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Import Compression and Export Performance in Developing Countries

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Abstract

In recent years many developing countries have had to compress imports to generate the trade surpluses needed to service foreign debt. However, since imports of intermediate and capital goods are critical inputs in export production, import compression can adversely affect export performance. In turn, slower export growth limits foreign exchange availability, inducing further import compression.

This paper develops a model that incorporates feedbacks between imports and exports arising from the effects of import compression on exports, and of the availability of foreign exchange on imports. Estimates using a sample of 34 developing countries and simulation experiments confirm both these hypotheses.

1/ The authors are grateful to Willem Buiter, Jonathan Eaton, Jacob Frenkel, Richard Haas, Henryk Kierzkowski, Jeroen Kremers, Assaf Razin, and Nadeem U. Haque for helpful comments, and to Tom Walter for excellent research assistance.

Contents

I. Introduction

While the economic downturn experienced by the industrial countries in the period 1980-83 had a major adverse impact on exports and the terms of trade of most developing countries, the debt crisis that began in 1982 exerted an especially strong effect on a number of middle-income developing countries which had previously relied heavily on the private international credit markets to finance their current account deficits. In these countries, external adjustment in the aftermath of 1982 mainly took the form of massive import compression to secure the merchandise trade surpluses required to service their existing debt. Although such an effort was viewed as unavoidable given the external financing constraints imposed by the severely reduced inflows of new private credit, it was apparent from the outset that adjustment of this magnitude could not be achieved except at significant cost in terms of sharp deflation and, especially in the early years, very low or even negative rates of domestic investment and growth.

These consequences of the debt crisis have been widely discussed in recent years and we do not propose to consider them in the present paper. 1/ Rather, we wish to analyze an additional adverse effect of rapid external adjustment that has thus far received less emphasis than it deserves. Specifically, we examine the direct effects of import compression on export performance. We will show that although the standard approaches to modelling trade flows of a developing country often neglect this linkage, 2/ it is likely to be of considerable practical importance. Hence this linkage must be recognized explicitly when projecting imports and exports and, more importantly, when policymakers attempt to assess the effectiveness of their external adjustment policies.

Before proceeding further, we must say more specifically what is meant by the terms import compression and export performance. Import compression refers to the effect of government policies that are specifically intended to reduce the volume of imports in order to obtain a rapid improvement in the merchandise trade balance in the face of binding external finance constraints. In other words, import compression occurs when the domestic authorities impose tariffs, quotas, or licensing schemes--or engage in severe domestic deflation--for the purpose of servicing external debt or rebuilding official exchange reserves. By the term export performance, we mean the response of the volume and value of exports to government policy actions and other exogenous shocks. There can be little doubt that some degree of import compression is generally

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1/ These issues have been considered at length by Dornbusch and Fischer (1985), Massad (1985), and by the papers contained in Smith and Cuddington (1985).

2/ For a survey of existing international trade models, see Goldstein and Khan (1985).

needed in order to adjust successfully to severe adverse external shocks. It is also a useful rule of thumb that strong export performance is prima facie evidence that good policies are in place at home. Indeed, strong export performance is often regarded as compelling evidence of the appropriateness of a country's external adjustment policies. 1/ Nevertheless, this paper will show that for a broad class of developing countries import compression can exert a powerful adverse impact on export performance, even if the "right policies" are being pursued.

To summarize the basic conclusion of this paper, our effort to understand the implications of the present developing-country debt crisis suggests two simple extensions to the standard analysis of the determinants of a developing country's exports and imports. We believe that our approach leads to the conclusion that the standard model is seriously deficient when it comes to describing the external adjustment of a developing country that faces severe external financing constraints. In particular, it has been widely stated that prolonged balance of payments adjustment via import compression is undesirable because it lowers both per capita consumption and the rate of domestic fixed capital formation. Our analysis suggests that, in addition to these well-known mechanisms, there is a direct negative feedback effect of import compression on export performance which constitutes an additional cost of rapid merchandise trade adjustment. Furthermore, there is evidence that the availability of foreign exchange is an important determinant of imports in developing countries, and this has not generally been incorporated in standard trade models. 2/

The remainder of the paper is organized as follows. Section II describes the extent of the developing-country debt crisis and the associated import compression. Section III first outlines the standard model of the determinants of a developing country's exports and imports, and then introduces our two extensions. The extended model allows for the effect of financing constraints on imports and of changes in the volume of imported inputs on exports, and incorporates the standard model as a special case. Section IV describes the estimation of the parameters of the two models from a time-series cross-section sample of developing countries. In Section V the standard and extended models are used in simulation experiments designed to contrast their conclusions regarding the short-run and long-run effects of external shocks and changes in domestic policies. Section VI summarizes the principal conclusions of the study.

1/ The cases of Korea and Singapore are frequently cited to support this view.

2/ In other words, external financing constraints usually induce the authorities to impose restraints on the availability of foreign exchange to domestic importers.

II. The Debt Crisis, Financing Constraints, and Import Compression

This section briefly describes recent trends in the international economy that have exerted a particularly strong effect on the trade-off between external financing and trade balance adjustment in the capital-importing developing countries. 1/ Though the events summarized here are familiar, it is worth recounting them in order to set the stage for our analysis of financing constraints and import compression.

It is by now widely accepted that both adverse shifts in the international environment confronting the developing countries and inappropriate domestic policies contributed to the debt crisis that began in mid-1982. 2/ Table 1 summarizes external factors that influenced the merchandise trade of capital-importing developing countries from 1978 to 1986 3/ and compares them with the average movements in these same factors during the years 1968-1977. The table shows that the sharp weakening of real domestic demand in the industrial countries from 1980 to 1982 was associated with an even more pronounced decline in their import volumes. The result was a fall in the volume of exports of fuel-exporting developing countries from 1980 onward, and a marked weakening in the growth rate of export volume for non-fuel exporters, particularly after 1982. The effects of these adverse movements in export volume on the value of exports were exacerbated by a pronounced worsening of the terms of trade for most categories of developing countries. For example, primary product exporters suffered particularly large terms-of-trade declines from 1980 to 1982, as did all non-fuel exporters. The terms of trade of fuel exporters continued to improve until 1982, but thereafter they experienced a large and protracted decline.

The economic downturn of 1980-82 was also associated with high and volatile levels of nominal and real interest rates in international financial markets. Table 1 shows that the Eurodollar interest rate, which had averaged less than 8 percent for the 1968-77 period as a whole, jumped to nearly 15 percent in 1980-82. In combination with the terms-of-trade

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1/ The group of capital-importing developing countries is a new category which first appeared in the October 1985 issue of the IMF World Economic Outlook. This group includes all developing countries except for eight Middle Eastern oil exporters that, on average, recorded current account surpluses during 1979-81 and were aid donors over the same period. There are thus 124 countries in the group of capital-importing developing countries, comprising 85 percent of combined developing-country GDP and about 68 percent of its exports. For definitions, see IMF, World Economic Outlook, April 1986, Statistical Appendix.

2/ See, for example, Khan and Knight (1983), Doroodian (1985), and Massad (1985).

3/ The values for 1986 are projections from the IMF World Economic Outlook April, 1986.

Table 1. The International Environment and Developing Countries, 1978-1986

	Annual Percentage Rates of Change (and percent)									
	Average 1968-1977	1978	1979	1980	1981	1982	1983	1984	1985	1986 1/
Industrial countries										
Real domestic demand	3.5	4.0	3.6	0.1	0.5	-0.2	2.8	5.1	2.8	3.6
Import volume	7.4	5.6	8.8	-0.7	-1.5	0.1	5.1	13.0	5.2	5.0
Eurodollar interest rate	7.6	8.7	12.0	14.4	16.6	13.1	9.6	10.8	8.3	*
Developing countries										
Export volume										
All developing countries	5.7	4.0	5.0	-4.0	-5.7	-8.1	2.9	7.1	0.4	3.8
Fuel exporters	4.7	-1.6	1.7	-13.1	-15.1	-16.5	-3.7	0.7	-4.1	2.6
Non-fuel exporters	7.1	9.4	8.4	9.1	6.5	0.7	8.3	11.7	3.4	4.3
Terms of trade										
All developing countries	5.0	-6.8	10.9	16.7	3.0	-1.2	-3.9	1.2	-2.2	-11.7
Fuel exporters	13.2	-10.3	26.8	43.8	11.8	0.1	-8.8	1.1	-4.2	-37.4
Non-fuel exporters	-0.3	-3.9	-1.2	-5.9	-5.3	-2.6	0.2	1.5	-1.2	3.6
Primary product exporters	0.6	-6.9	0.4	-7.9	-10.4	-6.2	0.9	3.5	-3.2	7.3
Capital-importing developing countries										
U.S. dollar export unit value	11.4	4.2	22.7	24.1	0.3	-5.7	-5.8	0.5	-3.5	-1.1
Real interest rate (percent) 2/	-3.5	4.3	-8.8	-7.8	16.2	19.9	16.3	10.2	12.3	*
Current account deficit (as percent of exports of goods and services)	-11.0	-16.0	-12.5	-12.6	-18.5	-17.8	-9.4	-4.1	-5.0	-5.5
Debt service as percent of exports of goods and services (percent)	*	19.0	19.1	17.1	20.5	23.6	22.0	22.9	24.1	24.2

Source: International Monetary Fund, World Economic Outlook, April 1986, Statistical Appendix; and International Financial Statistics.

1/ Projection.

