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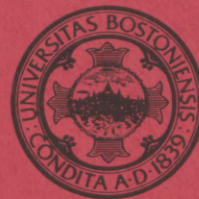
SHORT RUN RESPONSES TO FOREIGN EXCHANGE CRISIS

by
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Prepared for the Fifth World Congress of the Econometric Society
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ABSTRACT

A CGE model incorporating some 'stylized' facts observed in Latin American economies is used to examine alternative responses to a shortfall in the availability of foreign exchange. Some key features are the modelling of supply with excess capacity, the presence of QR's on exports and imports and the inclusion of quota derived rents as a source of income. Additionally, the economy is assumed small only on the import side. Hence, export prices are endogenous. The phenomenon of 'water in the tariff' is allowed for, such that the law of one price need not hold. Moreover, the real wage is assumed to have a variable degree of downward rigidity.

Four policy responses to a crisis are analyzed: (i) import controls, (ii) devaluation, (iii) cuts in government expenditure and (iv) export subsidization. A benchmark equilibrium is constructed for a semi-industrialized LDC. Numerical simulations show that policies (i) and (iv), by themselves, cannot adjust the economy to the crisis. A number of policy packages are considered. The main finding is that while none can avoid a fall in real GNP, the size of the fall as well as the behavior of the real wage, price level, income distribution and employment is very much affected by the type of adjustment policies followed.

Short Run Responses to Foreign Exchange Crisis

I. Introduction*

The so-called Latin American "debt-crisis" of the early 1980's triggered partly by the world recession of 1982 and the changes in world interest rates and partly by the macro policies of individual countries has once again made the issue of foreign exchange availability central to the macroeconomic behavior of many countries. In fact, most Latin American economies have recently reduced their rate of growth and modified their macro-economic policy in order to accomodate a much reduced flow of foreign exchange (IDB(1983)).

The responses of each country to the shortfall in foreign exchange have been varied, however, making use of a large number of instruments to bring about the necessary adjustments. Among these, changes in the nominal exchange rate, import controls, export subsidization and reduction in government expenditures have played a prominent role in recent Latin-American experience (Diaz-Alejandro (1984)). The use of any one of these instruments (or combinations thereof) implies different adjustment mechanisms for the economy and raises the interesting issue of whether and under what circumstances a particular combination of instruments

is "better" than others. Is currency devaluation a more effective way to face a shortfall of foreign exchange vis-a-vis reductions in government spending? Are export subsidies and/or import prohibitions less costly than reductions in the level of activity?

An exact response to these questions would require the use of a welfare function to allow us to rank the various alternatives. Given that the specification of such functions is controversial we prefer to simply calculate the effects of the various policies on the main macroeconomic indicators focusing on the behavior of the level of output, employment, the real wage and the factorial distribution of income.

The policy alternatives facing an economy, nevertheless, are constrained by the economic scenario holding at the time of the shock, as well as by the reaction functions of the main economic agents. Clearly, the effects of currency devaluation will be quite different depending on whether the nominal wage rate is exogenously specified or depends on the level of prices. On a similar vein, the success of export promotion (via export subsidies and/or changes in the exchange rate) will depend on the elasticities of demand for exports. Or, lastly, the impact of import restrictions will depend on whether the economy imported a large volume of competitive imports or whether in fact only non-competitive goods (for production and/or investment) constituted the import bill. This, in turn, might be related to

the degree of capacity utilization at the time of the shock.

The purpose of this paper is to construct a framework in which the issues just mentioned can be systematically investigated. This will consist of a computable general equilibrium (CGE) model appropiately modified to fit the short run conditions ruling in a typical Latin-American economy, together with a series of numerical simulations which will permit us to obtain quantitative estimates of the effects of various policies under alternative scenarios.

A CGE model seems to be the appropiate tool to use to study these issues. It allows us to incorporate a distinction between tradeable and non-tradeable goods as well as a distinction between exportables and importables which, for the problem at hand, seems to be of the essence. At the same time, a CGE model captures both changes in supply (like reductions in competitive imports, variations in prices of imported inputs or changes in capacity utilization) and demand (like changes in the level of exports or in the composition of consumption) brought about by any of the adjustment policies that are implemented. In this way the reactions of prices, quantities and income levels are made consistent with the behavior of the government and the rest of the world. Furthermore, by analyzing various policies with the same model it is possible to compare them directly, eliminating apparent differences that are generated when each policy is studied with its own specific framework.

The adjustment to foreign exchange shocks in a general equilibrium framework has previously been studied by de Melo and Robinson (1982) and Dervis, de Melo and Robinson (1983). Our framework, however, is different from theirs as it explicitly incorporates variations in capacity utilization and the behavior of government expenditures as important elements of any adjustment package together with changes in the level of prices that, under certain conditions, generate "forced savings" for some agents.[1] At the same time, the effects of quantitative restrictions on exports and imports on prices and income levels are also considered. On the other hand, however, our model is not as rich in terms of the number of different groups (or classes) of income recipients that are analyzed, and pays little attention to substitution possibilities among inputs in the production process.

Following current practice, we leave monetary considerations out of the model. While recently there has been some progress in incorporating monetary variables into CGE models (Taylor (1984)) we prefer to ignore them and to center our attention in carefully tracing out the effects of a foreign exchange crisis on the "real" economy. The extenct to which expectations, credit, currency substitution and other considerations affect the conclusions derived from a "pure" model will be the subject of further research.

The paper is organized as follows. Section II develops

the structure of the model. Section III introduces the equations governing the balance of trade and defines a "foreign exchange crisis". It then discusses how various policies that can be used to solve the crisis can be introduced into the model. Finally, it defines the economic scenario for a crisis in terms of the behavior of the real wage, the degree of capacity utilization and the price elasticities of demand for exports. Section IV briefly describes the data and the original calibration of the model. The results of various simulations are presented in section V, while section VI collects the main results of the paper and draws some policy implications.

II. The Model

II.1 Basic Assumptions

The notion of a semi-small economy -one that faces infinitely elastic supply curves for imports but negatively sloped demand curves for exports- has become standard in CGE models of trade (cf. Dervis et. al. (1983), Harris (1984)). While the assumption of downward sloping demand curves for exports is appealing, its strict application implies that whenever the economy expands the terms of trade must necessarily deteriorate and, furthermore, that there will always be positive exports of any tradeable good regardless of the relationship between domestic and world prices.

For the case of some Latin American economies, however, it

appears that for a positive -but finite- range the country can indeed increase exports at constant prices. Thus, whether the economy is small or not on the export side will vary from sector to sector and, at the same time, will depend on the volume of exports. Put differently, we assume export demand functions to be horizontal for a finite range and then to slope downwards as the volume of exports increases beyond that range. This formulation, furthermore, will not imply that every tradeable sector will always have positive level of exports.

Both exports and imports are assumed to be affected not only by tariffs and subsidies but also by quantitative restrictions (QR's).[2] The nominal exchange rate is assumed fixed.

As our focus is the short run, we ignore problems of choice of technique. We assume that capital goods installed in each sector are non-shiftable. As a result, the short run response to exogenous changes is mainly through variations in the rates of capacity utilization.[3] As output and capacity utilization levels can expand pari passu, however, there is no presumption that the marginal product of labor is decreasing. Once the assumption of full capacity utilization is dropped it appears to be more reasonable to take the labor/output ratios as constant. This in turn implies that domestic production occurs at constant costs, such that the short-run supply functions are horizontal up to the point of full capacity output.

The model includes three types of agents: workers, capitalists and the government. Workers receive income from a given nominal wage rate times the level of employment. The nominal wage rate is assumed to be inflexible downwards, although it might be tied to increases in the level of prices. A fixed proportion of workers income is taxed, and the rest spent on a basket of commodities whose composition depends on relative prices. For capitalists the story about consumption and taxes is the same. Thus private savings, and hence private investment, is not modelled.

Capitalists' income can be either derived from profits on current production -via a mark-up over wage and intermediate costs- or from rents associated with the export and import quotas whenever these are binding. Mark-up rates are assumed to have lower bounds below which production in the respective sectors would not occur. When the economy is operating below full capacity these minimum mark-up rates, which are taken to be exogenous, will also determine prices. This approach, while not fully satisfactory, is nevertheless introduced here to solve a difficulty associated with the existence of unutilized capacity. In particular, when production occurs at constant costs it is not possible to determine prices via the interaction of supply and demand. Under the stated conditions demand determines quantities produced and supply the equilibrium price which, however, should include some minimum payment to capital.[4] The minimum bounds

on mark-up rates are just a convenient way to formulate this phenomenon.[5]

On the other hand, if any good is imported the domestic price will equal the world price (plus tariff) for the respective sector and mark-up rates will then be determined as a residual. When demand exceeds capacity output for non-tradeable goods, however, we assume that mark-up rates -and hence prices- increase to clear markets. The same will be true, of course, for any sector with a binding import quota.

Finally, the government collects revenue from direct taxes on wages, profits and rents plus indirect taxes on exports, imports and value added. Government expenditures, on the other hand, are taken to be exogenous -subject to a constraint to be mentioned below- and consist of purchases of goods (including some non-competitive imports) and direct hiring of labor.

It should be pointed out that the inclusion of the government in a CGE model is particurlarly important in a Latin American context. This derives not only from its ability to set tariffs, subsidies and other tax rates but -perhaps more importantly- from the fact that government expenditures are an important component of final demand and thus play a central role in determining the level of output and employment. Furthermore, one must recognize that government purchases might not be price sensitive as would be the case of consumption and/or exports. Thus, expenditure switching policies have a smaller component of

demand on which to work and as a result the shifts in relative prices required to reduce consumption of importables or increase demand for non-tradeables might be larger than would otherwise be the case. Of course, the government might alter the size and composition of its expenditures but the point is that this will result from a policy decision and will not follow automatically from changes in relative prices or total tax collections.[6]

II.2 Demand and Supply

The balance equations for this economy can be written as:

(1) $q^{SF} + q^{SD} = Aq^{SD} + c_w + c_\pi + d + g,$ where:[7]

$q^{SF}(n,1)=$ vector of foreign supplies of domestically
    produced commodities, i.e., competitive imports

$q^{SD}(n,1)=$ vector of domestic supply

$A(n,n)=$ matrix of technical input/output coefficients

$c_w(n,1)=$ vector of workers consumption

$c_\pi(n,1)=$ vector of capitalists consumption

$d(n,1)=$ vector of exports

$g(n,1)=$ vector of government expenditures

It will be assumed that final demand is made up of two qualitatively different components. On the one hand consumption and exports, which depend on prices and the level of output. On

the other hand government expenditures, whose size and composition are exogenously given.

