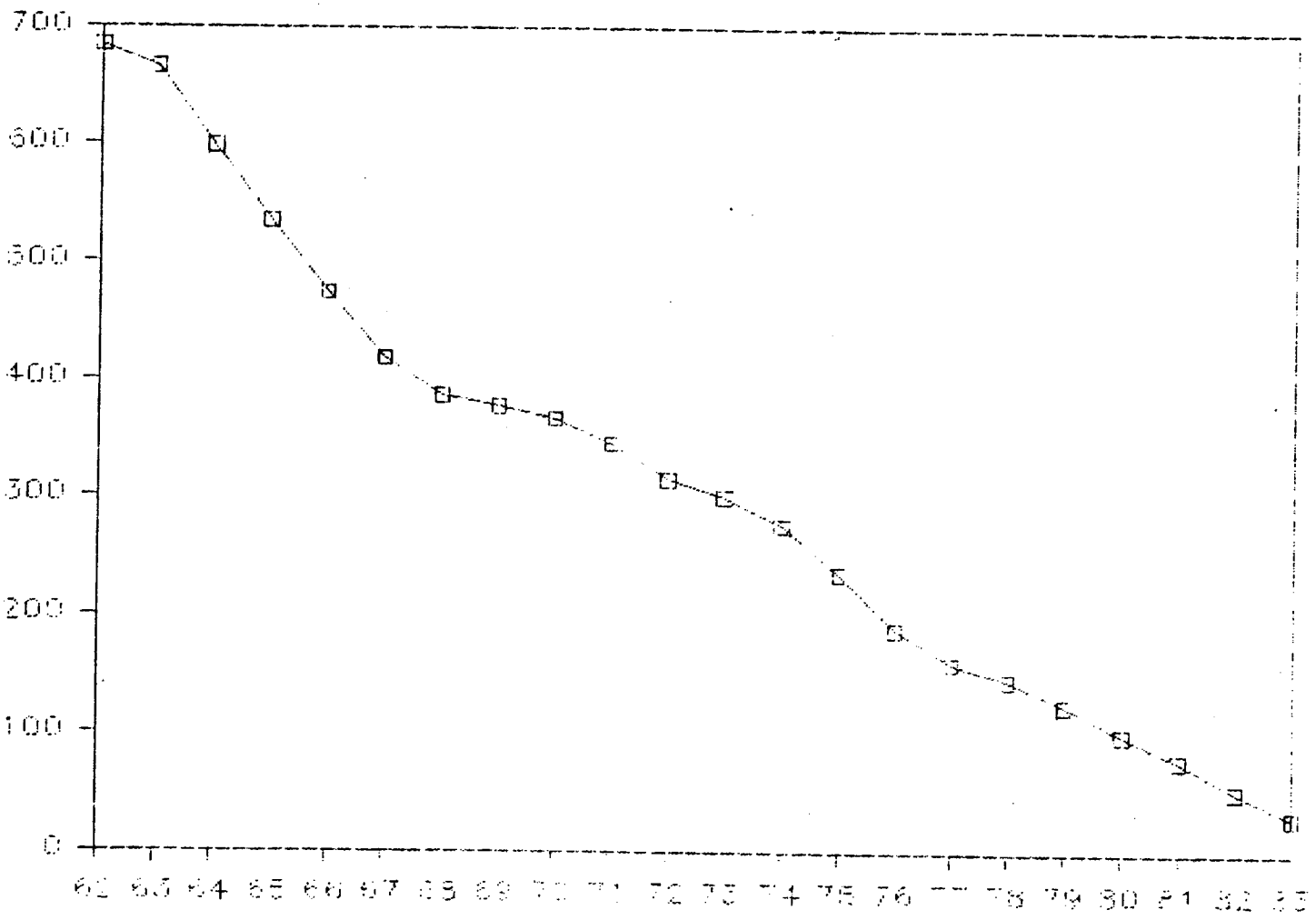
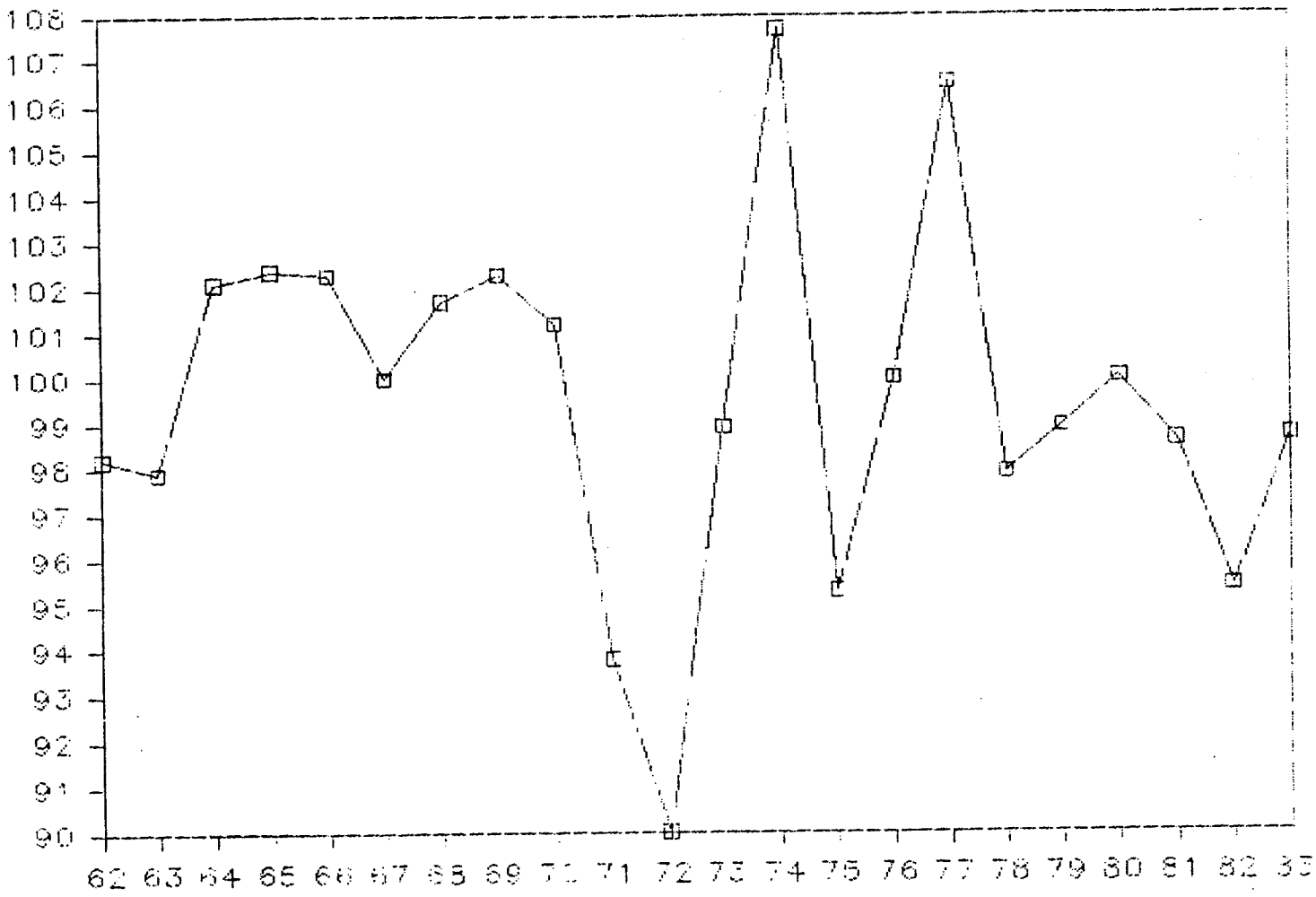