2/ Calculated as $100\ (r-\hat{p})\ (1+\hat{p})^{-1}$, where r is the annual average Eurodollar interest rate in London and $\hat{p}$ is the annual percentage rate of change in the U.S. dollar export unit value for capital-importing developing countries recorded in the same year.

movements already described, these developments caused unprecedented swings in real interest rates measured in terms of developing-country export prices. For example, a simple measure of the real Eurodollar interest rate faced by capital-importing developing countries as a group (using the average change in their export unit values) was strongly negative in 1979-80, but jumped by an astonishing 24 percentage points from 1980 to 1981.

These adverse real and financial developments in the international economy were important contributors to the worsening current account and debt-service ratios of the capital-importing developing countries that appear in the last two rows of Table 1. For present purposes it is important to see the impact of these factors on the financing situation. Table 2 presents data which give an overview of the consequences of the debt crisis for the pattern of financing of the current account deficits of capital-importing developing countries. This table is basically a flow-of-funds statement that reflects the ex post identity between the combined current account deficit to be financed (the uses of funds) and the sources of financing made available from asset transactions; non-debt-creating flows (such as official development assistance (ODA) and direct investment); and external borrowing from both official lenders and the private international credit market. Net asset transactions and recorded errors and omissions basically reflect private sector capital movements. Because these categories normally are a source of financing for the current account deficit they are listed as such in Table 2, even though, owing to private capital flight, these items gave rise to a large outflow of funds (i.e., negative entries in the table) for this group of countries during the years under review.

Table 2 indicates that from 1978 to 1981 the combined current account deficit of the capital-importing developing countries doubled, reaching a peak of $113 billion in the latter year. With the reduction in the flow of foreign credit that marked the onset of the debt crisis in 1982 it fell sharply, to only $36 billion in 1984. As regards the financing of the deficit, several aspects of the table are of interest. Development grants and direct investment (non-debt-creating flows) have remained stable at an inflow of about $25 billion since 1981. While movements in official reserves and related liabilities, asset transactions, and long-term borrowing from official creditors are of some interest, it is clear that the major changes in the overall amount and form of financing for the broad group of developing countries during the debt crisis occurred in just three items: "asset transactions, net," "recorded errors and omissions" and "other net external borrowing". The first two items reflect mainly private sector capital flows, while the third consists almost entirely of borrowing from private credit markets at long term (primarily in the form of syndicated Euro-credits) and short term (mainly trade credit). Table 2 makes it clear that the buildup to the debt crisis

Table 2. Capital-Importing Developing Countries: External Financing and Changes in Import Volume, 1978-86

(In billions of U.S. dollars)

	1978	1981	1982	1983	1984	1985	1986 1/
Combined current account deficit:							
Deficit on goods, services, and private transfers	56.4	113.0	103.0	60.4	36.4	43.0	55.3
Financed by:							
Non-debt creating flows	17.8	27.8	26.6	23.2	24.1	26.5	29.0
Use of reserves	-13.9	5.1	17.2	-9.4	-19.7	-2.2	-8.1
Asset transactions, net	-3.5	-12.5	-10.2	-9.6	-11.8	-6.2	-9.3
Recorded errors and omissions	-5.7	-19.6	-26.3	-10.9	-4.1	-3.8	--
Net external borrowing	61.7	112.3	95.8	67.2	48.0	28.7	43.7
Reserve-related liabilities	1.4	9.2	18.9	18.1	5.9	--	2.4
Long-term borrowing from official creditors, net	16.5	30.1	27.6	31.6	28.7	18.0	27.3
Other net external borrowing	43.9	73.1	49.3	17.5	13.4	10.8	14.1
Long-term	34.1	52.7	34.5	42.8	13.3	23.1	16.9
Short-term	9.7	20.4	14.8	-25.4	--	-11.3	-3.1
Growth of import volume:							
All capital-importing developing countries	7.8	4.5	-6.5	-2.7	4.6	2.6	2.3
Market borrowers	8.3	6.9	-7.4	-6.5	3.0	-1.2	2.8
Official borrowers	5.1	-2.5	-1.4	1.0	1.1	-1.2	5.0
Diversified borrowers	7.7	1.1	-6.3	6.8	10.2	13.5	0.2

Source: IMF, World Economic Outlook, April 1986, Statistical Appendix, Tables A40 and A25.

1/ Projection.

was associated with a significant amount of private capital flight. 1/ The outflow under the two headings for these items jumped from $9 billion in 1978 to $32 billion in 1981 and to over $36 billion in 1982. Simultaneously, private credit flows under the heading of "other net external borrowing" increased by $30 billion from 1978 to 1981, rising to a peak level of $73 billion. As a consequence, the outstanding debt of the capital-importing developing countries doubled between 1977 and 1981, reaching a total of $662 billion in the latter year. Over the same period, debt-service as a fraction of total exports increased from 19 percent to nearly 24 percent (Table 1).

The culmination of these developments in the debt crisis of 1982 is now well known. In mid-1982, the private credit markets reached the view that recent financing trends were no longer sustainable. The flow of new credits to many capital-importing developing countries suddenly evaporated, making rapid improvement of the trade balance a prime objective of economic policy. Our present concern is with the nature of the adjustments undertaken by capital-importing developing countries in response to these new external finance constraints in the immediate aftermath of the debt crisis. To understand these developments in terms of the data presented in Table 2 it is useful to distinguish two subgroups: "official borrowers" on the one hand, and "market and diversified borrowers" (hereafter called, simply, "market borrowers") on the other. Specifically, official borrowers are those countries--mainly low-income primary commodity producers--that receive most of their financing via ODA loans and grants. From the point of view of external balance, their policy problem has always been one of achieving a current account position that can be financed by an exogenously given and largely predictable flow of financing in the face of the vagaries of international market demand, domestic supply, weather conditions and the like. This problem is, of course, a very difficult one, and it was intensified by the effects of the severe recession in the international economy during the early 1980s. However, the data on which Table 2 are based strongly suggest that, for official borrowers as a group, financing flows remained at about the same level after 1982 as before; in other words the international debt crisis did not, in and of itself, exacerbate the external adjustment problems of official borrowers. 2/

Not surprisingly, this picture contrasts sharply with that for market borrowers. Broadly speaking, these are middle-income developing countries that had turned in reasonably satisfactory growth performance

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1/ For an analysis of the causes of capital flight, see Khan and Ul Haque (1985). Other papers relevant to this issue include Cuddington (1985), Dornbusch (1985), and Dooley (1986).

2/ This is not to deny that there were substantial fluctuations in ODA flows to individual countries, particularly those in Africa, during this period; see Tanzi (1986). For the group of official borrowers as a whole, however, these flows remained relatively stable.

during the 1970s, and that had made heavy use of the private credit markets to finance rising levels of consumption as well as their economic development efforts. For these countries, the flow of private credit, mainly from the Euro-market, had been in relatively elastic supply--at LIBOR plus a small spread--right up until 1982. After that year, as Table 2 suggests, these credits suddenly dried up. Countries that had relied mainly on market sources to finance their external position borrowed over $120 billion (net) from banks and other private creditors in 1981-82; in 1983-84 they could only obtain about $30 billion from these sources.

This contraction of new lending to the market borrowers, in conjunction with persistent problems of capital flight, profoundly altered the policy problems confronting policymakers in these countries. Before 1982, their task had essentially been one of development planning; that is, policymakers viewed their basic objective as that of deciding how much domestic investment the country should undertake, given the level of domestic saving. Put another way, they decided how large a current account deficit they should aim for at the current and expected real interest rate (deflated by the anticipated change in export unit values) prevailing in international credit markets. After mid-1982, this policy problem was turned on its head. Now market borrowers found the supply of credit from the private markets almost completely inelastic. Hence they had to decide how to improve their trade balances quickly enough so that their current account deficits were lowered to a level that could be financed under existing conditions. One can therefore view the fall in the current account deficit of capital-importing developing countries from $113 billion in 1981 to $60 billion in 1983 and $36 billion in 1984 as the financing constrained maximum level of the combined current account deficit that had to be attained, ex post, through both reductions in imports and enhanced export performance.

During 1982-84, this substantial external adjustment was achieved mainly by severe import compression and sharp cuts in public investment programs. For all capital-importing developing countries taken as a group, Table 2 shows that the reduction in import volume amounted to 6.5 percent in 1982 and nearly 3 percent in 1983. In addition, the figures suggest that import compression was a much more pronounced phenomenon in the case of the market borrowers than it was for official borrowers. Indeed, in some indebted developing countries in Latin America import volumes plunged by as much as 18 percent in 1982 and a further 23 percent in the following year. 1/ The remainder of this paper analyzes the consequence of this import compression for export performance and trade balance adjustment.

1/ IMF, World Economic Outlook, October 1985.

III. Models of Developing-Country Trade

The modelling of foreign trade relationships has a long history, as pointed out in a recent survey by Goldstein and Khan (1985). Indeed, there is a remarkable degree of consensus in the profession on the empirical forms of the demand and supply functions for imports and exports. 1/ Basically the model that has dominated the empirical trade literature is the "imperfect substitutes" model, and in many respects this can be regarded as the standard approach to specifying and estimating trade equations.

The key underlying assumption of the imperfect substitutes model is that neither imports nor exports are perfect substitutes for domestic nontraded goods. 2/ On the demand side, in accordance with conventional theory, the consumer is assumed to maximize utility subject to a budget constraint. The resulting demand function for imports will have as arguments the level of income in the home country, the price of the imported good, and the price of the domestic substitute. Correspondingly, export demand will depend on income in the rest of the world, the price of exports, and the price of foreign substitutes. The specification of the supply function is equally straightforward in the context of the imperfect substitutes model--the producer is assumed to maximize profits subject to a cost constraint. This procedure yields the supply of exports as a positive function of the price of exports, a negative function of the price of inputs, and a positive function of the level of gross output. 3/ In other words, export supply will expand with the profitability of producing and selling exports, and with increases in productive capacity.