Consumers are assumed to maximize a Stone-Geary utility function leading to the Linear Expenditure System for each group such that:

$$(2) \quad c_w = \underline{c}_w + [(1-t_w)Y_w - p \cdot \underline{c}_w] \hat{p}^{-1} \eta_w$$

$$(3) \quad c_\pi = \underline{c}_\pi + [(1-t_\pi)Y_\pi - p \cdot \underline{c}] \hat{p}^{-1} \eta_\pi \qquad \text{where:}$$

$\underline{c}_w, \underline{c}_\pi$ (n,1) = vectors of minimum consumption level for each group

Y_w, Y_π (1,1) = income levels of each group

t_w, t_π (1,1) = tax rates on income for each group

η_w, η_π (n,1) = vectors of marginal expenditure shares[8]

$$(\Sigma \eta_{iw} = 1 ; \quad \Sigma \eta_{i\pi} = 1)$$

$p(1,n)$ = vector of prices

$\wedge$ = an operator to turn a vector into a diagonal matrix

While the tax rates and expenditure shares can be taken as exogenous, the same is not true of income levels. For workers income is equal to the wage bill, which follows directly from the level of employment. For capitalists, on the other hand, income is obtained from profits on production together with any rents associated with the QR's on exports and imports. We thus write:

$$(4) \quad Y_w = w[lq^{SD} + g_1]$$

$$(5) \quad Y_\pi = (wl + ep^{nc}V + pA)\hat{\gamma}q^{SD} + R \, , \qquad \text{where:}$$

$w(1,1)$ = nominal wage rate

$l(1,n)$ = vector of labor/output coefficients

$g_1(1,1)$ = workers directly hired by the government

$e(1,1)$ = nominal exchange rate (domestic/foreign currency)

$p^{nc}(m,1)$ = vector of world prices for non-competitive intermediate imports expressed in foreign currency

$V(m,n)$ = matrix of non-competitive import coefficients

$\gamma(1,n)$ = vector of profit mark-up rates

$R(1,1)$ = rents on exports and imports

The behavior of exports can best be illustrated by means of graph 1. Here p_i^c is the exogenously given world price of good i, in foreign currency, while $\tilde{p}_i$ is the foreign currency price of the goods produced by the country. For $\tilde{p}_i > p_i^c$ the economy is not able to compete in world markets, with exports being equal to zero. For $\tilde{p}_i = p_i^c$, on the other hand, the economy is able to export any amount up to ρ_i. This is the range in which the economy is "small" on the export side and hence faces fixed terms of trade. If the country wishes to export more than ρ_i, however, it will have to reduce the foreign currency price of its exports below p_i^c, moving along

Graph 1
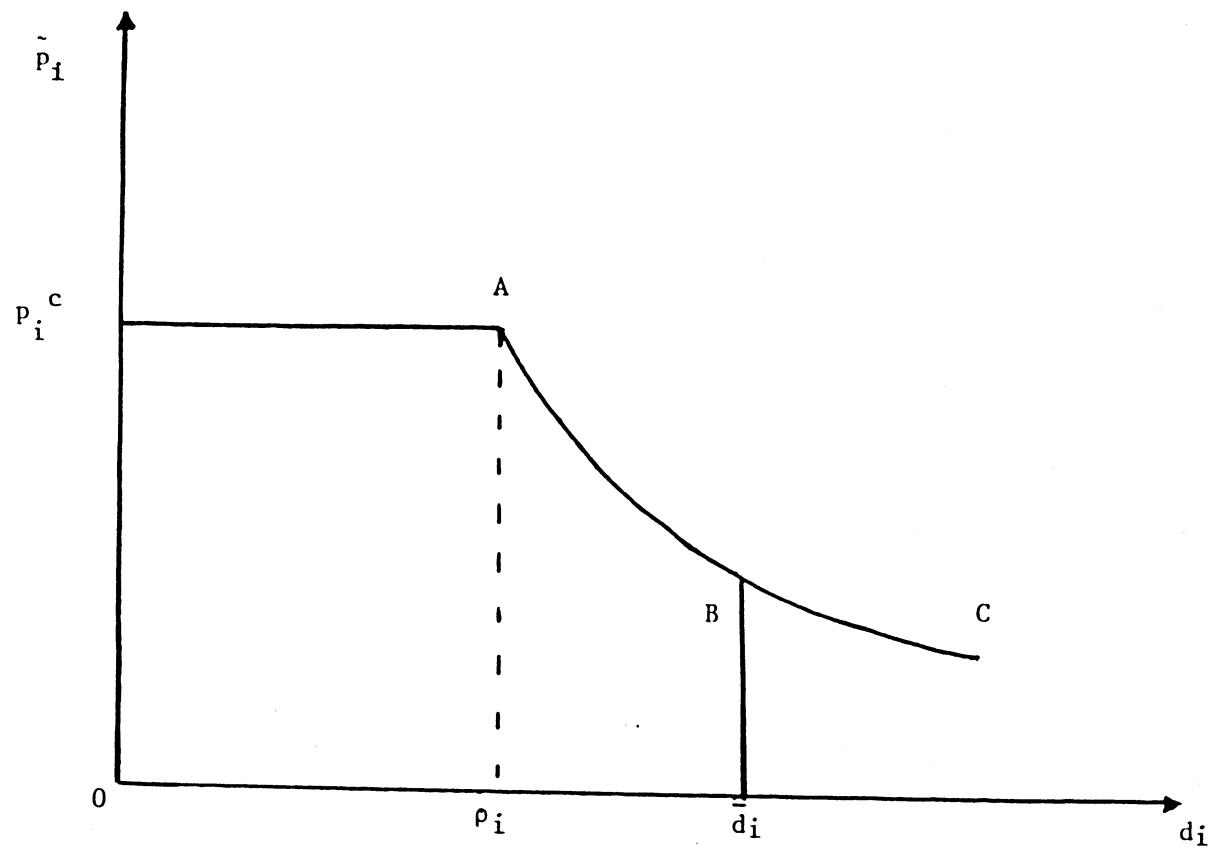
the segment AC. For simplicity we assume that along this range the export demand function has a constant elasticity given by $\beta_i \in [0, \infty)$. Of course, exports might be bounded from above by an export quota, $\bar{d}_i$, in which case the export demand function becomes vertical at point B.[9] Thus, we write the export functions as:

$$(6) \quad d_i = \begin{Bmatrix} \min[\rho_i (p_i{}^c / \tilde{p}_i)^{\beta_i}, \ \bar{d}_i] \\ \\ 0 \end{Bmatrix} \text{ as } \tilde{p}_i \begin{Bmatrix} \leq \\ \\ > \end{Bmatrix} p_i{}^c$$

The foreign currency prices of goods produced by the economy is simply given by:

$$(7) \quad \tilde{p}_i = p_i (1 + \tau_i)/e$$

where τ_i is the ad valorem export subsidy ($\tau_i < 0$) or tax ($\tau_i > 0$). As government expenditures are taken to be exogenous, we can calculate total demand as:

$$(8) \quad q^D = Aq^{SD} + c_w + c_\pi + d + g$$

We turn now to the R.H.S. of (1). The problem here is to determine endogenously the ordering of supplies, as the fact that domestic production occurs at constant costs together with the

assumption that the economy is small on the import side imply that foreign and domestic supply curves will be horizontal. This ordering will depend, quite clearly, on the relationship between domestic production costs and the prices at which imports can be obtained.

It is useful to calculate the minimum price, $\underline{p}_i$, below which domestic production will not occur:[10]

$$\underline{p}_i = (\underline{p}_i a_{ii} + p\underline{A}_i + ep^{nc}V_i + wl_i)(1 + \gamma_i) +$$
$$(wl_i + (wl_i + \underline{p}_i a_{ii} + p\underline{A}_i + ep^{nc}V_i)\gamma_i)\alpha_i \quad \text{or}$$

$$(9) \quad \underline{p}_i = [(p\underline{A}_i + ep^{nc}V_i)(1 + \gamma_i + \gamma_i\alpha_i) + wl_i(1 +$$
$$\gamma_i + \alpha_i + \gamma_i\alpha_i)]/[1 - a_{ii}(1 + \gamma_i + \gamma_i\alpha_i)]$$

where $\underline{A}_i$, V_i is the ith column of matrix $\underline{A}$, V; γ_i is the exogenously given minimum mark-up rate in sector i and α_i the value added tax rate.[11] Of course, the minimum price below which no imports will be forthcoming is given by $ep^c_i(1+t_i)$, where t_i is the ad valorem tariff rate. Thus, min $[\underline{p}_i, ep^c_i(1+t_i)]$ will constitute the floor price below which no supplies will be forthcoming, neither from domestic nor foreign suppliers.

When min $[\underline{p}_i, ep^c_i(1+t_i)] = \underline{p}_i$, domestic producers will be able to undercut foreign suppliers and will thus be the first source of supply. As long as the ruling price,

p_i, equals $\underline{p}_i$ any level of production is profitable and the actual quantity produced will be determined by demand conditions subject, however, to the maximum output that can be produced given the capital stock installed in that sector. For $p_i \,\varepsilon\, (\underline{p}_i,\ ep^c_i(1+t_i))$ profits for domestic producers are above the minimum bound so that producers will be induced to produce at full capacity output. If the ruling price is equal to $ep^c_i(1+t_i)$, on the other hand, foreign supplies will be forthcoming. Since at that price domestic producers are already at full capacity the actual quantity imported will equal the excess demand over domestic output subject, however, to any QR that apply to imports in the relevant sector. Of course, for any price that exceeds $ep^c_i(1+t_i)$ both domestic producers and importers will be willing to supply as much as their respective bounds allow them. If we denote by $\bar{q}^{SD}_i$ the maximum output producible at full capacity and by $\bar{q}^{SF}_i$ the maximum imports allowed given the import quota we can summarize the behavior of supplies for the case when $\min[\underline{p}_i,\ ep^c_i(1+t_i)] = \underline{p}_i$:

$$(10)\ \text{If } p_i \begin{cases} < \underline{p}_i & \rightarrow\ q_i^{SD} = 0\ ;\ q_i^{SF} = 0 \\[4pt] = \underline{p}_i & \rightarrow\ q_i^{SD} = \min(q_i^D,\ \bar{q}_i^{SD})\ ;\ q_i^{SF} = 0 \\[4pt] \varepsilon\ (\underline{p}_i,\ ep_i^c(1+t_i)) & \rightarrow\ q_i^{SD} = \bar{q}_i^{SD}\ ;\ q_i^{SF} = 0 \\[4pt] = ep_i^c(1+t_i) & \rightarrow\ q_i^{SD} = \bar{q}_i^{SD}\ ;\ q_i^{SF} = \min \\[4pt] & \qquad [\max[(q_i^D - \bar{q}_i^{SD}),\ 0],\ \bar{q}_i^{SF}] \\[4pt] > ep_i^c(1+t_i) & \rightarrow\ q_i^{SD} = \bar{q}_i^{SD}\ ;\ q_i^{SF} = \bar{q}_i^{SF} \end{cases}$$

This behavior can be depicted in graph 2, where the supply curve is the step-shaped curve $\underline{p}ABCD$. When demand is q^D_o, equilibrium is at point E with the ruling price equal to $\underline{p}$ -the shutdown price- and unused capacity equal to the distance EA. When demand equals q^D_1 output is at full capacity and price settles at $p^1 \in (\underline{p}, ep^C(1+t))$. Clearly at p^1 the relevant mark-up rate in the sector has increased beyond γ producing, in fact, the price increase from $\underline{p}$ to p^1. For larger values of demand, however, price cannot increase further as now imports are forthcoming. Thus when $q^D = q^D_2$ competitive imports equal to $(q_2 - q^{SD})$ appear with the ruling price being $ep^C(1+t)$. At this point mark-up rates are determined as a residual and, in particular, will be equal to:

$$(11) \quad \overline{\gamma}_i = [ep_i^C(1 + t_i)(1 - a_{ii}) - p\underline{A}_i - ep^{nc}v_i - wl_i(1 + \alpha_i)]/\{[ep_i^C(1 + t_i)a_{ii} + p\underline{A}_i + ep^{nc}v_i + wl_i] (1 + \alpha_i)\}$$

As long as the QR on imports is not binding, $\overline{\gamma}_i$ is an upper bound on the mark-up rate in the given sector. For greater values of demand, however, the import quota will be binding and it will be possible for mark-up rates to increase beyond $\overline{\gamma}_i$. Thus, when $q^D = q^D_3$ price settles at $p^3 > ep^C(1+t)$ the price at which total quantity demanded is equal to total supply $\overline{q}^{SD} + \overline{q}^{SF}$.