Figure 2 LDC Real Exchange Rate Index 1962-1983 (1980 = 100)



although it has been volatile, the real exchange rate has not exhibited any trends. This implies that the LDC exchange rate has tended to reflect differential inflation rates between the industrialised countries on the one hand and the LDCs on the other. On this basis figure 1 indicates that LDC inflation has consistently outstripped its counterpart in the industrialised countries.

Exports

We recognise that LDC exports do not form a homogenous group. In certain markets, especially for primary products, LDCs are price takers and the volume of exports depends on domestic supply conditions. In this case the supply of exports is likely to vary directly with export prices relative to domestic prices as well as LDC productive capacity.

In other markets, especially for manfactured goods, competition is likely to be imperfect, in which case export demand will reflect the price competitiveness of LDC exports and the level of economic activity outside the LDC bloc. These considerations suggest that the volume of LDC exports may be hypothesised in terms of equation (2):-

$$X = X(P_x^{-}/P_w, P_x^{+}/PE, \overset{+}{Q_L}, \overset{+}{Q}) \qquad (2)$$

where

P_w non LDC price level (in foreign currency)

Q_L GDP in LDCs

Q GDP in non-LDCs

and the signs of partial derivatives are indicated over the variables to which they refer.

On this basis it follows that LDC export prices will reflect domestic prices expressed in common currency, competing prices and primary product prices, i.e.

$$P_x = P_x(P_w, PE, P_{mn}) \qquad (3)$$

where

P_{mn} = price of non-oil primary products (foreign currency)

Beenstock (1987) has considered how P_{mn} may be determined empirically. The inclusion of this variable in equation (3) takes account of the fact that non-oil primary products are disproportionately represented in the exports of oil importing developing countries.

Imports

We hypothesize a conventional import demand function in which the volume of imports varies directly with domestic economic activity and inversely with the price of imports relative to the price of domestic output. However, we further hypothesize that imports are curtailed by LDC governments when reserves of gold and foreign exchange are in short supply. Conversely, when reserves are in abundance imports are allowed to be sucked in more rapidly; hay is made while the sun shines. This specification attempts to recognise the degree to which LDC exports are centralised and subject to bureaucratic fiat.