In the "perfect substitutes" model, by contrast, there are no separate import demand and export supply functions. Instead, the demand for imports and the supply of exports represent the excess demand for importables and exportables, respectively. While models that distinguish between importable, exportable, and nontradable goods have become increasingly popular in international economics, serious difficulties arise in their empirical

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1/ Goldstein and Khan (1985) claim that in certain respects, empirical work on the time-series behavior of foreign trade flows has changed little over the past 30 years. For earlier trade surveys, see Leamer and Stern (1970), and Magee (1975).

2/ If they were perfect substitutes then one would observe either the domestic or foreign good taking up the entire market when each is produced under constant or decreasing returns to scale. In addition, if imports and exports were perfect substitutes there would be no possibility of two-way trade. Both of these implications of the perfect substitutes model can generally be rejected on empirical grounds.

3/ Note that the supply of exports of the rest of the world is definitionally the supply of imports to the home country.

application. First, data on prices and quantities of importables, exportables, and nontradables do not exist. 1/ Second, the model requires estimation of demand and supply functions for importables and exportables, which has proven far more difficult to do than estimating import and export functions directly. For these reasons the imperfect substitutes model has continued to be the mainstay of empirical work on trade equations.

The imperfect substitutes model is also standard when it comes to explaining trade flows in developing countries. Most studies, including among others, those by Khan (1974), Bahmani-Oskooee (1984), Kim (1984), Bond (1985), Marquez and McNeilly (1985), and Balassa et al. (1986), relate the volume of imports or exports to relative prices and a scale variable. As such, there is no essential difference between the models used by economists for developing countries and those applied to developed countries. Certain studies, for example Hemphill (1974) and Zaidi (1984), do make allowance for the fact that imports in developing countries may be constrained by the availability of foreign exchange. In other words, the government may control the flow of imports through imposition of quotas and other quantitative restrictions, with the degree of control depending generally on the level of international reserves. If this were the case, then the standard model would no longer be an accurate representation of import demand. The theory of export supply is still very much a contested and unresolved subject in the literature, and we are unaware of any empirical study on developing countries that explicitly incorporates the effects of imports on the growth of exports.

In this section we first discuss the standard model of foreign trade for a capital-importing developing country. We then extend this model to take into account the effects of foreign exchange constraints on the import side, and the role of imported inputs in the production of exports.

1. The standard model

The standard model of merchandise trade, presented in terms of general functional forms, can be written as: 2/

$$XV^S = S[\frac{XUV}{CPID}, KX] \qquad S_1 > 0,\ S_2 > 0 \qquad (1)$$

1/ See Goldstein, Khan, and Officer (1980) for an attempt to construct such data and make use of it in estimating import equations for a number of industrial countries.

2/ Here the standard model is written as a static system. The dynamics of the model will be considered in more detail when the extended version is specified.

$$XV^d = D[\frac{XUV}{PW}, YWR] \qquad D_1 < 0, \; D_2 > 0 \tag{2}$$

$$XV = XV^d = XV^s \tag{3}$$

$$MV = M[\frac{MUV}{CPID}, GDPR] \qquad M_1 < 0, \; M_2 > 0 \tag{4}$$

$$TB_t = (XUV \cdot XV)_t - (MUV \cdot MV)_t \tag{5}$$

$$R_t = R_{t-1} + TB_t + DK_t \tag{6}$$

where XV and MV are the volumes of exports and imports, and XUV and MUV are their respective unit values. YWR and GDPR are the levels of real income in the world and domestic economies, respectively; and KX is the stock of fixed capital in the export sector. CPID is the domestic price level, PW the price of foreign substitutes, TB the merchandise trade balance, R the value of official foreign exchange reserves, and DK capital inflows. 1/ The functions S, D, and M with subscripts represent partial derivatives with respect to each variable in square brackets. All nominal magnitudes, XUV, MUV, PD, PW, TB, R and DK, are valued in units of foreign currency (dollars), so that the trade and overall balance-of-payments identities (5) and (6) are in terms of foreign currency, and no problems arise from valuation effects on net official foreign assets owing to exchange rate changes. 2/

We will specify the particular functional form of these behavioral equations later. The question at issue here is as follows: what does the standard model tell us about the effect of adverse external developments on the imports and exports of the domestic economy? To see this question in the simplest terms, let us suppose that KX, GDPR, YWR, MUV, PW, and CPID are exogenously given, and that since the home country faces binding external finance constraints DK is also given. What happens when there is an autonomous fall in rest-of-the-world income, YWR? The causal sequence yielded by the standard model can be traced as follows: other

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1/ The variable DK includes all financial inflows (ODA grants and loans, direct investment, and external borrowing) minus net payments to foreigners on investment income account. For simplicity, we also assume that there are no non-factor service receipts or payments.

2/ Thus a devaluation of the home currency would initially result in an equiproportionate decrease in the value of CPID.

things equal, a decline in world income would reduce both the unit value of the developing country's exports (via equation (2)--a terms-of-trade deterioration) and the volume of exports (owing to the reduced profitability of export supply--equation (1)). Starting from an initially balanced merchandise account with a constant level of net financial inflows, the home country's trade balance would move into deficit, leading to a decline in official foreign currency reserves as the domestic authorities attempted to maintain the initial exchange rate. This is of course a very familiar story. The point, however, is that given the level of domestic output and prices there is no negative feedback from import compression onto export performance. The standard model simply tells us that a decline in foreign income will cause the home country's trade balance to worsen, forcing it to use international reserves period after period if the exchange rate remains unaltered at its initial level.

Of course, one aspect of the standard model is the linkage from exports to domestic output--a decline in XV must result in a fall in GDPR via the well-known Keynesian export multiplier. As GDPR falls, imports will also decline, reducing the size of the trade deficit associated with the decline in YWR and moderating the rate at which the home country loses foreign exchange reserves. However, this is a familiar linkage that is analyzed extensively in the standard literature on the foreign trade multiplier. In order to simplify our analysis and highlight the differences between the standard model of merchandise trade and our extended model, we neglect this well-known feedback channel, leaving GDPR exogenous in both models. This means that we are implicitly assuming that the authorities use demand management policies to ensure that the change in domestic absorption is exactly equal in magnitude and opposite in sign to the change in the volume of exports.

2. The extended model

We wish to use the standard model outlined above not as a 'straw man', but rather as a benchmark against which to compare the implications of a model which contains two very simple extensions. In order to capture the effects of import compression associated with the post-1982 financing constraints on developing countries, our extended model introduces one extension to the import demand equation and one to the export supply function. Specifically, the standard import demand function must be extended to capture the phenomenon of import compression; that is, it must allow for the fact that the authorities' desire to restore their holdings of international reserves to desired levels will cause them to institute policies designed to reduce home-country imports relative to the volume that private economic agents would have demanded in the absence of the reserve constraint. On the export side, the model must be extended to take account of the fact that gross exports are the sum of value-added by the domestic export sector plus the amount of imported inputs. It is worth emphasizing at the outset, however, that in extending the standard model of a developing country's trade account it is always necessary to

take cognizance of the severe limitations on the types of macroeconomic and trade data that are, in practice, available for these economies. The model set out below is devised with these data limitations in mind.

a. Export volume

Our extension to the export supply equation is a very simple one that pays due attention to the fact that export volume is analogous to a gross output concept, rather than a value-added concept. Let the export sector's partial equilibrium desired supply of gross exports, XV^S, be specified in log-linear form as:

$$\log XV_t^S = \alpha_{11} + \pi \log MIX_t + (1-\pi) \log VAX_t \qquad (7)$$

That is, XV^S is a Cobb-Douglas function of the volume of domestic value-added by the export sector, VAX, and the volume of imported inputs, MIX, where π and $(1-\pi)$ are parameters reflecting the elasticities of gross export supply with respect to the volumes of imported and domestic inputs, respectively. Of course, for many developing countries there are serious deficiencies in the data on the volume of imported inputs used by the export sector. In order to render our model empirically more tractable for a pooled sample, the first simplifying assumption necessitated by limitations on data availability is that the price elasticity of the demand for MIX is the same as that for total import volumes, MV. Thus:

$$\log MIX_t = \alpha_{12} + \log MV_t \qquad (8)$$

where $\exp(\alpha_{12})$ is the ratio of imported inputs to total imports.

Substituting equation (8) into equation (7) we obtain:

$$\log XV_t^S = (\alpha_{11} + \alpha_{12}\pi) + \pi \log MV_t + (1-\pi) \log VAX_t \qquad (9)$$

The next step is to specify the supply function for value-added in the export sector. Given competitive cost-minimizing behavior by the sector, it can easily be shown that value-added by the export sector (VAX) will be a positive function of the price of exports relative to domestic prices (both measured in units of foreign currency) and of the stock of fixed capital in the export sector, KX. Combining these assumptions gives:

$$\log VAX_t = \alpha_{13} + \beta_1 \log (XUV/CPID_t) + \beta_2 \log KX_t \qquad (10)$$

Since capital stock data are not available for most developing countries, 1/ we will assume that value-added in the export sector can be specified as a general function of labor (LX) and capital (KX):

$$VAX = F(LX, KX)$$

such that $F(\lambda LX, \lambda KX) = \lambda VAX$, which implies that $VAX = f(\frac{LX}{KX})KX$.

Assume further that VAX is a constant proportion of trend GDP (TGDPR) for the economy as a whole. Then we can write the capital stock as:

$$\log KX = \alpha_{14} + \beta_2 \log TGDPR \tag{11}$$

where $\beta_2 < 1$ implies (LX/KX) rises as KX increases, while $\beta_2 > 1$ implies (LX/KX) falls as KX rises.