A second possibility arises, of course, when $\min[\underline{p}_i,$

Graph 2
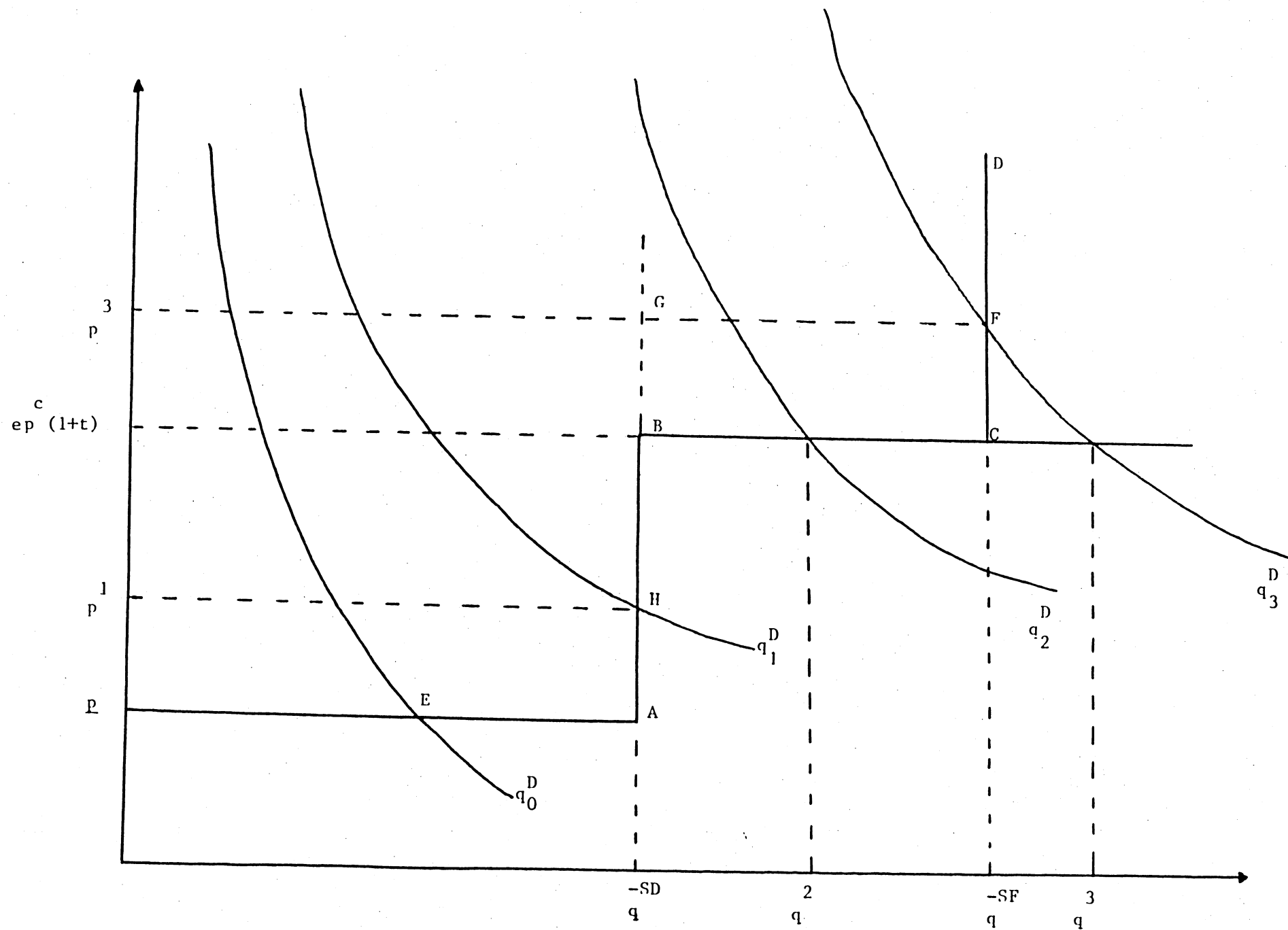
$ep^C_i(1+t_i)] = ep^C_i(1+t_i).$[12] In this case, foreign suppliers will undercut domestic producers and will be the first source of supply. As long as $q^D_i < \bar{q}^{SF}_i$ the ruling price will be $ep^C_i(1+t_i)$ and no domestic production will occur. If, however, the quantity demanded exceeds the QR on imports price will increase to clear the market and when $p_i = \underline{p}_i$ domestic production will be forthcoming. As long as domestic producers operate below full capacity, competition will insure that $\underline{p}_i$ is the ruling price and γ_i the mark-up rate. If, of course, demand exceeds $\bar{q}_i^{SF} + \bar{q}^{SD}_i$ price and mark-up rates will have to increase beyond $\underline{p}_i$, γ_i, respectively, until the quantity demanded is brought into equality with the total quantity supplied. Thus, we can summarize the behavior of supply when $\min[\underline{p}_i, epi^C(1+t_i)] = ep_i^C(1+t_i)$ by:

$$
(12) \quad \text{if } p_i
\begin{cases}
< ep_i^C(1+t_i) & \rightarrow \quad q_i^{SF} = 0 \ ; \ q_i^{SD} = 0 \\[6pt]
= ep_i^C(1+t_i) & \rightarrow \quad q_i^{SF} = \min(q_i^D, \bar{q}_i^{SF}) \ ; \ q_i^{SD} = 0 \\[6pt]
\varepsilon \ (ep_i^C(1+t_i), \underline{p}_i) & \rightarrow \quad q_i^{SF} = \bar{q}_i^{SF} \ ; \ q_i^{SD} = 0 \\[6pt]
= \underline{p}_i & \rightarrow \quad q_i^{SF} = \bar{q}_i^{SF} \ ; \ q_i^{SD} = \min \\
& \qquad\quad [\max[(q_i^D - \bar{q}_i^{SF}), \ 0], \ \bar{q}_i^{SD}] \\[6pt]
> \underline{p}_i & \rightarrow \quad q_i^{SF} = \bar{q}_i^{SF} \ ; \ q_i^{SD} = \bar{q}_i^{SD}
\end{cases}
$$

Once again, (12) will generate a supply curve similar to the one depicted in graph 2 except, of course, that now

$ep_i^C(1+t_i)$ will be the lower bound on price and competitive imports will be the first segment of the step-shaped function.

It is important to note that the ruling price will equal $ep^C_i(1+t_i)$ only when $q^{SF}_i \in (0, \bar{q}^{SF}_i)$, that is to say, when imports are forthcoming but are not subject to a binding import quota. When, however, sourcing is first from domestic producers - eq. (10) - the ruling price can be below $ep^C_i(1+t_i)$ generating the so-called case of 'water in the tariff'. Conversely, the ruling price will exceed $ep^C_i(1+t_i)$ only when the QR on imports has become binding. Thus, it will be true that whenever $q^{SF}_i > 0 \rightarrow p_i \geqslant ep^C_i(1+t_i)$. This behavior of price will then have important implications for the determination of exports. In particular, equations (6) and (7) imply that when $q^{SF}_i > 0 \rightarrow d_i = 0$ such that exportables and importables will form two mutually exclusive sets.[13]

From the preceding analysis we can note that as long as tariffs protect domestic producers (i.e. $ep^C_i(1+t_i) > p_i$) supplies are determined by (10) such that competitive imports are excess demands over domestic capacity output (as in Schydlowsky (1978) or Bourguignon, et. al. (1983)). On the other hand, if tariffs fail to protect producers and no quotas are in place ($\bar{q}^{SF}_i = \infty$, see below) then competitive imports will be the sole source of supply and domestic production will shut down. When, however, tariffs do not protect but the import quota is binding ($q^D_i > \bar{q}^{SF}_i$) domestic production will occur as

now the quota allows a domesic price equal or greater than the shut-down price, $\underline{p}_i$. In this case one will be able to observe competitive imports at the same time that the sector operates below full capacity output.[14] Thus, the proposition that competitive imports are excess demands over capacity output will only hold in models where no QR on imports exist. But even in these cases, one must insure that $\underline{p}_i$ is indeed below (or equal to) $ep^c_i(1+t_i)$. This, nevertheless, cannot be guaranteed a priori as the shut-down price is not exogenously given but depends, as (9) indicates, on the vector of prices ruling in the economy as a whole.

Lastly, it is useful to write, for future reference, the vector of total supply as $q^S = q^{SD} + q^{SF}$ and obtain:

$$(13) \quad x(p) = q^D(p) - q^S(p)$$

as the vector of excess demands.

II.3 Traded and Non-Traded Goods

The endogenization of exports and competitive imports developed above presents some difficulties if certain goods cannot be either exported or imported due to their physical characteristics. Fortunately, our approach can easily handle these situations through the appropiate manipulation of the vectors of quantitative restrictions. We will now adopt the

convention that for any good j that cannot be traded $\bar{q}^{SF}_j = \bar{d}_j = 0$. Conversely, any good i that can be traded without any quantity restrictions will be one for which $\bar{q}^{SF}_i = \bar{d}_i = \infty$. The case of import and export quotas will be those for which $\bar{q}^{SF}_i, \bar{d}_i \in (0, \infty)$.