These considerations suggest the following specification for the volume of imports:-

$$M = M(\overset{+}{Q_L}, \overset{-}{P_m}/PE, \overset{+}{RES}/RES^*) \qquad (4)$$

where RES* denotes the authorities' desired level of reserves.

In our empirical work described in section III we assume that RES* is proportionate to imports. However, Edwards (1984) and Eaton and Gersovitz (1981) propose more sophisticated hypotheses. Import prices are assumed to reflect their component parts:-

$$P_m = P_m(P_o, P_{mn}, P_w) \qquad (5)$$

where P_o denotes the price of oil expressed in world currency.

Debt and the Exchange Rate

Two more or less separate analytical approaches have evolved regarding the determination of net LDC foreign indebtedness. One approach, e.g. Cline (1984), determines the growth of debt as the counterpart to the current balance and the change in reserves of the central bank. Thus net capital inflows to LDCs are treated as a residual. The second approach e.g. Kapur (1977) and Riedel (1983) determined capital flows directly rather than as a residual from the balance of payments identity. While this may appear to be more satisfactory, it implies that the current balance and the change in the reserves are residually implied by the determination of capital flows.

Clearly neither approach is satisfactory and what is required is an integration of the two approaches so that capital flows, the current balance and the change in reserves are compatible with each other. If the exchange rate is perfectly flexible, the current and capital account balances for given central bank intervention are rendered compatible by exchange rate movements that clear the foreign exchange market. But LDC exchange rates are not perfectly flexible, in which case compatiblity must be rendered in another way.

The approach we adopt is as follows. First, LDC exports are determined independently along the lines discussed above. Secondly, capital flows to LDCs reflect developments in the market for sovereign loans (see below) in which LDCs have desired debt positions in stock terms. In the short run, however, actual and desired debts might differ, reflecting adjustment costs, and there may also be distress borrowing if liquidity, measured e.g. by the reserves-import ratio, is low. Thirdly, reserve movements are determined residually via the balance of payments identity in the short run. In the longer run the authorities have a desired reserves position that they wish to achieve. This is achieved by interfering with imports as suggested by equation (4). They might also attempt to stimulate export earnings, but we could find no evidence for this. Finally, they might alter the exchange rate when the reserves come under pressure.

These considerations suggest the following adjustment mechanisms for external indebtedness and the exchange rate:-

$$\Delta \ln D = D(\overset{+}{D^*/D}, \overset{+}{RES^*/RES}) \qquad (6)$$

$$\Delta \ln E = E(\overset{-}{RES^*/RES}, \overset{+}{P_w/PE}, \overset{+}{AID} + \Delta D) \qquad (7)$$

Note that equation (7) implies that the equilibrium real exchange rate varies directly with aid and capital inflows, reflecting the so-called 'Dutch Disease' theory of the exchange rate as applied to developing countries. D*, the desired level of indebtedness, in equation (6) is assumed to reflect the development cycle theory of indebtedness, see e.g. Beenstock (1984, chapter 10), in

The coefficient of r is ambiguous, as is the constant term. Nevertheless, it is likely (as our empirical estimates suggest) that these coefficients will generate stability.

It follows that in the long run that D = D*, RES = RES* and

$$XP_x - MP_m + AID + \dot{D}^* - RD^* = \dot{RES}^*$$

$$E = P_w/P + \frac{\beta_3}{\beta_2}(\dot{D}^* + AID)$$

Rather than devote space here to the analytical properties of various dynamic multipliers we report empirical dynamic multipliers in section IV. In the meanwhile we note that the system that has been described is capable of yielding stable, dynamic solutions for all of the state variables.

III. Estimation

The Data

As described in the data appendix, our definition of LDCs is based on the IMF's 'oil importing developing countries'. It therefore excludes Mexico, which currently has debts equal to $105 billions. Nevertheless, the IMF data, as presented in table 1, have the advantage of consistency, even if their coverage is not ideal.

To estimate D we have relied on the World Debt Tables of the World Bank. Because their data only refer to medium-term loans we have had to generate a residual item (Z) to satisfy the balance of payments identity.

As will be inferred from the appendix, in certain cases, e.g. LDC indebtedness (D) where stock data was unavailable prior to 1972, data problems were formidable. This necessitated substantial efforts to generate time series for D which was projected backwards via equation (1). Fortunately, thanks to the efforts of Avramovic (1964), we had estimates for D for the late 1950s. We found that our backward projections closely approximated the actual data for this earlier period. In the meanwhile, table 2 records the growth rates of real LDC indebtedness over the period as a whole. The table indicates that indebtedness grew at a faster rate prior to the 1970s. However, during this time the base was small although from Avramovic (1964) it is evident that the World Bank feared a debt crisis in the early 1960s.