Substituting (11) into (10) gives:

$$\log VAX_t = (\alpha_{13} + \alpha_{14}) + \beta_1 \log XUV_t - \beta_1 \log CPID_t + \beta_2 \log TGDPR_t \tag{12}$$

Finally, we assume that actual export volume adjusts to optimal supply XV^S according to the partial-adjustment process:

$$\Delta \log XV_t = \gamma_1[\log XV_t^S - \log XV_{t-1}] \qquad 0 < \gamma_1 < 1 \tag{13}$$

Substituting (9) and (12) in (13) and solving for the level of XV:

$$\begin{aligned}\log XV_t = {} & \gamma_1[\alpha_{11} + \alpha_{12} + (1-\pi)(\alpha_{13} + \alpha_{14})] + \gamma_1 \pi \log MV_t \\ & + \gamma_1 (1-\pi) \beta_1 \log XUV_t - \gamma_1 (1-\pi) \beta_1 \log CPID_t \\ & + \gamma_1 (1-\pi) \beta_2 \log TGDPR_t + (1-\gamma_1) \log XV_{t-1}\end{aligned} \tag{14}$$

1/ This lack of capital stock data relates to both the export sector and the domestic economy as a whole.

b. Export price

Next it is necessary to make some assumptions about the form of the foreign demand function for exports. The simplest approach would be to suppose that world demand for a country's exports was infinitely elastic. Such an approach implicitly assumes that the home country accounts for only a small share of the total market for its exportables. Hence changes in its supply alter its share of the market within such a small range that it exerts a negligible effect on the price. However, this convenient simplifying assumption is no longer appropriate in a debt crisis situation, as the home country's competitors will simultaneously be trying to expand their exports as well. Furthermore, given the presence of many types of restrictions faced by developing countries in their export markets, it is highly unlikely that an individual country can sell all its wants at a given market price. In these conditions, it is more appropriate to allow for the fact that even a small country will face a downward-sloping world demand function for its exportables.

We take account of the possibility that developing countries face a less than perfectly elastic demand function by deriving the unit value of exports as follows. World demand for the home country's export good is:

$$\log XV_t^d = \alpha_2 + \beta_3 \log YWR_t - \beta_4 \log (XUV/PW)_t \qquad (15)$$

where XV^d is the partial equilibrium demand for exports (in volume terms).

Assume that the export price adjusts as follows:

$$\Delta \log XUV_t = \gamma_2 [\log XV_t^d - \log XV_{t-1}] \qquad 0 < \gamma_2 < 1. \qquad (16)$$

Substituting for XV^d from equation (15), and solving equation (16) for the price of exports yields:

$$\log XUV_t = \gamma_2 \alpha_2 + \gamma_2 \beta_3 \log YWR_t - \gamma_2 \beta_4 \log XUV_t + \gamma_2 \beta_4 \log PW_t + \log XUV_{t-1} - \gamma_2 \log XV_{t-1} \qquad (17)$$

or,

$$\log XUV_t = \frac{\gamma_2}{1+\gamma_2 \beta_4} [\alpha_2 + \beta_3 \log YWR_t + \beta_4 \log PW_t - \log XV_{t-1}] + \frac{1}{1+\gamma_2 \beta_4} \log XUV_{t-1} \qquad (18)$$

c. Import volume

It is clear from the specification of the equation for the volume of gross exports (14) that in the extended model anything that constrains the level of imports will also have an adverse impact on the developing country's export performance. It now remains to describe the nature of this constraint. We assume that in a developing country that faces financing constraints the authorities' desire to accumulate reserves (or to reduce net official liabilities to foreigners) will induce import compression. This process is specified as follows. The long-run, or equilibrium, demand for imports takes the familiar form:

$$\log MV_t^d = \alpha_3 + \beta_6 \log GDPR_t - \beta_7 \log (MUV/CPID)_t \qquad (19)$$

where MV^d is the demand for (the volume of) imports. The actual volume of imports is assumed to adjust as:

$$\Delta \log MV_t = \gamma_3 [\log MV_t^d - \log MV_{t-1}], \qquad 0 < \gamma_3 < 1 \qquad (20)$$

From the statistics presented in Section II, it is evident that since mid-1982 many developing countries' capacity to import has been constrained by the availability of (real) international reserves. Such a situation is analogous to imposing a liquidity constraint on the demand for imports, in addition to an income constraint. Here we argue that the speed with which any disequilibrium is eliminated depends on the stock of real reserves as a proportion of the size of the disequilibrium in the demand for imports, as follows: 1/

$$\gamma_3 = \gamma_{31} + \frac{\gamma_{32} \log (R/MUV)_t}{[\log MV_t^d - \log MV_{t-1}]} \qquad (21)$$

where R is the stock of international reserves. Both γ_{31} and γ_{32} are expected to be positive.

1/ In equation (21) the scale term $[\log MV_t^d - \log MV_{t-1}]$ is introduced to eliminate the nonlinearity that would arise in the reduced-form equation for imports below. In a sense, therefore, equation (21) can be viewed as a linear approximation to a general function relating the speed of adjustment to the level of real reserves, i.e., $\gamma_3 = f(R/MUV)$, $f' > 0$.

Substituting equations (19) and (21) into equation (20) we obtain:

$$\Delta \log MV_t = \gamma_{31} [\alpha_3 + \beta_6 \log GDPR_t - \beta_7 \log (MUV/CPID)_t] - \gamma_{31} \log MV_{t-1} + \gamma_{32} \log (R/MUV)_t \quad (22)$$

or, in terms of the level of import volume:

$$\log MV_t = \gamma_{31} \alpha_3 + \gamma_{31} \beta_6 \log GDPR_t - \gamma_{31} \beta_7 \log (MUV/CPID)_t + (1-\gamma_{31}) \log MV_{t-1} + \gamma_{32} \log (R/MUV)_t \quad (23)$$

Thus the extended model that we consider consists of the three structural equations (14), (18) and (23), along with the definition of the trade balance (5) and the overall balance of payments identity (6). Note that the standard model (1) to (6) is entirely nested within the extended model; we obtain the former from the latter simply by imposing the additional restrictions that $\gamma_{32} = \pi = 0$. The greater generality of the extended model is due to the fact that it contains two feedback effects that are neglected in the standard treatment. First, in a financing-constrained developing country, any fall in the authorities' holdings of official international reserves will induce them to invoke policy measures that reduce the rate at which import volume adjusts to the home economy's desired level. The strength of this negative feedback is measured by the parameter γ_{32}. Any import compression is implicitly assumed in our model to fall equally on imports of final goods and inputs. The second negative feedback is that any constraint on the level of imports will also limit gross export volume. The strength of this effect depends positively on the size of the elasticity of gross exports with respect to imported inputs, π.

IV. Parameter Estimates

Both the standard and extended models have been estimated for a pooled cross-section time-series sample of 34 developing countries using annual data for the decade 1971-80. 1/ This sample was chosen solely on the criterion that each country has reasonably consistent annual data for all the variables in our model. However it turns out that, fortuitously, the sample can be said to be broadly representative of the capital-importing developing countries as a group. Table 3 gives a breakdown of the characteristics of the sample. As the table shows, the sample

1/ This procedure yields a sample of 340 observations.

Table 3. Characteristics of the Pooled Sample of 34 Developing Countries

	Borrows Mainly from:		Main Exports 2/				Geographic Region					Low Income 3/
	Private Market 1/	Official Lenders 1/	Manufactures	Primary Products	Remittances	Fuel	Europe	Western Hemisphere	Middle East	Asia	Africa	
Cyprus	x				x		x					
Greece	x				x		x					
Malta		x			x		x					
Turkey	n.a.	n.a.		x			x					
Yugoslavia	x		x				x					
Bolivia	x			x				x				
Brazil	x			x				x				
Colombia	x			x				x				
Dom. Rep.		x		x				x				
Ecuador	x					x		x				
Honduras		x		x				x				
Paraguay	x			x				x				
Guyana		x		x				x				
Jamaica		x		x				x				
Suriname	x			x				x				
Trin. & Tob.	x					x		x				
Israel	n.a.	n.a.	x						x			
Jordan		x			x				x			
Burma		x		x						x		x
Korea	x		x							x		
Malaysia	x			x						x		
Pakistan		x			x					x		x
Philippines	x			x						x		
Sri Lanka	n.a.	n.a.		x						x		x
Thailand	n.a.	n.a.		x						x		
Fiji		x		x						x		
W. Samoa		x			x					x		
Burkina Faso		x			x						x	x
Ethiopia	n.a.	n.a.		x							x	x
Kenya	n.a.	n.a.		x							x	x
Malawi		x		x							x	x
Mauritius	n.a.	n.a.		x							x	
Rwanda		x		x							x	x
S. Africa	x			x							x	
Sub-total	14	13	3	22	7	2	5	11	2	9	7	8

Source: IMF, World Economic Outlook, October 1985, Statistical Appendix.

1/ "Private Market" refers to countries that obtained at least two thirds of their external borrowings from commercial creditors during 1978 to 1982. "Official Lenders" refers to those countries, other than China and India, which obtained two thirds or more of their external borrowings from official creditors during 1978 to 1982. "n.a." means not available.

2/ This definition groups countries by predominant export category. The four categories are: manufactures (SITC 5 to 8 less diamonds and gemstones); fuel (SITC 3); other primary commodities (SITC 0, 1, 2, 4 and diamonds and gemstones); and "services and remittances." Countries are assigned to the latter category if their receipts on services and remittances made up at least half of their exports of goods and services in 1980. Otherwise, they are assigned to that category (of the rema for at least half of their total merchandise trade exports in 1980.