Thus, the set of all goods, N, is partitioned into two mutually exclusive and exhaustive subsets: Set I of tradeable goods ($\bar{q}^{SF}_i, \bar{d}_i > 0$) and set J of non-tradeable goods ($\bar{q}^{SF}_j = \bar{d}_j = 0$). Clearly, these two sets are exogenously specified. In fact, however, out of all goods in set I only a subset -depending on prices and demand conditions- will actually be traded (either q^{SF}_i or $d_i > 0$). Let us define, therefore, set R as the set of endogenously determined traded goods. Clearly $R \subseteq I$. As N is the set of all goods, $H = N \backslash R$ will be the set of endogenously determined non-traded goods.

The imposition of trading restrictions, particularly on the import side, along with the existence of non-tradeable goods will have important implications for the mechanism by which excess demands are eliminated. Quite clearly, for non-tradeables excess demands must be eliminated by increases in mark-up rates that will, in turn, increase price and decrease quantity demanded. For tradeable goods that have no import quotas, excess demands are cleared through the trade balance. Thus, the relative profitability of tradeable vs. non-tradeable production will change when there are exogenous changes in demand. As the

stock of capital is fixed in each sector, however, this seems an admisible and even likely short-run event.

Import and export quotas, nevertheless, can alter these results. Thus, consider q^D_3 in graph 2. In the absence of the import quota price would have settled at $ep^C(1+t)$ with a larger volume of imports $[=(q^3 - \overline{q}^{SD})>\overline{q}^{SF}]$. With the QR, however, price settles at p^3 generating a higher mark-up rate in the relevant sector. In consequence, a binding import quota will imply that the sector behaves like a non-tradeable, with excess demands being cleared through price adjustments.

The case of an export quota can be analyzed by means of graph 3, where we have assumed that $\min[\underline{p}, ep^C(1+t)] = \underline{p}$. The export demand function begins at $ep^C/(1+\tau)$ - where $\tilde{p} = p^C$ - and slopes downwards as of point D. In the absence of the export quota total demand is given by q^D_2 and price settles at p^2. With an export quota set at $\overline{d}$, however, the export demand curve becomes vertical at A and hence the market demand curve has a kink at point I and is now equal to q^D_1, with equilibrium at point E and price settling at $\underline{p}$. Thus export quotas, as opposed to import quotas, generate a lower price and mark-up rate, whenever they are binding.

One further effect of export and import quotas must be noted. It concerns the fact that when quotas are binding income not associated with production will flow to quota holders. In particular, these flows of income -which are properly called

Graph 3
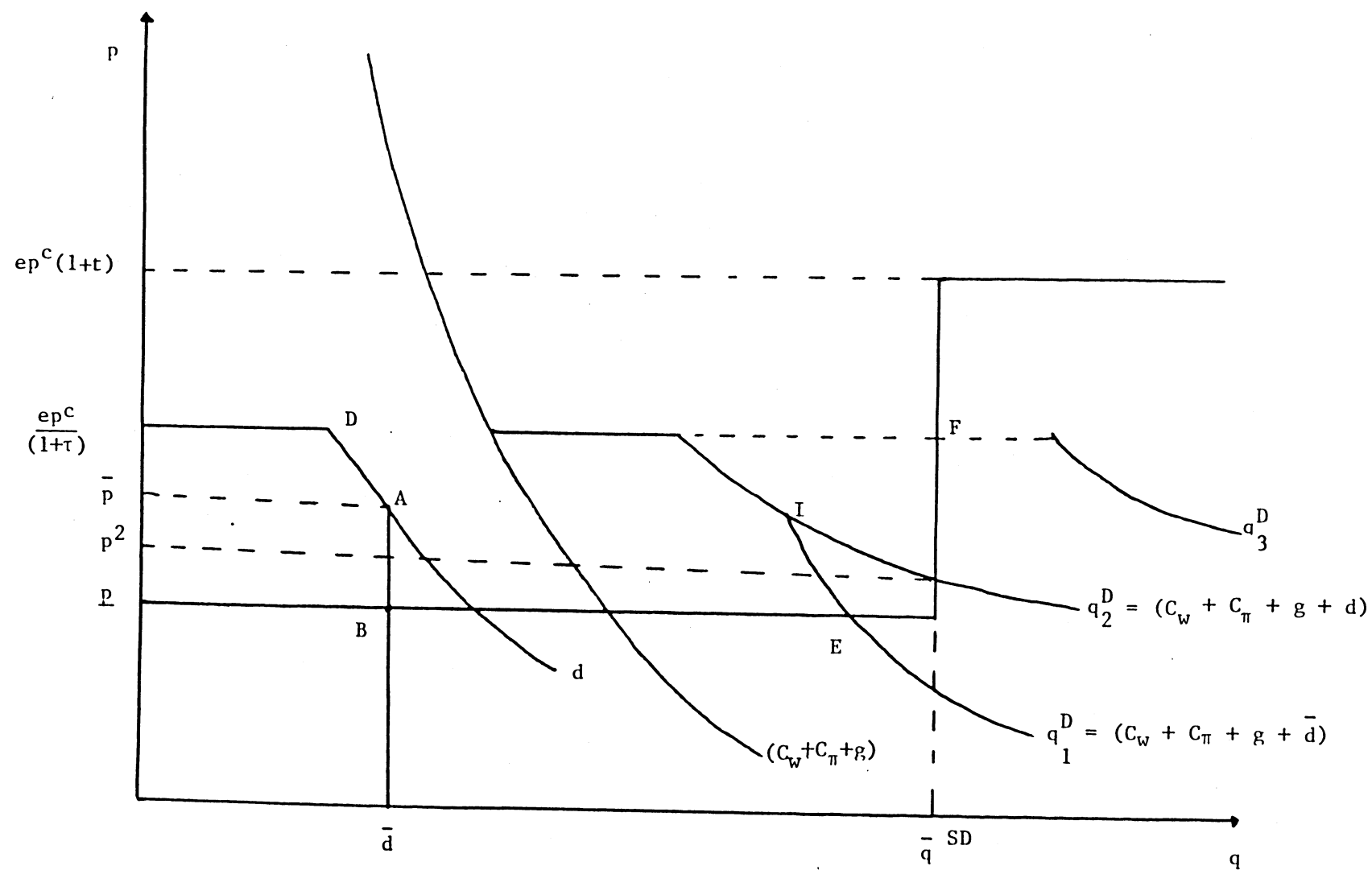
rents- will accrue to capitalists in the respective sectors, assumed here to be the sole holders of the quotas. It follows that import quotas, when binding, affect income distribution not only by raising the relevant mark-up rates and thus profits on current production but, additionally, by the rents derived from the ability to sell some imports at a price that exceeds the world price.

Export quotas will also affect income distribution first by lowering price and thus mark-up rates on current production and, second, by the ability to sell a restricted quantity in the world market at a price that exceeds the domestic price. Since the domestic currency price received by exporters (denoted by $\bar{p}_i$) is not given exogenously, however, we must move along the export demand function once export quantities are known to calculate this price. We thus have:[16]

$$
(14) \qquad \bar{p}_i = \begin{cases} \dfrac{ep^c}{(1+\tau)} \\[2em] \dfrac{ep^c}{(1+\tau)}\left(\dfrac{d_i}{\rho_i}\right)^{-1/\beta_i} \\[2em] 0 \end{cases} \quad \text{as} \quad d_i \quad \begin{cases} \leq \rho_i \\[2em] > \rho_i \\[2em] = 0 \end{cases}
$$

Given the domestic currency prices paid by importers and received by exporters we can calculate total income from rents

as:

(15) $R = [p - ep^C(I+t)] q^{SF} + (\bar{p}-p)d$

where the first term in the R.H.S. of (15) is equal to the area BCFG in graph 2 while the second term is area pAB$\underline{p}$ in graph 3. The value of R can then be substituted in (5) to give total income accruing to capitalists.

II. 4 Feasibility

So far, very few restrictions have been placed on the parameters of the model. Nevertheless, the existence of non-tradeable goods and import quotas together with the fixed capital stock in each sector do impose certain limitations on output levels. In particular, even if there was no consumption of non-tradeables or goods subject to import quotas, it is still necessary to satisfy the demand for these products derived from the exogenous component of final demand, i.e., the vector of government expenditures. Let us, therefore, explicitly write total demand as a function of vector g, $q^D(g)$. Clearly, there exists a vector $\bar{g}$ such that $q^D_n(\bar{g}) = \bar{q}^{SD}_n + \bar{q}^{SF}_n$ for at least one n $\mathcal{E}$ N. It follows that there exists no price adjustment in the economy that could satisfy a vector of government expenditures that is greater than $\bar{g}$. We must therefore define the set:

(16) $\quad G = \{ g \mid 0 \lesssim g < \bar{g} \}$

which is the set of vectors of government expenditures that will allow feasible solutions for this economy. In what follows it will be assumed that any vector g exogenously chosen belongs to set G.[17]

Before concluding this section it is useful to note that government expenditures, aside from constituting purchases of goods (vector g) and direct hiring or labor (g_1) will also comprise purchases of non-competitive imports. These can be thought of as imported capital goods associated with the investment component of government expenditures and will be denoted by the vector $g_v(m,1)$ whose composition is taken as given. Thus, the expenditure side of the government is described by the triplet (g, g_1, g_v). While this captures the different impact that government purchases have on the various markets, it complicates the analyzes if our focus is only the real "size" of government expenditures. This could be defined as the value ($p.g + ep^{nc}g_v + wg_1$). However, this is not satisfactory as prices themselves will react to changes in (g, g_v, g_1), thus requiring to divide the changes into a "real" and a "price" component. As an alternative we will multiply all government purchases by the scalar $\lambda > 0$, which can be taken as an index of the real size of government expenditures. Thus, the composition of government expenditures

will now be taken as fixed.[18]

III. Modelling of Adjustment Policies

III.1 Equilibrium and Macroeconomic Aggregates

For given values of installed capacity in each sector ($\bar{q}^{SD}$), world prices (p^C, p^{nc}), tax rates (t_{π}, t_w, α) and trade policy ($\tau, t, \bar{d}, \bar{q}^{SF}$) the values of three key parameters -the nominal exchange rate, the nominal wage rate and the size of government expenditures- will be crucial in determining the short run behavior of the economy. Let us denote by w^o, e^o, and λ^o the initial values of these parameters. Given these, an equilibrium will be defined as the set of price and output vectors such that:

(17) $\quad x(p^o) = 0$

Inspection of the equations presented above shows that no analytical solution can be obtained, as only positive values are allowed for some vectors and certain minimum conditions must be satisfied. Therefore, an algorithm was designed to solve the model.[19]

Condition (17) describes a short run equilibrium in the goods market only without guaranteeing, in particular, balanced trade, equal profit rates in all sectors, or full utilization of capacity. At this equilibrium we can measure the following

macroeconomic aggregates:

$$P^O = p^O f$$

$$\omega^O = w^O/P^O$$

(18) $$\varepsilon^O = e^O/P^O$$

$$N^O = 1q^{SD^O} + \lambda^O g$$

$$Y^O = Y_w + Y_\pi + e^O p^C \hat{t} q^{SF} + [w^O 1 + (w^O 1 + pA + e^O p^{nc} V)\hat{\gamma}] \hat{\alpha} q^{SD}$$

where P^O is an index of the price level (with f being a fixed (column) vector of weights used in the construction of a price index), ω^O and ε^O measure the real wage and exchange rate, N^O the level of employment and Y^O the associated level of income.