Table 2 Real International Indebtedness of Oil Importing LDCs (quinquennial growth rates %)

1955-60	133.6
1960-65	82.4
1965-70	73.1
1970-75	27.5
1975-80	48.8
1980-84	48.4

Econometric Methodology

Our primary objective is to estimate equations (2) to (7). As described in the appendix, our data consist of annual observations dating back to the early 1960s. Although this is rather brief for our purposes, it is most probably just about long enough to carry out meaningful empirical investigation.

Since the relationships in equations (2) to (7) are unlikely to hold instantaneously, we estimate them in terms of 'error correction models', see e.g. Salmon (1982), and apply the dynamic estimation methods proposed by Mizon and Hendry (1980). In this way we hope to embed the relationships hypothesised in section II in the long term solution of the model.

The equations reported below are estimated by OLS. The justification for this reflects several considerations. First, it turns out that the estimated equations are largely recursive. Secondly, the LDCs' balance of payments is assumed not to influence their domestic economic activity in the current period. Thirdly, economic activity in the non-LDC world is assumed to be independent, at least in the current period.

Results

Our main results are listed in table 3 where e.g. equation($\hat{6}$) is our estimate of equation (6). In this equation we have normalised LDC external debt by their exports, which implies that exports are one of the variables that affect the target level of debt. Other development indicators consist of investment as a proportion of GDP (I) and changes in the rate of growth. The former implies that more investment generates more foreign borrowing. The latter implies that LDCs tend to shed debt when growth accelerates in the short run. The inclusion of the volume of rescheduling reflects the argument that desired lending to LDCs falls when sovereign risk increases. This assumes that perceptions of sovereign risk and the volume of loans rescheduled

Oil Importing Developing Countries (OLS)

Table 3 Model Listing

LDC Exports

Export values $ (1964-1983):-

$$\ln X\$ = 0.38 + \ln(XP_{xL})$$

Export unit value index $ (1964-1983)

$$\underset{}{\ln P_{xL}} = \underset{(1.91)}{-1.37} + \underset{(7.44)}{0.484}\ \ln P_{mn}\$ + \underset{(2.03)}{0.271}\ln(P_L E_L) + \underset{(3.73)}{0.274}\ \ln P_{xLt-1} \quad (\hat{3})$$

$$\sigma = 0.0288 \quad \bar{R}^2 = 0.997 \quad DW = 1.9$$

Export Volumes (1964-1983):-

$$\ln X = \underset{(1.1)}{0.638} + \underset{(2.25)}{0.243}\ \ln Q - \underset{(3.94)}{0.449}\ \ln(P_{xL}/P_{xi})_{t-1}$$

$$\underset{(2.16)}{-0.231}\ \ln(P_{xL}/P_{xi}) + \underset{(3.25)}{0.0083Q_L} + \underset{(3.8)}{0.443}\ \ln X_{t-1} \quad (\hat{2})$$

$$\sigma = 0.018 \quad \bar{R}^2 = 0.998 \quad LM(4,3.59) = 2.41$$

LDC Imports

Import values $ (1964-1983):-

$$\ln M\$ = -10.4 + \ln(MP_{m_L})$$

Import unit value index $ (1962-1983):-

$$\underset{m_L}{\ln P} = \underset{(7.45)}{1.25} + \underset{(3.28)}{0.285}\ \ln P_{xi} + \underset{(11.43)}{0.298}\ \ln P_o\$ + \underset{(1.62)}{0.14}\ln P_{mn}\$ \quad (\hat{5})$$

$$\sigma = 0.035 \quad \bar{R}^2 = 0.996 \quad DW = 1.07$$

Import volume index (1963-1983):-

$$\ln M = \underset{(5.28)}{-1.62} + \underset{(6.06)}{0.187}\ \ln(RES/M\$)_{t-1} + \underset{(2.96)}{1.26}\ \Delta\ln Q_L + \underset{(5.6)}{0.74}\ \ln Q_L$$

$$+ \underset{(3.65)}{0.412}\ \ln M_{t-1} - \underset{(1.57)}{0.08}\ \ln(P_{mL}/P_L E_L) \quad (\hat{4})$$

$$\sigma = 0.0157 \quad \bar{R}^2 = 0.998 \quad LM(4,3.49) = 0.641$$

LDC Medium-term debt $ (1962-1983):-

$$\Delta\ln(D/X\$) = \underset{(1.88)}{0.626} - \underset{(2.1)}{0.222}\ln(RES/M\$)_{t-1} + \underset{(1.4)}{0.0338}\ln I_{t-1}$$

$$- \underset{(3.1)}{5.33}\,\Delta\ln Q_L - \underset{(2.24)}{0.025}\ln RSCH - \underset{(2.5)}{0.216}\ln(D/X\$)_{t-1} \quad (\hat{6})$$