3/ Low-income countries are those for which World Bank estimates of per capita GDP did not exceed the equivalent of $410 in 1980.

includes countries from all geographic regions. Out of the 34 countries considered, 14 are included in the Fund's classification of "market borrowers" (that is, countries for which two thirds of the flow of external borrowing during the years from 1978 to 1982 came from commercial creditors). Of the remaining countries, 13 are categorized as "official borrowers" on the same criterion. As regards productive structure, the sample includes primary producers, service and remittance receiving countries, 1/ and exporters of manufactures. Seven members of the sample are low-income countries (that is, countries with a per capita GNP of less than $480 in 1980).

In the pooled estimation, we allowed for country-specific constant terms in each equation. Since the model is log-linear, this assumption means that the basic ratio of each dependent variable to some scale variable is allowed to differ from country to country according to its size, openness, and the choice of units for nominal variables. From a purely statistical point of view, the country-specific constants are intended to confront the problem of heteroscedasticity across country blocks in the pooled sample.

The behavioral component of the model consists of equations (14), (18) and (23). The parameters of the standard model were obtained by estimating subject to the additional restrictions that $\pi = 0$ in equation (14) and $\gamma_{32} = 0$ in equation (23). As the model is simultaneous, the estimation was by two-stage least squares, using as instruments all the predetermined variables in the system. Since our ultimate interest is in a comparison of the dynamic adjustment paths of the two models, we have simply obtained estimates of the (just-identified) semi-reduced form of the structure. In other words, we have not imposed the non-linear over-identifying restrictions that would be required to calculate standard errors for the basic behavioral parameters, though the point estimates of these for the export supply and import demand equations can be derived from the estimated coefficients of the models. 2/

The parameter estimates of the two models are presented in Table 4. With two exceptions, all of the estimated parameters are significantly different from zero at the 5 percent level. The only exceptions are the estimated elasticities of export volume with respect to trend GDP in each model. Most important is our finding that the parameters reflecting the two feedbacks that are included in the extended model, but not in the

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1/ Service and remittance receiving countries are those whose receipts from services (such as tourism) and private transfers (mainly workers' remittances) were at least 50 percent of their total exports of goods and services in 1980.

2/ We cannot obtain the point estimates for the export price equation because it is under-identified.

Table 4. Results: Standard and Extended Models 1/

Equation (Dependent Variable)	Explanatory Variable	Standard Model: Interpretation in Terms of Basic Behavioral Parameters	Standard Model: Estimated Parameter of Semi-Reduced Form	Standard Model: t-value	Standard Model: R^2	Extended Model: Interpretation in Terms of Basic Behavioral Parameters	Extended Model: Estimated Parameter of Semi-Reduced Form	Extended Model: t-value	Extended Model: R^2
(14) Export volume									
(log XV)					0.992				0.993
	log MV_t	--	0 2/	--		$\gamma_1\pi$	0.157	(3.4)	
	log XUV_{t-2}	$\gamma_1\beta_1$	0.126	(3.3)		$\gamma_1(1-\pi)\beta_1$	0.122	(3.3)	
	log $CPID_t$	$\gamma_1\beta_1^*$	0.097	(2.0)		$\gamma_1(1-\pi)\beta_1^*$	0.125	(2.6)	
	log $TGDPR_t$	$\gamma_1\beta_2$	0.076	(0.9)		$\gamma_1(1-\pi)\beta_2$	0.043	(0.5)	
	log XV_{t-1}	$(1-\gamma_1)$	0.743	(16.9)		$(1-\gamma_1)$	0.695	(15.3)	
(18) Export price									
(log XUV)					0.870				0.870
	log YWR_t	$(1+\gamma_2\beta_4)^{-1}\gamma_2\beta_3$	1.188	(2.6)		$(1+\gamma_2\beta_4)^{-1}\gamma_2\beta_3$	1.188	(2.6)	
	log PW_t	$(1+\gamma_2\beta_4)^{-1}\gamma_2\beta_4$	0.719	(3.1)		$(1+\gamma_2\beta_4)^{-1}\gamma_2\beta_4$	0.719	(3.1)	
	log XV_{t-1}	$(1+\gamma_2\beta_4)^{-1}\gamma_2$	0.263	(5.3)		$(1+\gamma_2\beta_4)^{-1}\gamma_2$	0.263	(5.3)	
	log XUV_{t-1}	$(1+\gamma_2\beta_4)^{-1}$	0.369	(6.0)		$(1+\gamma_2\beta_4)^{-1}$	0.369	(6.0)	
(23) Import volume									
(log MUV)					0.992				0.992
	log $GDPR_t$	$\gamma_{31}\beta_6$	0.420	(7.5)		$\gamma_{31}\beta_6$	0.327	(5.5)	
	log $(MUV/CPID)_t$	$\gamma_{31}\beta_7$	0.197	(4.3)		$\gamma_{31}\beta_7$	0.145	(3.0)	
	log MV_{t-1}	$(1-\gamma_{31})$	0.605	(14.5)		$(1-\gamma_{31})$	0.627	(15.1)	
	log $(R/MUV)_t$	--	0 2/	--		γ_{32}	0.056	(3.6)	

1/ Estimates on annual data for 34 countries for the period 1971 to 1980 were obtained using two-stage least squares.
2/ Exclusion restriction imposed in estimation.

standard model, are both highly significant. In the estimation of the export volume equation (14) we also found that export prices lagged by two periods yielded the most plausible results.

As already noted above, the large size of the pooled sample made it infeasible to estimate the model subject to the over-identifying restrictions needed to obtain the parameters of the basic behavioral equations. Nevertheless, even if our main interest lies in comparing how the two models respond to shocks, it is important to ensure that these paths are not the result of implausible values for the underlying behavioral parameters. Thus, Table 5 gives the point estimates that we obtain for these parameters.

While we have a standard error for only one of the underlying behavioral parameters, the point estimates appear reasonable and it may be worth discussing the values of some of the more important ones. The elasticity of import volume with respect to the discrepancy between the authorities' target level of official exchange reserves and their actual level (γ_{32}) is highly significant, with a t-value of 3.6, indicating that this particular extension of the standard model is statistically robust. The estimated value suggests that, for the sample as a whole, the response of import volumes to changes in the authorities' holdings of international reserves is elastic but not highly so, a result that we find plausible empirically. As regards our other extension, π (the elasticity of the volume of gross exports with respect to imported inputs) has a point estimate of 0.53. This value suggests that the extension of the standard specification of export supply is certainly worthwhile.

The estimate of the partial equilibrium price elasticity of import demand β_7 may at first strike the reader as rather low, about 0.4. 1/ However, this value is consistent with our basic hypothesis that in developing countries like those considered in our sample, and for which our extended model is intended to be relevant, total imports contain a large proportion of inputs as well as final goods. To the extent that the domestic price index that we have used encompasses the effects of wage movements on consumer prices, this parameter reflects an average of the substitutability of imports for domestic labor in production (which is typically assumed to be quite small) as well as the substitutability between final goods imports and domestically-produced goods and services in total domestic demand. In other words, since imports are used as inputs to production as well as for consumption, the price elasticity of total imports will depend partly on the degree of factor substitution that is possible, given the production technology of the export sector. Thus this point estimate is also consistent with our general argument for extending the standard specification.

1/ It is certainly lower than the values reported by Khan (1974) for total imports of individual developing countries.

Table 5. Point Estimates of Behavioral Parameters

Parameters	Value: Standard Model	Value: Extended Model	Description
Export volume (XV)			
π	0 1/	0.515	Elasticity of exports with respect to imported inputs
γ_1	0.257	0.305	Adjustment parameter
β_1	0.490	0.824	Export price elasticity of supply of exports
β_1^*	0.377	0.845	Domestic price elasticity of supply of exports
β_2	0.295	0.291	Scale elasticity
Import volume (MV)			
γ_{31}	0.395	0.373	Adjustment parameter
β_6	1.063	0.876	Income elasticity of import demand
β_7	0.499	0.389	Price elasticity of import demand
γ_{32}	0 1/	0.056 2/	Import compression parameter

1/ Exclusion restriction imposed in estimation.
2/ t-value = 3.6.

To summarize, the point estimates obtained from our pooled sample for the underlying behavioral parameters of the model have values that are consistent with our priors. Hence the time paths traced out by the two models following an exogenous shock, and the differences between them, are not due to an unusual choice of parameter values. By implicitly assuming that all imports are consumer goods, the standard specification of the import equation yields an erroneous theoretical presumption that the price elasticity of imports should be higher than it actually is in an economy where a substantial fraction of total imports consists of inputs to domestic production.

V. Simulation Experiments

This section describes several simulation experiments designed to compare the standard model of the determinants of a developing country's trade balance with our extended version, and to illustrate the effects of a variety of exogenous shocks in the context of each model. Both versions of the model contain three behavioral equations--export volume XV, export unit value XUV, and import volume MV. They also contain identities for the trade balance (TB) and the overall balance of payments, as measured by the change in the level of reserves R. All other variables, YWR, GDPR, MUV, CPID and DK are treated as exogenous in the simulations, even though some of them, particularly domestic real income and prices, would obviously have to be endogenized in order to have a full explanation of the external adjustment process in a developing country. We hold them exogenous solely to highlight the differences in the dynamic behavior of our standard and extended models, owing to the two extra feedbacks that the latter contains. More will be said below about the special assumptions needed to treat GDPR and CPID as constant during the adjustment process. For purposes of the simulations, the constant terms in each equation were re-calculated to ensure that the model yields a consistent stationary state when the exogenous variables are stationary.