At the same time, the fiscal balance of the government can be obtained substracting from government spending the revenue obtained from indirect taxes on exports, imports and value added, as well as direct taxes on wages, profits and rents, such that:

(19) $$F^O = \lambda^O[p^O g + e^O p^{nc} g_v + w^O g_1] - \{[e^O p^C \hat{t} q^{SF^O} - p^O \hat{\tau} d^O +$$
$$[w1 + (w1 + pA + ep^{nc}V)\hat{\gamma}]\hat{\alpha} q^{SD} + t_w Y^O_w + t_\pi Y^O_\pi\}$$

On the other hand, the balance of trade (in foreign currency) will be given by:

(20) $$B^O = p^C q^{SF^O} + p^{nc}(Vq^{SD^O} + \lambda^O g_v) - p^C_e \cdot d$$

where p^c_{ei} is the foreign currency price of exports net of subsidies.

Since no private savings or investment has been considered, macroeconomic accounting will imply that $F^o = e^o B^o$

It is clear that if the values of the nominal wage and exchange rate and the size of government expenditure are set independent of each other, it will be most unlikely that the equilibrium solution be associated with balanced trade. In what follows we shall assume that $B^o(e^o, w^o, \lambda^o) > 0$. As long as the rest of the world is willing to transfer to this economy B^o units of foreign exchange the values of w^o, e^o and λ^o will all be consistent with each other.[20] Put differently, with B^o as the accomodating variable it will be possible to satisfy the actions taken by the different agents in the economy.

III.2 A Foreign Exchange Crisis

We shall assume now that the flow of foreign exchange that the economy was receiving from the rest of the world is suddenly reduced.[21] Let $B^1 < B^o$ denote the new level of foreign resources to which the economy must adjust. As a result, the values of (e^o, w^o, λ^o) will no longer be consistent with each other and a foreign exchange "crisis" will have set on. The key question at this point is which individual parameter(and/or combinations thereof) will adjust such that at the new

equilibrium (denoted by the superscript 1) the values of exports and imports are indeed consistent with B^1, the new flow of foreign exchange available to the economy.

If we assume that in the short run technology, world prices and installed capacity can be taken as given then only a combination of exchange rate, wage and trade policy together with fiscal actions can adjust to the "crisis". Of this set of variables, however, one can question the extent to which the nominal wage rate can be taken as a policy variable. It seems to be more fruitful to assume that the post-crisis nominal wage rate, w^1, is linked by some indexing mechanism to variations in the price level triggered by any other changes that occur in the economy. If we measure the changes in the price level by $\delta = (P^1 - P^0)/P^0$ then we can write

(21) $\quad w^1 = \max[w^0, w^0(1+\Omega\delta)] \; ; \; \Omega \, \varepsilon \, [0, 1]$

where Ω is the indexing factor. Thus, when $\Omega = 0$ the nominal wage rate will be completely insensitive to changes in the economic environment, while $\Omega = 1$ will imply that the real wage does not fall from the level ruling in the initial equilibrium. Note that (21) imposes downward inflexibility of the nominal wage rate a condition which, in our view, reflects reasonable rigidities of the labor market.

For given values of Ω, the nominal wage rate ruling in the

new equilibrium will be endogenous, as a result of which only e, and λ together with trade and tax policy will be the adjustment variables that can be exogenously chosen. Of course, the effectiveness of various adjustment mechanisms will be a function of Ω.

III. 3 Import Controls

Import controls are a possible response to the foreign exchange crisis, without modifying either the nominal exchange rate or the size of government expenditures. In analyzing import controls it is crucial to specify the rules by which they are applied. We will consider a 'stylized scenario', which seems to be typical of many Latin American economies, where quantitative restrictions on competitive imports together with foreign exchange rationing for non-competitive imports play the central role. Furthermore, we will assume that import controls are applied sequentially, first limiting competitive imports and only at a later stage , when competitive imports have been shut-out, applying to non-competitive imports.

A second assumption that will be made is that of proportional rationing, i.e., that the reduction in import quotas for competitive imports and foreign exchange for non-competitive imports applies in the same proportion to all sectors. Of course other rules for import controls could be considered and would matter for the final equilibrium. Nevertheless, we believe that

the cases analyzed here will illustrate the main channels by which import controls affect the short run equilibrium of the economy.

It is useful now to introduce the scalars Φ_c and Φ_{nc} which measure the proportions by which import quotas for competitive imports and foreign exchange allocations for non-competitive imports, respectively, must be reduced so as to accomodate the lower levels of foreign exchange inflows. If we denote by E and M the total value (in foreign currency) of exports and imports, respectively, then we will be looking for the values of Φ_c and Φ_{nc} such that:

(22) $E^1(\Phi_c^1, \Phi_{nc}^1, e^0, \lambda^0) + B^1 = M^1(\Phi_c^1, \Phi_{nc}^1, e^0, \lambda^0);$
$\Phi_c, \Phi_{nc} \in [0,1]$

where, of course, $\Phi_c^0 = \Phi_{nc}^0 = 1$, and following our rationing rules, $\Phi_{nc}^1 < 1$ if, and only if, $\Phi_c^1 = 0$.

Consider first the effects of controls on competitive imports. At the initial equilibrium these are given by q^{SF^0}. A straight forward method for cutting competitive imports would be to set the vector of imports quotas to $\bar{q}^{SF} = \Phi_c q^{SF^0}$ for some value of Φ_c less than unity. Clearly, for any sector i where $q_i^{SF^0} > 0$ a binding quota will be introduced. Graph 4 considers the impact of this on various markets. In panel (a) a market for an importable with an initial equilibrium satisfying $\min[p_i^0, ep_i^c(1+t_i)]$ =

Graph 4

Panel (a)

p

p^1

$p^o = ep^c(1+t)$

p^o

J G H

C D E F

A B

q^D

q^D

q^{SD} $\Phi_c q^{SF^o}$ q^{SF^o} q

Panel (b)

p

J D

$\underline{p}^1$ H F I

$\underline{p}^o$ E C

B

$ep^c(1+t)$ G A

q^D

$\Phi_c \bar{q}^{SF^o}$ $\bar{q}^{SF^o}$ $\bar{q}^{SD}$ q

Panel (c)

$ep^c/(1+\tau)$

$\underline{p}^1$ B

$\underline{p}^o$ A

d

d^1 d_o $\bar{q}^{SD}$ q
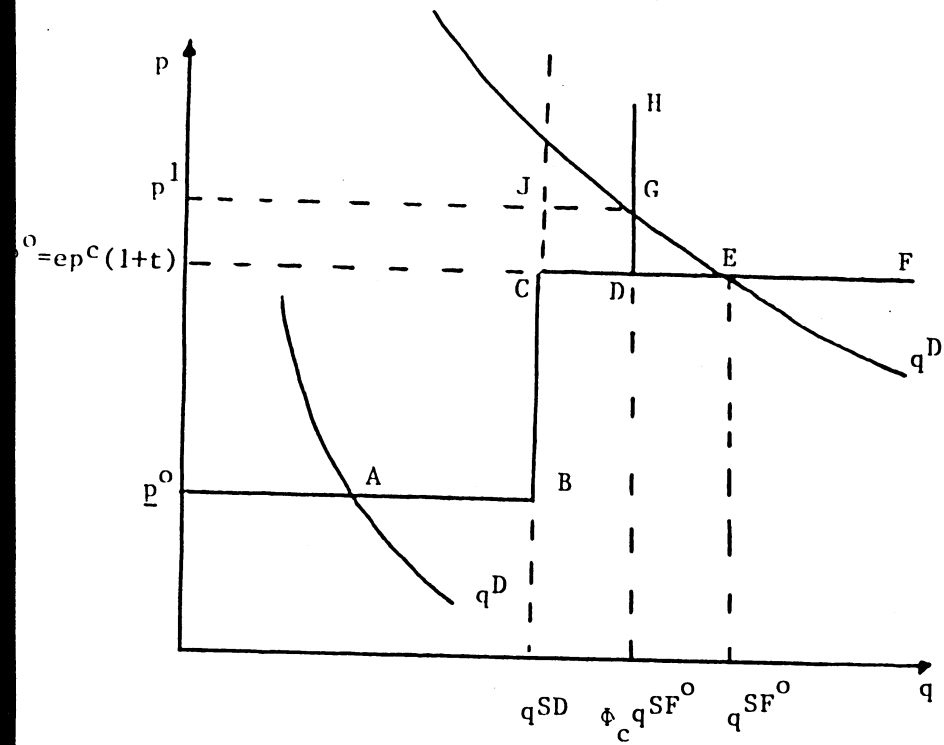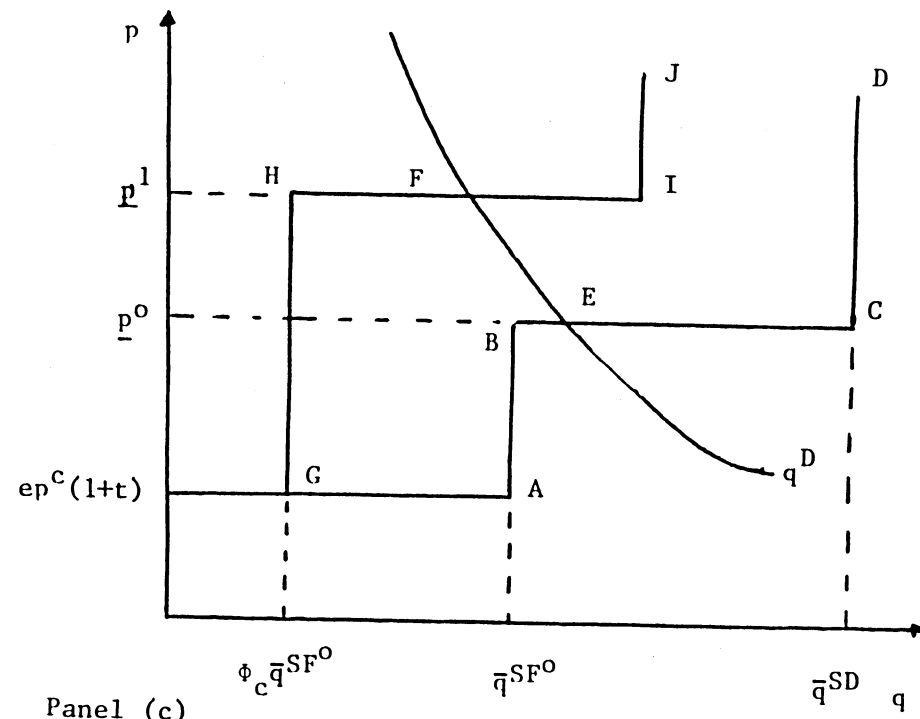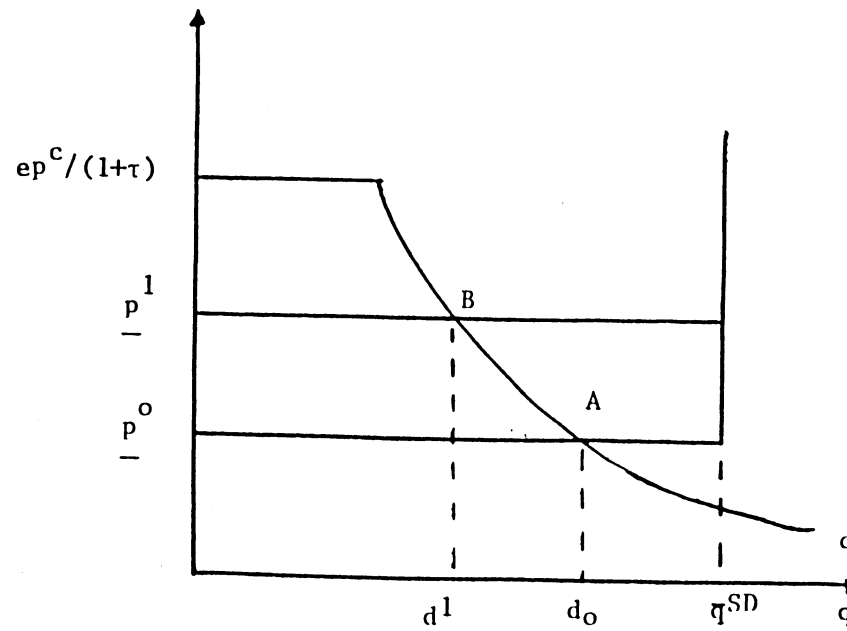
$\underline{p}_i^{\,O}$ is depicted, with the supply curve being given by $\underline{p}^O BCF$. If the initial demand curve, $q_1^{\,D}$, was such that the equilibrium was found at E the ruling price would be $ep_i^{\,C}(1+t_i)$ with competitive imports equal to q^{SFO}. With an import quota equal to $\Phi_c q^{SFo}$ the effective supply becomes $\underline{p}^O BCDH$, with equilibrium at G and domestic price at $p_i^{\,1} > ep_i^{\,C}(1+t_i)$. Thus, the import reduction has a direct counterpart in a price increase. This price increase, in turn, will have immediate repercussions on costs of production in other sectors of the economy.