$$\sigma = 0.0586 \qquad \bar{R}^2 = 0.61 \qquad LM(4,3.41) = 1.45$$

Exchange Rate (1964-1983)

$$\Delta\ln E = \underset{(6.\ 6)}{-0.912} - \underset{(8.,02)}{0.962}\,(\Delta\ln P_L - \Delta\ln P) + \underset{(3.67)}{3.9}\left(\frac{AID + \Delta D}{Q_L P_L}\right)_{t-1}$$

$$+ \underset{(4.46)}{0.242}\ln(RES/M\$)_{t-1} + \underset{(2.21)}{1.83}\,\Delta\ln Q_L - \underset{(1.26)}{0.204}\ln(P_{xL}/P_{xi})_{t-1} \quad (\hat{7})$$

$$\sigma = 0.024 \qquad \bar{R}^2 = 0.966 \qquad DW = 2.14$$

Balance of Payments

$$\Delta RES = X\$ - M\$ + AID + Z + \Delta D \qquad (1)$$

Glossary

X$	Export value index, $
X	Export volume index
P_{xL}	Export unit value index, $
P_L	LDC GDP deflator, domestic currency
E_L	Exchange rate index, $ per unit of LDC currency
P_{xi}	Export unit value index of industrialised countries, $
Q_L	GDP
M$	Import value index, $
M	Import volume index
P_{mL}	Import unit value index, $
RES	Reserves, $
D	Medium term debt, $
I	Investment as % of GDP
RSCH	Rescheduling at constant prices
AID	Official development assistance, $
Z	Residual from balance of payments, $

Notes:

't' values are shown in parentheses

LM (a, b) is the lagrange multiplier test for a order autocorrelation where b is the critical value of χ^2 at p = 0.05. See Breusch and Pagan (1980).

are positively correlated. The coefficient of the reserve-import ratio accords with our hypothesis that when liquidity rises they use this as an opportunity to reduce indebtedness.

The stationary state solution to equation (6) may be written as

$$\ln D^* = 2.9 + \ln X\$ - 1.03\ln(RES/M\$) + 0.161\ln I) - 0.116\ln RSCH$$

which accords fairly closely with equation (6). The stationary state solution to equation ($\hat{5}$) may be written as

$$\ln M = -2.76 + 0.32\ln(RES/M\$) + 1.26\ln Q_L - 0.14\ln(P_{mL}/P_L E)$$

which implies that the target level of reserves is proportionate to imports, while imports vary directly with GDP and inversely with their relative price. The coefficient of the reserves-import ratio in equation (4) accords with our hypothesis that when reserves are run down, LDCs cut back on their imports, but when they are liquid the opposite happens. Equation (4) also implies that the short run marginal propensity to import is higher (after the initial period) than its long run counterpart.

In equation (2) the volume of LDC exports varies directly with GDP in the industrialised countries and inversely with the relative price of LDC exports. It also varies directly with the level of GDP in the developing countries. Our estimates suggest that the long price elasticity of demand for LDC exports is greater than unity. We were unable to estimate satisfactorily any hypothesised positive effect of domestic relative export prices upon the supply of LDC exports.

Equation (7) , the exchange rate equation, includes the

variables specified in equation (7). A stronger reserves position raises the exchange rate as do aid and capital inflows. The last term in the equation implies that the exchange rate tends to move in inverse proportions to relative price movements between the LDCs and the industrialised countries. Note that P_{xL} and P_{xi} are measured here in common currency. However, the first term in equation $(\hat{7})$ implies that the exchange rate responds rapidly to differential rates of inflation. The main difference between equation $(\hat{7})$ and (7) is the inclusion of a term in the rate of LDC growth that appears to strengthen the exchange rate. We confess that this has been included on ad hoc statistical grounds, although many exchange rate equations include positive terms in domestic economic activity.

The stationary state solution implied by equation $(\hat{7})$ is

$$\ln E = -4.47 + 19.1 AID/QP + 1.19 \ln(RES/M\$) + \ln(P_{xi}/P^{1}_{xL})$$

where P^{1}_{xL} denotes LDC export prices measured in domestic (LDC) currency. The equation implies that if aid inflows rise by one percent of LDC GDP the LDC real exchange rate rises by 0.19% in the long run. We defer the policy implications of this important new result to section IV.

The model is closed by equations $(\hat{3})$ and $(\hat{5})$ for the export and import price deflators (unit values) respectively. In the former case we failed to detect any competitive price effect from the industrialised countries export prices (P_{xi}). In the latter case the sum of these coefficients appeared to be significantly less than unity.

IV. Simulations

In this section we carry out two types of simulation exercise. In the first we implement a full dynamic simulation of the model as represented by the equations in table 3. In this exercise initial conditions are set according to the data upto and including 1963 after which the model is used to solve for the endogenous variables over the next 20 years. Because the simulation is dynamic, lagged exegenous variables are model-generated rather than data.