The equations of the extended model are exactly the same as equations (5), (6), (14), (18), and (23) of Section III and the parameters used are those given in Table 4. For convenience, the equations of the simulation model are reiterated in Table 6. Recall that the coefficients of the XV and MV equations of the standard model were estimated subject to the restrictions $\pi = \gamma_{32} = 0$ over exactly the same pooled sample as that on which the extended model was estimated, and the parameters of the standard model are those presented in column 2 of Table 4. Thus, the simulation results for the standard model will differ from ours both because the former contains two additional exclusion restrictions and because these restrictions imply different estimates of values for the structural parameters in equations (14) and (23).

Table 6. Equations of the Simulation Model 1/

$$\log XV_t = A_0 + A_1 \log MV_t + A_2 \log XUV_{t-2} - A_3 \log CPID_t + A_4 \log TGDPR_t + A_5 \log XV_{t-1} \quad (14)$$

$$\log XUV_t = B_0 + B_1 \log YWR_t + B_2 \log PW_t - B_3 \log XV_t - B_4 \log XUV_{t-1} \quad (18)$$

$$\log MV_t = C_0 + C_1 \log GDPR_t - C_2 \log MUV_t + C_2 \log CPID_t + C_3 \log MV_{t-1} - C_4 \log (R/MUV)_t \quad (23)$$

$$TB_t = (XUV \cdot XV)_t - (MUV \cdot MV)_t \quad (5)$$

$$R_t = R_{t-1} + TB_t + DK_t \quad (6)$$

The simulation results reported in this section compare the effects on the two models of three separate exogenous shocks:

(1) a 5 percent decline in real income in the rest of the world;

(2) a 10 percent increase in the dollar price of imports (i.e. a deterioration in the home country's terms of trade); and,

(3) a 10 percent devaluation of the home currency that is maintained in real terms. 2/

As already noted, the simulations are highly stylized and are intended primarily to highlight the different dynamic paths of the two models, particularly as regards their conclusions concerning the adverse effects of import compression on export performance. Specifically, the

1/ The structural parameters A_i, B_j, C_k are those which premultiply the variables in the three behavioral equations. The values taken by these structural parameters for the standard and extended models respectively, together with their definitions in terms of the basic behavioral parameters, may be found in Table 4.

2/ It is obvious that a crucial element of any full macroeconomic model is missing from our system at this point. In particular, a nominal devaluation can lead to permanent depreciation of the real exchange rate only because the model does not contain an explicit monetary sector.

paths of the two models following each of the above shocks are compared under the extreme simplifying assumption that both domestic real output and the domestic consumer price index are exogenously given. It is perhaps worthwhile to digress briefly to outline the considerations that motivate these two simplifications. In the case of real output, the implicit assumption is that the domestic authorities operate their demand management policies such that shifts in the merchandise trade balance are exactly offset by changes in the opposite direction in domestic absorption, thus leaving GDPR unchanged from its initial level throughout the period of adjustment to an exogenous shock. Of course, the assumption that the consumer price index is exogenous is more problematical. The implicit assumption is that the domestic authorities succeed in operating some form of incomes policy that lowers the absolute price of domestic output enough so as to keep CPID unchanged over the period, even though import prices increase as a result of devaluation.

1. A decline in foreign real income

Because the sharp downturn in economic activity in most industrial countries in 1981-82 was a contributing factor to the developing-country debt crisis of subsequent years, the first simulation experiment examines the effects of an exogenous decline in foreign income on the home country. The panels of Chart 1 depict the induced effects on export and import volumes, and on the merchandise trade balance, using both the standard model (dashed lines) and the extended model (solid lines). The simulated paths of exports and imports are in terms of deviations from their initial steady-state levels. The panel for the trade balance is in terms of percent of GDP.

In the simulation experiments with the standard model (dashed line in Chart 1) the five percent decline in foreign real income eventually causes the developing country's export volume to fall by 4 percent relative to its initial value, while export unit values are reduced by 7 percent. These two effects, of course, combine to push the dollar value of exports down by about 11 percent. In the standard model, our assumption that the developing country's real income remains constant implies that import volume and value are unchanged after the foreign demand shock, 1/ so there is a permanent rise in the trade deficit and the home country must use official reserves year after year to finance the persistent overall deficit in its balance of payments. 2/

1/ Quite obviously this is only a hypothetical outcome, since a country would have a finite level of reserves which would eventually be exhausted, forcing some type of adjustment.

2/ This conclusion would obviously be altered if the negative feedback onto import volume from an induced fall in income were included in the two models discussed here.

Given the experience of recent years as described in Section II, it is apparent that the path traced out by the standard model is not a very plausible outcome in the case of a country that faces a binding external finance constraint. In the extended model, the decrease in export value and volume associated with a recession in the rest of the world also leads to a trade deficit and a decline in the home country's official foreign exchange reserves. Assuming that initial reserve levels were considered just adequate by the home-country authorities, their desire to rebuild reserves will induce them to implement a variety of measures, such as tariffs, quotas, and licensing schemes, which compress the level of domestic imports. To the extent that import compression affects the volume of imported inputs as well as final goods, it leads to a further decline in export volume. This, however, induces a renewed fall in exchange reserves and the continued effort to restore them to their initial level compresses imports still further. Thus, in contrast to the standard model, the extended model suggests that recession abroad is likely to induce a "vicious circle" of import compression and weakening export growth in the developing country. Of course, the effect of slower growth in the volume of exports on total export receipts is cushioned to some degree by the smaller fall in export unit values in the extended model that is the consequence of the decline in domestic export supply. But this offset turns out to be fairly modest.

As Chart 1 indicates, the strong adverse impact of world recession on import compression and export performance in the extended model (solid lines) is clearly evident in the first years following the shock. However, an additional feature of the extended model, not allowed for in the standard version, is that the final equilibrium can only be re-established when the ratio of official reserves to imports is stable once more. This means that the import compression policies and their associated adverse effects on export performance must persist throughout the adjustment process. Under our assumptions, adjustment continues until the home country's trade account returns to the initial (balanced) position that prevailed prior to the start of the world recession. This is why the standard and extended models yield the widely divergent simulated paths for the trade balance in the bottom panel of Chart 1.

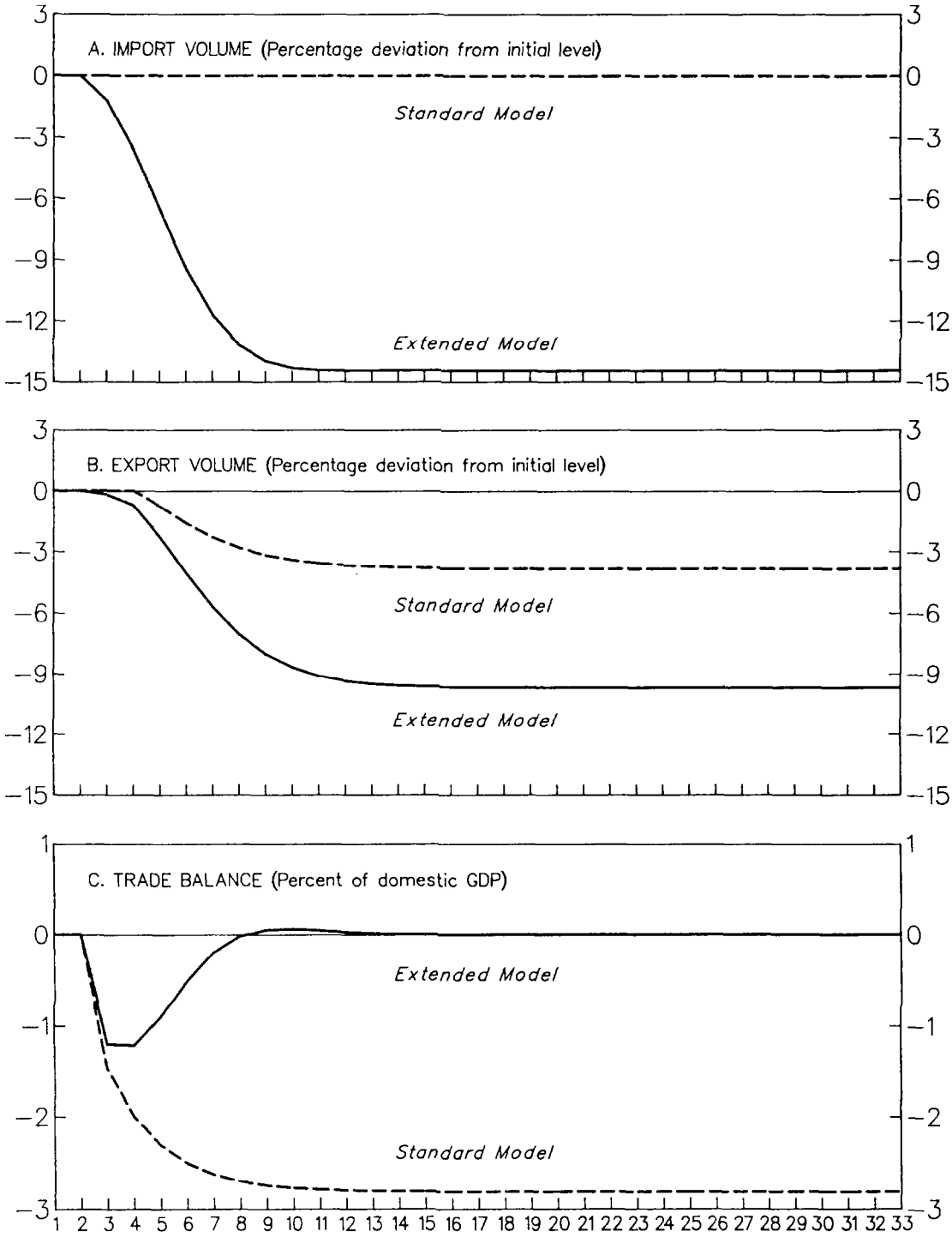
Our comparison of the main cumulative effects of this exogenous shock in the content of the standard and extended models is summarized in Table 7.