Of course, if the initial equilibrium had been at point A (with excess capacity AB) there would have been no direct effect either on imports or prices. Thus, it would appear that the foreign exchange savings from import controls on competitive imports are negatively correlated to the degrees of excess capacity at the time of the crisis.

A second possibility in markets for importables arises if $\min [\underline{p}_i^{\,O}, ep_i^{\,C}(1+t_i)] = ep_i^{\,C}(1+t_i)$. In this case, depicted in panel (b), the initial supply curve is given by $ep_i^{\,C}(1 + t_i)$ ABCD with equilibrium at E, domestic price at $\underline{p}^O$ and domestic output equal to the distance BE. Considering the quota reduction together with price changes in other sectors (such as panel (a)) that will have increased costs of production, the new supply curve is given by $ep_i^{\,C}(1+t_i)$GHIJ with equilibrium at F and price at $\underline{p}^1 > \underline{p}^O$. Interestingly, in this case the quota

reduction is accompanied by an increase in domestic output (from BE to HF) and we obtain the result of an import cut together with an increase in the sector's output, price and employment.

Since import restrictions increase prices in some sectors (with the effect being magnified the higher is the value of Ω, the wage indexing factor) there will be a spill-over effect into the market for exportables. This is shown in panel (c) with the equilibrium shifting from A to B and exports falling to d_i^1 as a result of cost increases which shift the sector's shut-down price from $\underline{p}_i^0$ to $\underline{p}_i^1$. Whether this reduces total export revenues in foreign currency will depend on the values of β_i, the price elasticities of demand for exports. For any sectors where $\beta_i > 1$, however, export quantities and export revenues will move in the same direction and will thus fall. The magnitude of the endogenously induced fall in export revenues associated with the import quotas will clearly depend on the input structure of exports. If exports are (directly or indirectly) intensive in importables subject to progressively smaller import quotas (as Φ_c approaches zero) the net effect could be a worsening of the balance of trade.

Put differently, in a general equilibrium context one cannot establish that B will be a monotonically increasing function of Φ_c. Graph 5 depicts the relationship between B and Φ_c once the feedback effect of import quotas on exports is

Graph 5
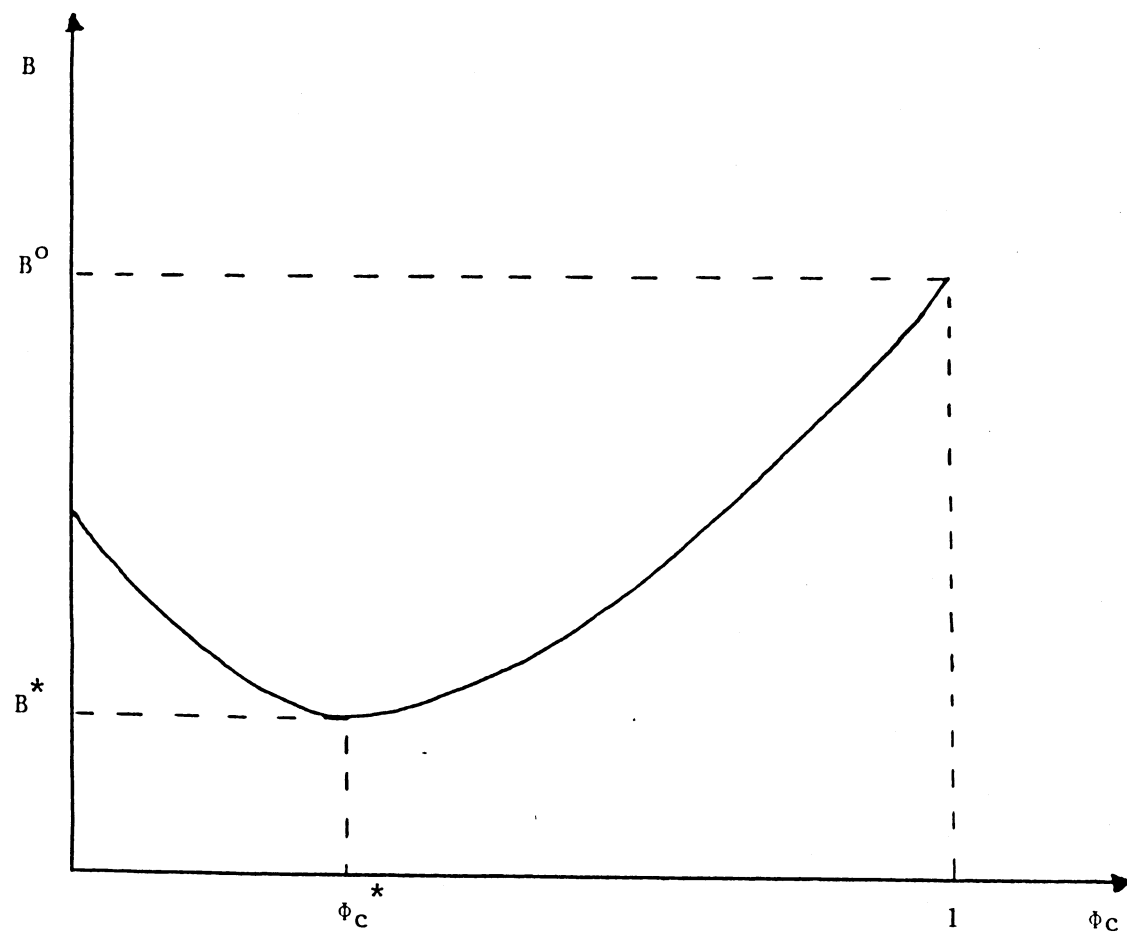
considered. As import quotas are reduced ($\Phi_c \to 0$) the balance of trade improves from its original position at B^o. However, for import quotas smaller than $\Phi_c^* > 0$ the loss of export revenues associated with the price increases dominates the savings from the import cut, with a worsening balance of trade. The important result that follows is that even if our only aim is to improve the trade balance the optimal import quota-- that which minimizes the value of B-- need not be zero.

Real incomes will also change as a result of the import restrictions affecting in turn consumption demand and changing the location of the demand curves in graph 4 (not shown). The direction of change in real income, however, is difficult to determine. Employment stays constant in market (a), increases in (b) and falls in (c). Whether the real wage rate drops or not depends on the value of Ω. For $\Omega = 1$ the change in total labor income will follow the changes in employment and thus will depend on whether sectors that are activated by the import restrictions (panel (b)) dominate those that suffer a drop in output (panel (c)). For $\Omega < 1$, of course, one would require that employment increases more than compensate for the drop in the real wage rate so as to avoid a fall in total real labor income.

Capitalists' income will also be affected. Note in panel (a) the creation of quota rents associated with the import restrictions (equal to area CDGJ). In panel (b), on the other

hand, quota rents change from $ep^c(1+t)AB\underline{p}^o$ to $ep^c(1+t)$ $GH\underline{p}^1$. At the same time, profits on current production increase pari passu with the output increase (from BE to HF). Of course, the opposite holds in the markets for exportables.

Without knowledge of the relevant parameters it appears that the only results that can be established are that controls on competitive imports will have a positive effect on the level of prices with an ambiguous effect on real output. The key question at this point, nevertheless, is whether these controls will be succesful in satisfying (22), i.e., in 'solving' the foreign exchange crisis. If at $\Phi_c = \Phi_c*$ it still holds that $B^* > B^1$ (see graph 5) there will be a need to restrict imports of non-competitive goods, to further improve the balance of trade.

To consider the effects of limiting non-competitive imports it is useful to recall that, aside from the purchases made by the government (vector g_v) these enter as inputs into the production process. As a result they can also limit domestic capacity output. It is necessary, therefore, to write:

$$(23) \quad \overline{q}_j^{SD} = min[K_j/b_j, \; D_j/p^{nc}v_j]$$

where K_j is the capital stock installed in each sector, b_j the respective capital/output ratio and D_j the foreign exchange allocated to the sector. Ignoring inventory

accumulation, the maximum amount of foreign exchange that a sector can absorb for its production process will be given by:

(24) $\overline{D}_j = (p^{nc} V_j) K_j/b_j$

such that if the amount of foreign exchange that a sector can obtain falls short of $\overline{D}_j$ it will not be able to produce at "full capacity output" where this level of output is defined by the capital stock installed in each sector. Foreign exchange rationing for non-competitive imports will limit the economy's ability to fully utilize its capital stock even if effective demand so requires it. Put differently, even in the short run effective maximum output will be an endogenous variable as D_j in (23) will depend on the rules by which foreign exchange is rationed to different sectors.