Hendry and Richard (1982) have argued that dynamic simulations do not constitute meaningful validation exercises, and we agree with this point of view. On the other hand they provide information about the eigenvalues of the model and indicates whether the system as a whole tracks the trends in the data. In view of our expectation that the latter condition should be met in the present case, it is as well to check the matter out directly.

In the second set of exercises we calculate the dynamic multipliers that are implied by the model. These multipliers measure the responses overtime of these endogenous variables to shocks in the exogenous variables. Apart from informing about the properties of the model the exercise, as we shall see, is not without normative significance.

Dynamic Simulations

Table 4 Dynamic Simulation Errors %

	Exports	Imports	Exchange Rate	Debt	Reserves
1964	3.4	1.1	-2.0	2.0	8,0
1965	1.7	1.9	0.3	2.6	-0.8
1966	-1.7	-3.6	-1.7	-4.4	0.2
1967	0.5	0.3	-0.4	-5.7	-1.2
1968	1.4	0.7	3.0	-11.6	-2.6
1969	-0.1	1.7	0.2	-13.5	-9.1
1970	0.2	-2.1	-4.7	-9.5	0.3
1971	8.3	3.2	-0.6	-11.0	6.8
1972	5.0	6.2	-3.3	-5.1	-3.4
1973	2.1	-2.6	-6.3	3.1	6.4
1974	-6.5	6.3	0.3	-0.7	-33.3
1975	2.8	-9.5	-10.5	14.5	10.4
1976	3.1	2.7	0.6	16.1	10.5
1977	1.3	3.8	4.3	13.2	1.6
1978	1.1	-3.3	-1.6	4.5	16.1
1979	-2.2	1.0	0.7	-1.8	8.3
1980	-6.3	1.2	1,3	-6.9	-2.1
1981	-3.2	-2.1	-1.7	0.3	10.2
1982	-1.0	5.7	6.3	-0.9	0.7
1983	-4.4	3.6	3.6	-5.6	-15.2

In table 4 we report the percentage errors generated by the dynamic simulations. If indeed the model failed to track the data these errors would tend to cumulate over time. The fact that they do not indicates that the model tracks the main trends in the data. It is, of course, well known that if the

underlying equation residuals are white noise the dynamic simulation errors must be autocorrelated. This explains the pattern in the residuals reported in table 4. The residuals implied by table 3 are of course much smaller and random.

It should be recalled that the reserves are generated via the balance of payments identity; there is no behavioural equation for this variable. It is therefore particularly gratifying to note that they dynamic simulation errors for the reserves also tend to die out over time, although occasionally (e.g.1974) they can be large. This suggests that the model provides a good account of LDC reserves as well as the variables for which there are behavioural equations.

Generally speaking the largest errors occur during 1974-76, i.e. around the time of the first OPEC oil price rise. This is perhaps not surprising, but the fact that the same constellation of errors is not repeated at the time of OPEC II suggests that the model does not systematically mishandle oil price shocks.

Comparative Statics

Space prevents us from reporting the entire set of dynamic multipliers that are generated by the model. However, we hope that the following selection sheds some light on its properties. We begin with the effects of a ceteris paribus increase in aid (or autonomous capital inflows) of 10 percent. The results are described in table 5.

The most important implication of this shock is that it

Table 5 10% Increase in ODA

Year	Exchange Rate (%)	Import Volumes (%)	Export Volumes (%)	Reserves (%)	Debt (%)	Real Exchange Rate
1	0.74	0.07	-0.04	0.19	0.14	0.2
2	1.54	0.17	-0.22	0.26	0.22	0.47
3	2.16	0.26	-0.48	0.01	0.18	0.71
4	2.67	0.27	-0.73	-0.43	0.19	0.91
5	2.97	0.22	-0.97	-0.92	0.24	1.05
6	3.11	0.13	-1.15	-0.32	0.38	1.12
7	3.2	0.05	-1.27	-1.55	0.56	1.17
8	3.25	-0.03	-1.35	-1.57	0.76	1.19
9	3.36	-0.03	-1.4	-1.26	0.95	1.24
20	3.85	-0.4	-1.8	-3.7	2.15	1.43

Table 6 5% Rise in GDP in Industrial Countries

Year	Exports (%)	Imports (%)	Reserves (%)	Exchange Rate (%)
1	1.2	0	2.7	0
2	1.9	0.6	6.1	1.0
3	2.4	1.4	6.8	2.3
4	2.4	1.8	6.7	3.3
5	2.3	1.9	5.9	3.8
6	2.1	1.8	5.0	4.2
7	2.1	1.7	3.7	4.5
8	2.0	1.4	3.5	4.5
9	1.9	1.4	3.1	4.7
10	1.9	1.3	2.6	4.8
20	1.8	1.4	4.7	5.5

indicates an increase in the nominal and real exchange rates for LDC currency. The latter rises by more than the former because currency appreciation induces LDC exporters to cut their profit margins by lowering their export prices. As the currency appreciates imports rise because importables become relatively cheap while exports fall as they become relatively expensive. The additional aid thus pushes the trade balance into deficit via the "crowding out" mechanism that is identified by the model.