The net result is that in the long run the extended model shows much more severe effects of a downturn in foreign markets on developing countries' export performance than is evident in the simulations with the standard model, owing mainly to the negative feedback from import compression. Even taking the level of GDP as given, Table 7 makes it clear that when the new equilibrium is eventually established the effects of import compression mean that export volume is some 10 percent lower in the extended model, compared with only a 4 percent reduction in the standard model. The export price fall is, of course, smaller in the extended

CHART 1

EFFECTS OF A FIVE PERCENT DECLINE IN FOREIGN REAL INCOME

(Deviation from baseline, in percent)



model, but owing to the relatively large price elasticity that is assumed for the rest-of-the-world's demand for home-country exports, the deterioration in export performance is still larger in the extended model, whether measured in volume or in value terms.

Table 7. Long-Run Effects of a 5 Percent Fall in Income in the Rest of the World

(Cumulative change from baseline, in percent)

Model	Import Volume	Export Volume	Export Unit Value	Export Value
Standard	0	-3.9	-7.1	-11.3
Extended	-14.5	-9.7	-4.4	-14.5

2. A rise in import prices

As indicated in Section II, another contributor to the developing countries' external adjustment problems in the early 1980s was the generally adverse movement in their terms of trade. Since one component of the terms of trade--export unit values--is endogenous to our model, the aggregate trade balance effects of the preceding simulation of a fall in income abroad were the combined result of a decline in developing country export and import volume as well as an external-demand induced deterioration of the home country's terms of trade. But terms of trade effects may also occur because of a rise in import prices (MUV) relative to domestic prices (CPID), and it is interesting to determine how such a change affects both the terms of trade for domestic exportables (XUV/MUV) and the balance of payments in the standard and extended models. Thus, our second experiment simulates the effect of an autonomous 10 percent increase in the dollar price of imports, holding all other exogenous variables constant. The rise in import prices in this experiment is a permanent one, so that it should be viewed as the consequence of some (unspecified) shift of tastes in industrial countries away from developing country exports. 1/

1/ A rise in dollar import prices caused, say, by inflation in the rest of the world--a purely nominal change--would not be expected to result in a deterioration in the terms of trade of developing countries in the long run.

Again the results of the experiment are presented graphically in Chart 2, with a summary of the cumulative effects in Table 8. In the standard model, as the charts indicate, the 10 percent rise in the price of imports relative to that of home goods induces substitution away from imports by domestic residents. As a result, the volume of imports eventually falls by 5 percent of its initial value. In percentage terms, however, the decline in import volume is less than the rise in import prices, so that the value of imports rises. Neither the volume nor the value of exports is affected in the standard model, so under the assumption that domestic prices and real income remain constant the increase in import prices induces a permanent 10 percent deterioration in the terms of trade, a permanent trade deficit, and a continuous drawdown of the home country's stock of international reserves.

Table 8. Long-Run Effects of a 10 Percent Rise in Import Prices

(Cumulative change from baseline, in percent)

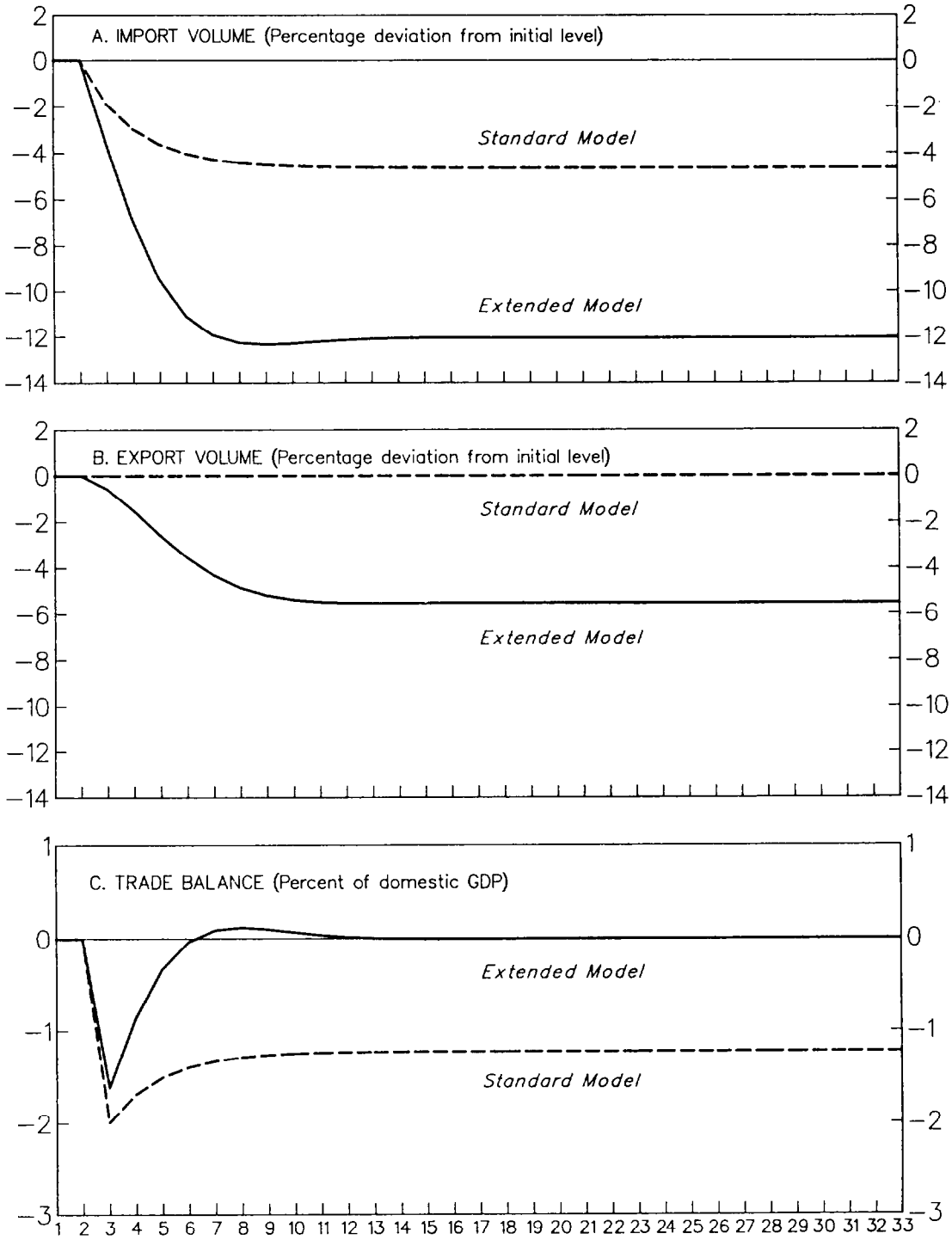
Model	Import Volume	Export Volume	Export Unit Value	Export Value
Standard	-4.6	0	0	0
Extended	-12.1	-5.5	2.4	-3.3

For the first few periods after the import price shock, the simulated path of the trade balance in the extended model is similar to that of the standard one (bottom panel of Chart 2). But the long-run effects are quite different and, we believe, more reasonable. As in the previous case, the volume of imports rapidly declines after the exogenous shock to prices in the rest of the world, but as imports fall in the financing-constrained environment, exports also fall. As the level of official reserves declines, the authorities' desire to rebuild them compresses imports still further, exerting an additional negative effect on export supply. Table 8 shows that as a result of these two mechanisms import volume falls much more in the extended model than in the standard model, by over 12 percent in the long run, as against about 5 percent. However, the dollar value of imports, which rises on impact after the import price shock, eventually declines over the longer run, relative to its baseline level. The conclusion of the extended model that the value of imports gradually settles to a level some 3.3 percent lower than it was prior to the external price shock is in sharp contrast to the result of the standard model, where exports are unaffected. Table 8 shows that export

CHART 2

EFFECTS OF A TEN PERCENT INCREASE IN IMPORT PRICES

(Deviation from baseline, in percent)



volume eventually falls by over 5 percent. Since the home country faces a downward-sloping demand function for its exports, the reduction in export supply raises export prices in our model by about 2 percent in the new steady state, so that the deterioration in the terms of trade is smaller in the extended model than it is in the standard model (7.6 percent as against 10 percent). Thus the weakening of export performance as a result of the import price shock is less when measured in value terms than it is in volume terms. As regards the trade balance and the level of reserves, the effects are much different in the extended model, owing to the feedback that eventually ensures the restoration of the initial ratio of reserves to imports. As in the simpler model, the exogenous rise in import prices initially results in a trade deficit. In the extended model this persists for some time even though import volume and value eventually fall, owing to the induced deterioration in export volume performance. Reserves are used at a steadily declining rate to finance the trade deficit, and the new equilibrium involves a lower value of both exports and imports, and a permanently lower stock of international reserves.

To summarize, the above two simulations of the effects of adverse shocks in the external environment suggest several conclusions. In the extended model, any exogenous change that causes an overall balance of payments deficit will thereafter compress the level of imports relative to what it would otherwise have been. This import compression will also reduce gross exports, creating a negative feedback effect that weakens the trade account and the overall balance of payments still further. In certain cases, the negative effect of import compression on export performance will be partly offset by a rise in export prices, but since foreign export demand appears to be relatively elastic, on average, the offset will be less than one-for-one. Thus the adverse effects of import compression feed on themselves, even if the authorities maintain control over aggregate domestic demand and the real exchange rate. By failing to take account of these feedbacks, the standard model tends to suggest that the process of balance of payments adjustment is less burdensome to developing countries than is actually the case in practice.