Consider the mechanisms by which controls on foreign exchange for non-competitive imports affect the economy. Let q^{SD*} (e^o, λ^o, $\Phi_c = 0$, $\Phi_{nc} = 1$) be the level of output that would be observed when competitive imports have been shut-out, but no rationing is imposed on non-competitive imports. At this level of output the desired demand for foreign exchange by each sector would be given by $D_j* = p^{nc}V_j q_j^{SD*}$. As we have assumed that at this output level $(E + B^1) < M$ a rationing scheme for foreign exchange must be introduced, given the decision to keep constant the nominal exchange rate and size of government

expenditures. Following our previous discussion, each sector will be allocated a proportion Φ_{nc} of its desired foreign exchange, with the equilibrium value of Φ_{nc} being the one that satisfies (22).

The effects of such policy adjustments can be illustrated in graphs 6 and 7 which depict, respectively, the market for a non-traded good and an exportable product.[22]   In the upper quadrant of graph 6 the supply curve is given by $\underline{p}*CD$ with the kink at point C determined by the capital stock installed in the sector.   In the lower quadrant we measure foreign exchange requirements for non-competitive intermediate imports, with the slope of the line being given by $p^{nc}v_j$.   With competitive imports shut-out the initial equilibrium is at A with D^* units of foreign exchange used in sector j. With foreign exchange rationed to $\Phi_{nc}D_j*$ the effective supply curve is $\underline{p}_i*EF$ with equilibrium output at q^{SD^1} and price at $p^1 > \underline{p}_i*$.

It is clear that rationing of foreign exchange will reduce output and employment, as well as increase price.   It is important to point out that the price change is brought about by an increase in the sector's mark-up rate because the reduction in effective supply must clear the excess demand at A solely through price changes.   Thus, this price increase is independent of the value of Ω. A positive value for Ω would imply some reaction of nominal wages to the price change and would shift $\underline{p}_i*$ upwards narrowing the gap between p^1 and $\underline{p}_i*$ and thus reducing the actual increase in the sectors mark-up rate from

Graph 6
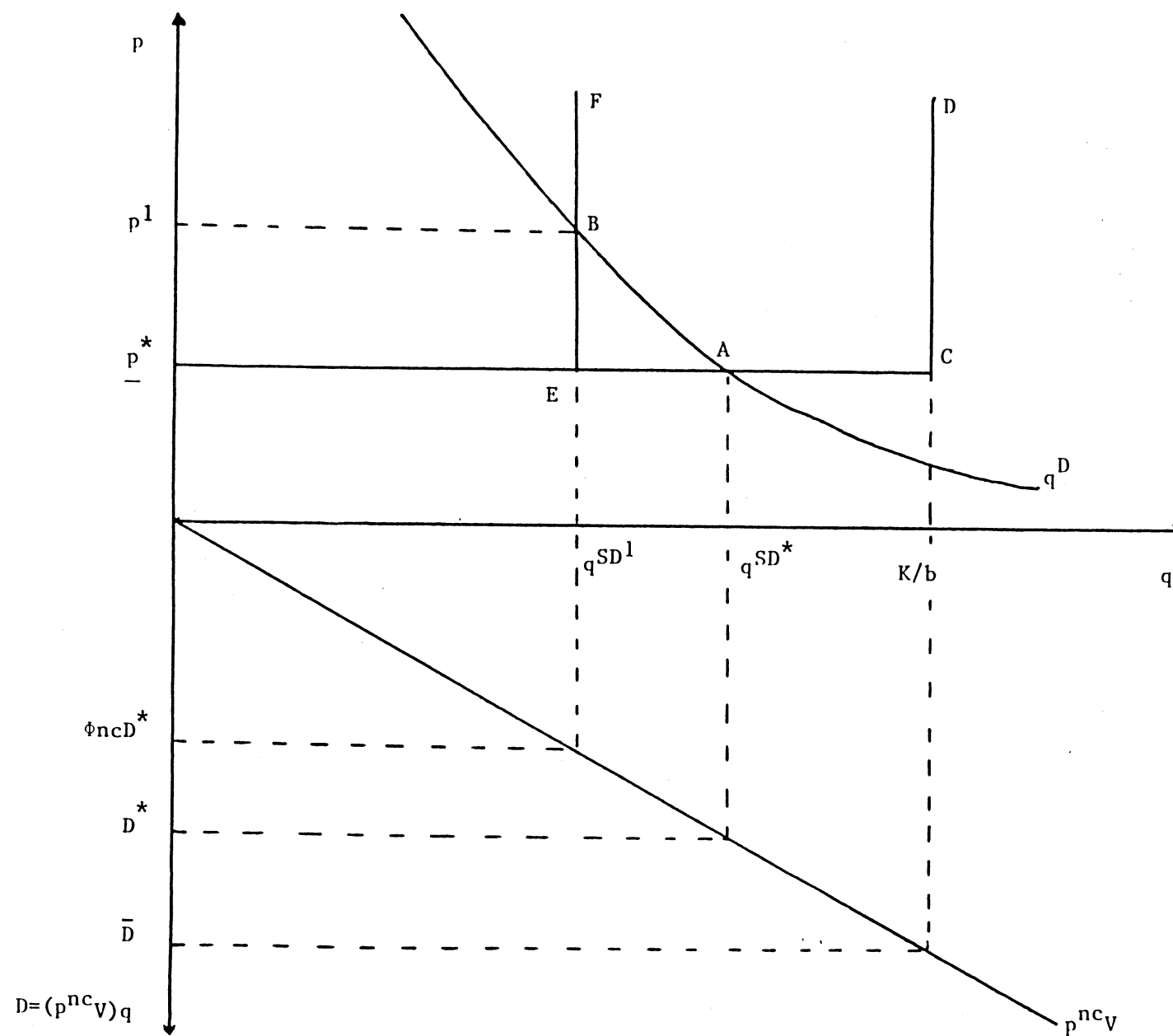
$\underline{\gamma}_i$ at $p_i{}^*$ to $\gamma_i{}^1$ at p^1.   We thus obtain a result which at first sight might appear paradoxical: prices increase even if the nominal wage and exchange rate are constant and there is "excess capacity" in the economy.

As in the case of controls on competitive imports, rationing foreign exchange for intermediate inputs will also have an impact on the behaviour of exports. In this case, however, this effect is brought about not only indirectly by changes in costs of production but also through limits on the effective ability to export.   This is illustrated in graph 7 where in the lower quadrant we have added a function measuring total revenue obtained from exports.[23]   With competitive imports shut-out the initial equilibrium would be at A with exports at d^*, total revenue from exports Od^*HJ and total expenditures in foreign exchange $Od^*GD_j{}^*$.   With foreign exchange rationed to $\Phi_{nc}D_i{}^*$ effective supply is now $p_j{}^*CF$ with equilibrium at B and exports reduced to d^1. In this case the lack of foreign exchange for intermediates will directly limit the ability of the economy to generate exports and, moreover, could actually produce a net loss of foreign exchange (if area $JHGD_j{}^*$ exceeds $\Phi_{nc}D_j{}^*MKL$).

When foreign exchange is rationed for non-competitive imports output and employment fall.   Thus, even if wages are fully indexed ($\Omega = 1$) total wage income in constant prices will fall.   The same is not necessarily true, however, of capitalists

Graph 7

Graph 7
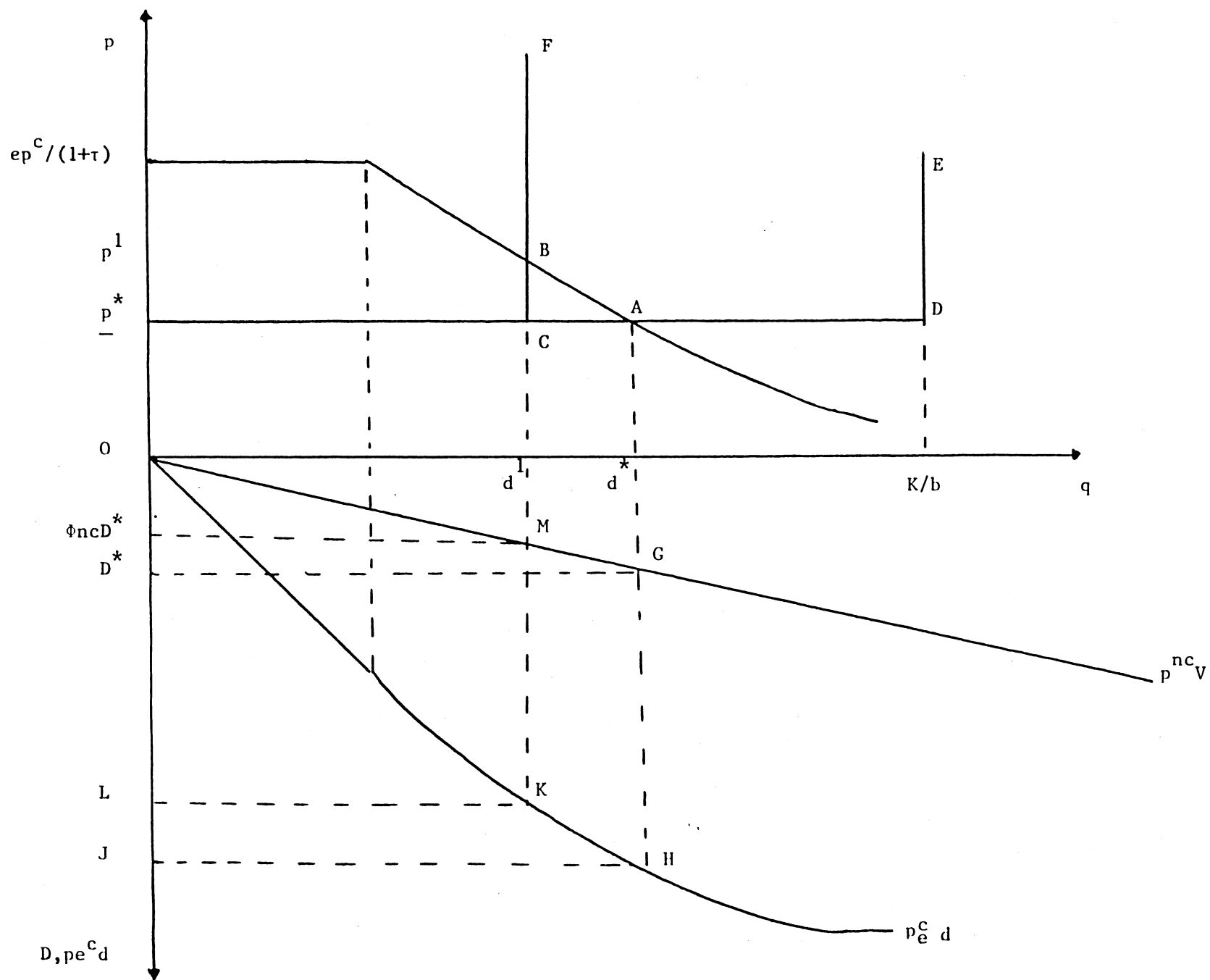
income. While production contracts, mark-up rates increase to clear markets in all sectors where effective supply was determined by the foreign exchange available.