Initially the reserves strengthen thanks to the extra aid. However, four years after the shock the trade imbalance is so large that the reserves fall relative to their baseline values. Eventually the fall in reserves has become so serious that import restrictions have to be imposed so that in year 8 imports are lower than in the base run. Indeed, the haemorrhage of reserves eventually induces distress borrowing.

The normative implications of this simulation are serious because reduced exports, reserve losses and debt growth can hardly be regarded as the developmental objectives of transfers of official aid to developing countries. These adverse effects occur because the LDC exchange rate is not in general independent of aid flows. Exchange rate effects should therefore be taken into consideration when analysing the benefits and costs of aid transfers (and capital transfers).

In table 6 we report the simulated effects of a 5 percent rise in industrialised countries GDP. Exports rise because the demand for them increases. As export earnings rise the reserves

are boosted, which eventually triggers additional imports. However, as the reserves strengthen the exchange rate appreciates hich chokes off some .export demand and further boosts the demand for imports. In the long run we would expect the reserves to rise because imports are higher and because central bank's demand for reserves depends upon the level of imports.

In interpreting the precise quantitative properties of these dynamic multipliers it should be recalled that their values are generally state-dependent in nonlinear models such as the present one. This means that e.g. the apparent oscillatory pattern of the reserves may reflect this phenomenon rather than the dynamic structure of the model. Year one is in fact 1964 while year 20 is 1983; it is not necessarily the case that a given shock will manifest indentically in 1964 as it would in 1983. Bearing this caveat in mind the simulations imply that the model is stable.

Higher oil prices raise oil import bills and deplete the reserves (table 7) which in turn induce distress borrowing and a lower exchange rate. The latter helps to promote exports through improved competitiveness. It also helps to reduce imports as does the shortage of reserves. By the third year imports (expressed in value terms) fall relative to their base run values. This implies an even stronger fall in import volumes because of the deterioration in the terms of trade. In the long run the lack of external indebtedness rises in part because in equation $\hat{(6)}$ the demand for debt is normalised with respect to exports.

A higher GDP deflator in LDCs (table 8) raises the price of LDC exports via equation $(\hat{3})$ which in turn induces a currency depreciation. An interesting implication of the model is that the short run fall in the exchange rate is not much smaller than its long run counterpart, suggesting that the exchange rate is allowed to reflect relative price movements quite rapidly. This property is reflected in figure 2 as already noted. In the long run the volumes of exports and imports revert to their baseline values as is appropriate. In the interim exports are smaller and imports higher reflecting the temporary loss of competitiveness.

Table 7 10% Rise in Oil Prices

Year	Imports (%)	Reserves (%)	Exchange Rate (%)	Export Volumes (%)	Debt (%)
1	2.6	-7.4	0	0	0
2	0.4	-10.8	-2.5	0.2	1.8
3	-1.0	-8.5	-4.5	0.7	4.3
	-0.9	-6.3	-5.2	1.4	5.8
5	-0.4	-5.0	-5.4	1.9	6.5
6	-0.1	-4.1	-5.8	2.3	6.4
7	0.2	-3.2	-6.2	2.5	6.0
8	0.3	-3.4	-6.3	2.7	5.5
9	0.3	-2.9	-6.6	2.9	5.2
10	0.4	-1.9	-6.6	3.0	4.9
20	0.2	-4.0	-6.6	3.0	4.5

Table 8 20% Rise in LDC Price Level

Year	Export Volumes (%)	Import Volumes (%)	Exchange Rate (%)
1	-0.1	0.1	-16.1
2	-0.1	0.1	-16.1
3	-0.2	0.1	-16.1
4	-0.3	0	-16.3
5	-0.2	0	-16.4
6	-0.2	-0.1	-16.5
7	-0.2	-0.1	-16.5
8	-0.1	-0.1	-16.5
9	-0.1	0	-16.6
10	-0.1	0	-16.6
20	0	0	-16.6

Table 9 20% in LDC GDP

	Export Volumes (%)	Import Volumes (%)	Debt (%)	Exchange Rate (%)	Reserves (%)
1	5.2	17.5	-56.5	39.7	-14.5
2	4.9	45.11	17.6	7.5	-143.0
3	10.8	-13.9	146.0	-32.2	-57.0
4	26.4	-8.3	213.0	-8.0	6.7
5	19.3	16.1	177.0	32.4	21.0
6	13.7	24.4	111.9	20.8	-5.6
7	13.4	18.1	76.7	-7.5	-27.2
8	19.6	9.6	71.7	-23.0	-29.8
9	28.0	6.4	77.1	-28.7	-11.1
10	35.0	11.0	78.2	-24.0	9.0
20	34.0	30.2	45.7	10.3	58.2

Note that the long run fall in the exchange rate is proportionately less than the increase in the GDP deflator because the equilibrium exchange rate in the model is defined in terms of traded goods prices and the weight of the GDP deflator in equation (3) is less that 100 percent in the long run.