3. An Exchange Rate Depreciation

One possible response to adverse changes in the external environment is a devaluation of the domestic currency. However, in order to be effective when there has been a permanent deterioration in the equilibrium terms of trade, a devaluation must permanently reduce domestic prices in terms of tradables. Such a change can come about via a combination of two policies--a nominal devaluation and measures to control domestic prices in order to ensure that the real exchange rate remains below its initial level.

The final simulation experiment that we consider is a 10 percent real devaluation of the home currency. This is a very stylized experiment, since we are implicitly assuming some (unspecified) combination of

exchange rate devaluation and supporting policies that prevent domestic factor and product prices from rising back to their initial level in terms of foreign currency.

This real devaluation induces substitution away from imports and increases the profitability of the export sector (see Chart 3). In the standard model, which neglects the fact that a rise in gross exports will require an increased flow of imported inputs, we get (dashed lines) a rise in the volume of exports, a decrease in the volume of imports (through the substitution effect) and--despite some decline in export unit values--a permanent balance of trade surplus.

In the extended model (solid lines in Chart 3), the profitability and substitution effects also lead initially to an improvement in the trade balance. In contrast to the standard model, however, there is a rise of about half a percent in the developing country's demand for imports at constant GDP for each one percent rise in gross exports. Furthermore, the improvement in the trade balance leads to an overall balance of payments surplus that raises the level of international reserves, inducing an increase in the rate at which import volume responds to any excess demand for imports. Thus in the extended model the level of imports rises as exports rise, and the trade surplus is gradually reduced until it is back to its initial level once more. The contrast between the conclusions of the two models is strikingly apparent in Table 9. Whereas the standard model leads to the conclusion that a devaluation will yield, at constant GDP, a permanent fall in import volume and a permanent merchandise trade surplus, the extended model suggests that the rise in the volume of gross exports of 4.5 percent will eventually be associated with a 2.6 percent rise in the volume of imports, leading to a balanced merchandise trade account in the long run.

Table 9. Long-Run Effects of a 10 Percent Real Devaluation

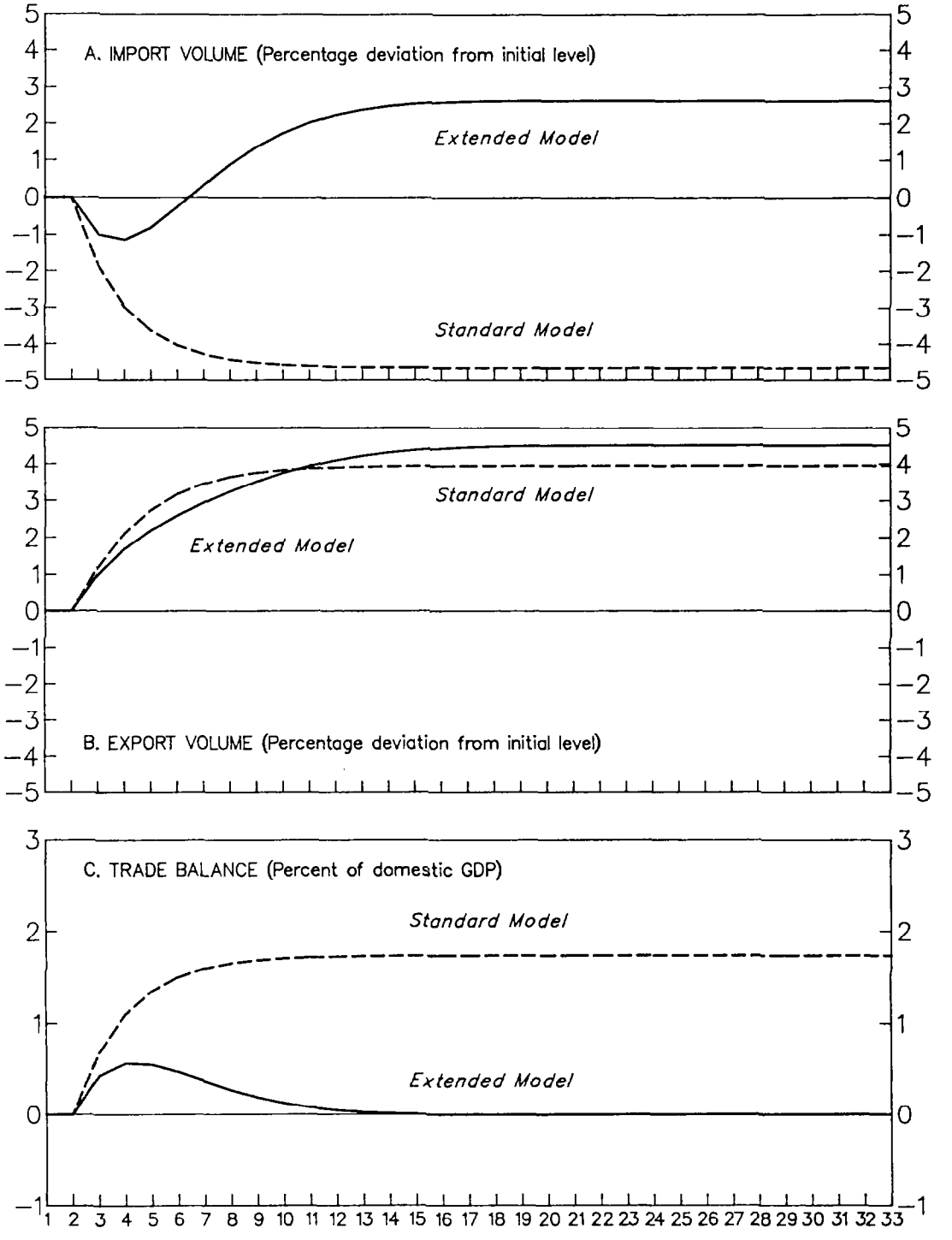
(Cumulative change from baseline, in percent)

Model	Import Volume	Export Volume	Export Unit Value	Export Value
Standard	-4.6	3.9	-1.6	2.3
Extended	2.6	4.5	-1.9	2.6

CHART 3

EFFECTS OF A TEN PERCENT DEVALUATION

(Deviation from baseline, in percent)



VI. Conclusions

Given that a large-scale spontaneous resurgence in external financing flows through the private credit markets is an unlikely prospect in the near term, the highly-indebted developing countries must either continue to adjust their current account balances or actively seek further external financing from concerted lending and official sources. Both the countries in question and the international community are discovering that the costs of adjustment via reduction in imports are significantly larger than had been anticipated. This recognition has led both to uncertainties about whether the indebted countries can maintain their adjustment efforts and to plans, such as the Baker initiative, to provide larger net foreign transfers and reschedulings of foreign debt.

Our research in this paper suggests one possible reason why adjustment has proved to be so onerous for developing countries. This is because a policy of generating trade surpluses to meet debt obligations through import compression has a direct adverse impact on export performance. The standard trade model, on which presumably many earlier projections were based, tends to treat the levels of imports and exports as effectively independent of each other. Adjustment in the context of such a model, therefore, involves policies to promote exports and reduce imports, without taking into consideration the fact that in developing countries the two variables are intimately linked. In these countries imports are themselves a critical input into the production of exports, and import compression will naturally have an adverse impact on export performance. Other things equal, the slower growth of exports will in turn reduce foreign exchange availability and lead to a greater need for import compression to achieve the desired, or required, trade balance and current account surpluses. In other words, a "vicious cycle" of falling imports and exports can be set in motion.

This paper developed a model that takes account of the direct effects of imported inputs on exports and of the availability of foreign exchange reserves on the level of imports. The model was estimated for a sample of 34 developing countries and then subjected to several exogenous environmental and policy shocks. The results of these experiments tend to confirm the basic hypotheses advanced in the paper. Broadly speaking, an exogenous shock that gives rise to a 10 percent reduction in the volume of imports would, other things equal, lower the volume of exports in our model by about 2 percentage points in the short run, and by over 5 percentage points in the longer run. The fall in exports would in turn reduce the volume of imports further. Obviously, these effects are large enough to warrant serious concern about the policy of import compression.

It might be possible to offset these direct feedbacks by taking measures to increase the proportion of inputs, relative to final goods imports, in the constrained level of total imports, but such a policy has significant costs in terms of its adverse effects on the level and

pattern of domestic consumption in countries where living standards are already low. In addition, weak export performance will itself tend to reduce the growth of GDP, and may induce a decline in capital formation. Taking these additional feedbacks into account would lead inevitably to the conclusion that a protracted period of current account adjustment via import compression would be more burdensome than even our extended model suggests.

What policies can, therefore, be recommended to transform the potential "vicious cycle" into a "virtuous cycle" with both exports and imports expanding, and a large enough merchandise trade surplus to meet debt-servicing obligations? Obviously, increasing the transfer of resources to the developing world, which is a cornerstone of the Baker plan, is one such policy. Access to additional foreign financing would reduce the degree of import compression, and this would help exports, another important feature of the Baker plan. But assisting exports from the supply side alone is not enough, and any policies in this direction have to be supplemented by measures designed to stimulate the demand for developing countries' exports, particularly to the industrial world; rising protectionist pressures against the exports of developing countries will obviously undo an export promotion strategy. To achieve the goal of external adjustment in developing countries--characterized by a sustainable current account position as well as a low rate of inflation, a rate of growth of income that allows for a steady improvement in living standards, and a manageable level of foreign debt--requires imaginative solutions on the part of the international economic community that go beyond simple import compression.

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