In our final simulation we consider the effects of a 20% rise in LDC GDP. Note that this term enters equation (2) in a semi-logarithmic manner which makes the solution values of the dynamic multipliers particularly state-dependent. This is the main reason why the impulse responses reported in table 9 are irregular. This does not, of course, invalidate the model which implies that the positive elasticity of exports with respect to GDP varies proportionately with GDP. This in turn implies that growth disproportionately favours exports as far as the LDCs as a whole are concerned.

Export volumes rise because a secular rise in GDP raises productive potential which boosts exports from the supply side. However, it also raises the demand for imports. Their oscillatory path reflects the fact that initially extra GDP depletes the reserves which eventually induces an element of import restraint. The fall in reserves induces distress borrowing but in year one debt falls on account of the term in $\Delta^2 \ln Q_L$ in equation (6). This reminds us that these simulations are inherantly synthetic and that in practice GDP never rises on a one-and-for-all basis.

The long run increase in debt reflects the long run increase in exports. However, as far as one can gather, the exchange rate and the reserves oscillate around their baseline values with no particular trend emerging.

V. Conclusions

The simulations abstracted from the costs of debt service in order to concentrate on the underlying properties of the model. In subsequent work we intend to use this model in conjunction with a parallel model that has been estimated for the industrialised countries, Beenstock (1987), to explore the economic interdependence between the industrialised countries, the oil importing developing countries and the oil exporting countries. At that stage we will integrate debt service and IPD into the analysis.

An omission from the present model has been the two way linkages between the balance of payments and economic growth in the developing countries. While growth affects the balance of payments in the model, it is likely that e.g. import restraint will damage growth prospects. Also export growth might stimulate domestic economic activity. This is a major issue which, however lies beyond our present terms of reference and until we deal with it will to some extent leave our analysis incomplete.

Although our present preoccupations have been positive rather than normative the model has a number of properties that are of some policy interest.

i) The LDC balance of payments process appears to be stable and self-correcting.

ii) Exchange rates tend to adjust quite rapidly and in a stabilisinig manner.

iii) LDC external borrowing reflects liquidity as well as developmental requirements.

iv) Aid induces higher exchange rates which damage exports.

Data Appendix

X — Non oil developing countries' export volume, calculated as the ratio of export value (US$) over export unit value (US$). 1980 = 100.

Source: IMF, International Financial Statistics Yearbook.

P_{xL} — Non oil developing countries' export unit value, in terms of US$, 1980 = 100.

Source: IMF, IFS Yearbook.

M — Non oil developing countries' import volume; calculated as the ratio of import values (US$) over the export unit value (US$), 1980 = 100.

Source: IMF, IFS Yearbook.

P_{mL} — Non oil developing countries' import unit value, in terms of US$, 1980 = 100.

Source: IMF, IFS Yearbook.

Q_L — Non oil developing countries' GDP, in terms of their domestic currency, at constant prices, 1980 = 100.

Source: IMF, IFS Yearbook.

Q — Industrial countries' GDP, expressed in terms of their currency, at constant prices, 1980 = 100.

Source: IMF, IFS Yearbook.

P_L — Non oil developing countries' GPD deflator, expressed in their currency, 1980 = 100.

Source: IMF IFS Yearbook.

E_L — Effective exchange rate of the US$ against LDC currency; calculated from the ratio of LDC GDP in US$ over LDC GDP in LDC currency.

Source: IMF, IFS Yearbook

IFS Supplement on Price Statistics.

IFS Supplement on Output Statistics.

RES/M$ Non oil developing countries' reserves in terms of weeks of imports.

Source: IMF, IFS Supplement on Reserves.

IFS Yearbook.

P_{xi} Industrial countries' export unit value, in US$, 1980 = 100

Source: IFS Yearbook.

P_{mn}\$ Primary commodities price index, in US$, 1980 = 100. (Excluding crude petroleum).

Source: United Nations, Monthly Bulletin of Statistics.

P_o\$ Crude petroleum price index, in US$, 1980 = 100.

Source: United Nations, Monthly Bulletin of Statistics.

I Non oil developing countries' gross capital formation as a percentage of their GDP.

Source: IMF, IFS Supplement on Output Statistics.

D Non oil developing countries' medium term debt, in US$, 1980 = 100.

Source: World Debt Tables, Avramovic (1964) and own calculations.

RSCH Non oil developing countries' debt, in US$, 1980 = 100.

Source: Euromoney, August 1982.

World Debt Tables 1983-84.

AID Official Development Assistance in US$, World Development Reports, World Bank.

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