To summarize: the effectiveness of import controls will depend on a number of parameters. Broadly speaking, if at the time of the crisis the economy was operating with little slack controls on competitive imports might be sufficient to cut the import bill and, as long as the indirect effects of price increases on exports are not too significant, accomodate the reduced flow of foreign exchange. This depends not only on the input structure of exports but also on the price elasticities of demand. Interestingly enough, in this scenario high price elasticities for exports play a perverse role and make the adjustment more difficult, since export revenues become quite sensitive to changes in domestic prices.

On the other hand, if the economy was operating with significant excess capacity, or if the drop in foreign exchange availability is "too" large, rationing of foreign exchange for non-competitive imports will become necessary. At this point the adjustment will imply further price increases accompanied, however, by reductions of output, employment and the ability to export. At the same time, the real exchange rate will have fallen together with total wage income. Of course, for a sufficiently low value of B^1 it might not be possible to find an equilibrium satisfying (22). This is particularly so since a

component of final demand (namely, government expenditures) has been assumed not to bear any of the costs of adjustments.[24] In this situation it will be necessary to consider other instruments to face the foreign exchange crisis.

III.4 Devaluation

An alternative response to the foreign exchange crisis is an increase of the nominal exchange rate, without changing the size of government expenditures or the trade regime. Thus, the problem would be to find the value of e such that:

$$(25) \quad E^1(e^1, \lambda^0) + B^1 = M^1(e^1, \lambda^0)$$

where, at the same time, no rationing of non-competitive imports is imposed and quotas on competitive imports stay at their initial level.

Consider the impact of an increase in the nominal exchange rate on the original equilibrium assuming initially that $\Omega = 0$ such that the nominal wage rate does not react to any price changes. Production costs will increase since the price of non-competitive intermediate imports will have increased in domestic currency. Since for all sectors that were operating below full capacity at the time of the devaluation the ruling price was equal to the shut-down price, $\underline{p}_i^0$, the cost increase will immediately be translated into a higher domestic

price. This can be illustrated in graph 8 where the initial supply curve is given by p_i^0ABCD. With demand equal to q_1^D such that there was excess capacity the equilibrium would switch from H to I, with a higher domestic prices at p_i^1 and lower domestic output.

For sectors that are operating at full capacity, however, the initial ruling price would have exceeded p_i^0. In this case the cost increase rather than being translated into higher prices could be absorved by lower mark-up rates. Thus, if the initial demand was q_2^D in graph 8 the equilibrium price would have been p^2, with profit margins above the required minimum equal to the distance AJ. With the devaluation unit costs would increase to p_i^1, but price would remain at p^2 contracting profit margins to the distance EJ. Thus it is not necessarily the case that a devaluation, by increasing the costs of imported intermediates will always increase prices in the respective sector. As one would expect, whether a cost increase is translated into higher prices or profit margin reductions depends crucially on the behavior of demand.

For sectors that were importing at the initial equilibrium, the devaluation will also affect price. Once again, however, it will not be necessarily true that the devaluation will be fully transmitted into higher prices as a good might change from being traded to non-traded, with its consequent impact on price determination. This can be seen in

Graph 8

p

p^5 .... R .... Q

$e^1 p^c (1+t)$ .... N .... G

F

p^3 L

$e^0 p^c (1+t)$ .... K .... M C

B

q_3^D q_4^D

p^2 .... J

$\underline{p^1}$ I E

q_2^D

$\underline{p^0}$ H A

q_5^D

D

q_1^D

$\bar{q}^{SD}$ $\bar{q}^{SF}$ q
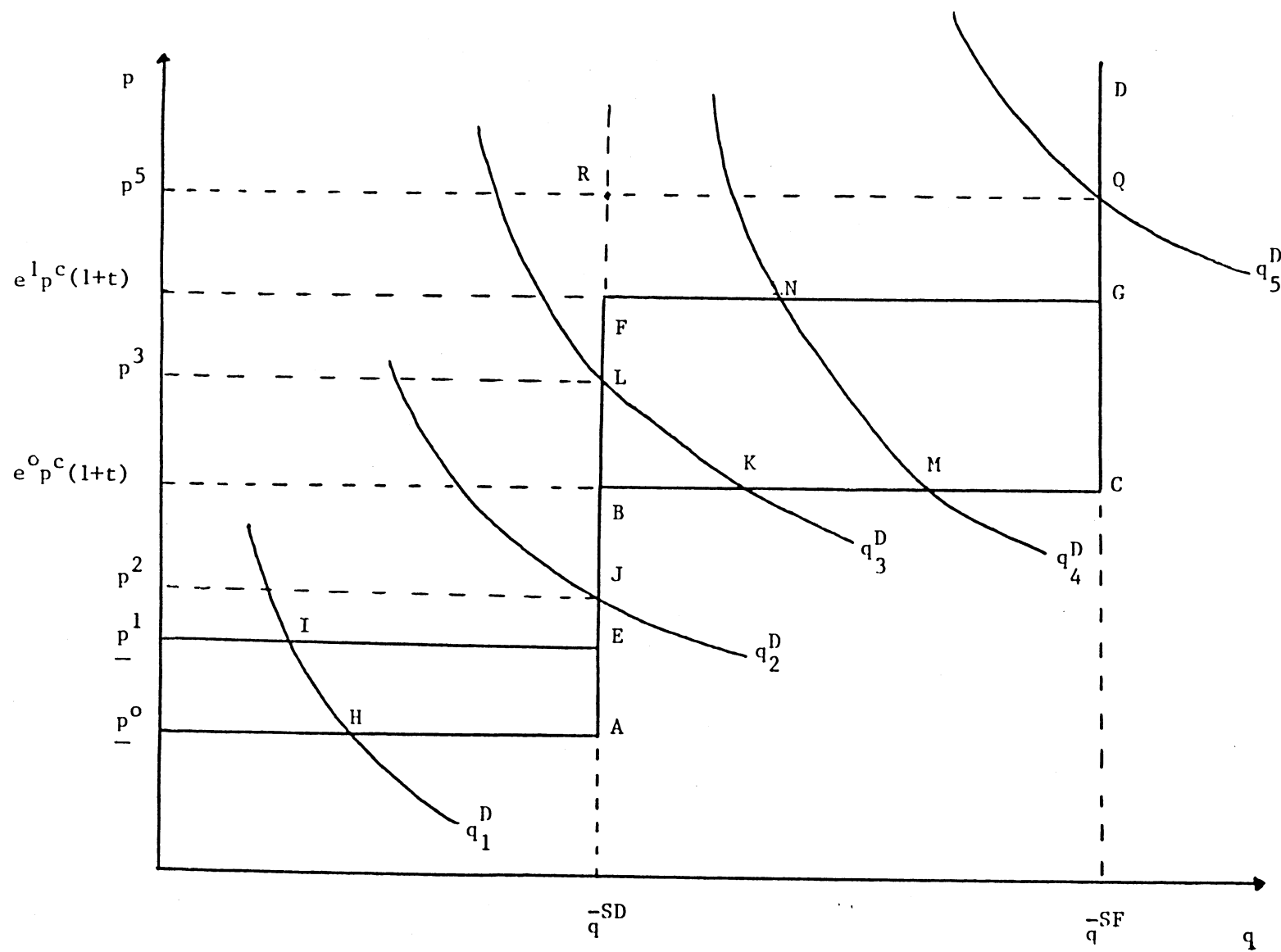
graph 8 where, as pointed out before, the initial supply curve is given by $\underline{p}_i^O ABCD$ while the supply curve after the devaluation is $\underline{p}_i^1 EFGD$.[25] If demand was given by q_3^D the initial equilibrium would have been at K, with domestic price given by the world price (plus tariff). With the devaluation, however, equilibrium is at L with price at p^3. Thus, the devaluation completely reduces imports of good i and effectively turns it into a non-traded good. Of course, if demand was given by q_4^D, good i would still be traded after the devaluation and the equilibrium would shift from M to N with price increasing by the full amount of the devaluation.[26]

In sectors where the original equilibrium satisfied $\min(\underline{p}_i^O, e^O p_i^C(1+t_i)) = e^O p_i^C(1+t_i)$, on the other hand, the situation can be reversed, with goods becoming traded-- at the margin-- after the devaluation. Thus, in graph 9 the initial supply curve is given by $e^O p_i^C(1+t_i)ABCD$, with equilibrium at I and price $\underline{p}_i^O$. In this case the devaluation alters the min (.) condition and changes the supply curve to $\underline{p}_i^1 EFGH$ such that equilibrium is at J with price given by $e^1 p_i^C(1+t_i)$ together with a significant expansion of domestic output (from BI to $\underline{p}_i^1 E$).

Consider now the market for exportables. The important element in this context is, of course, that the devaluation will lower the foreign currency price of our products, which will in
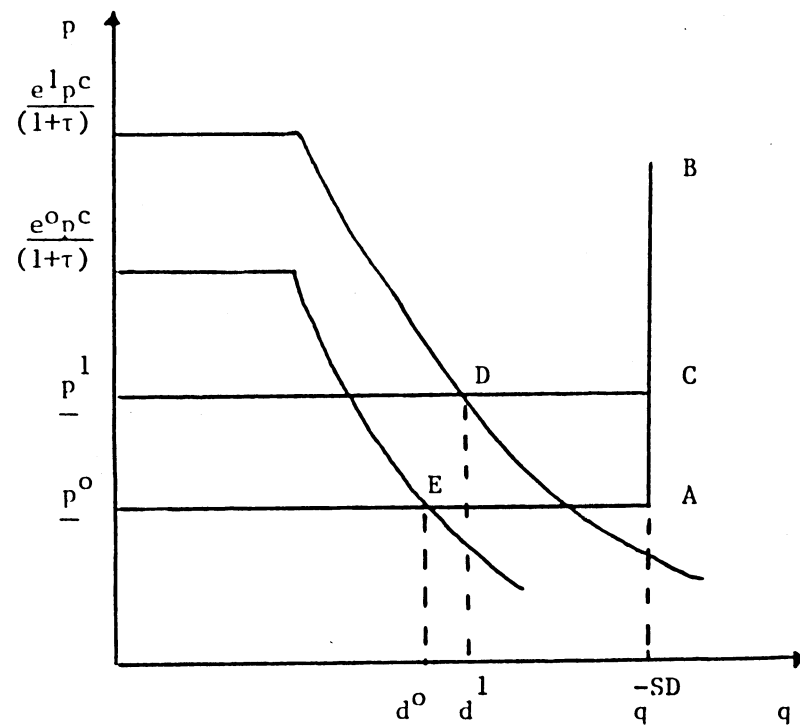
Graph 9
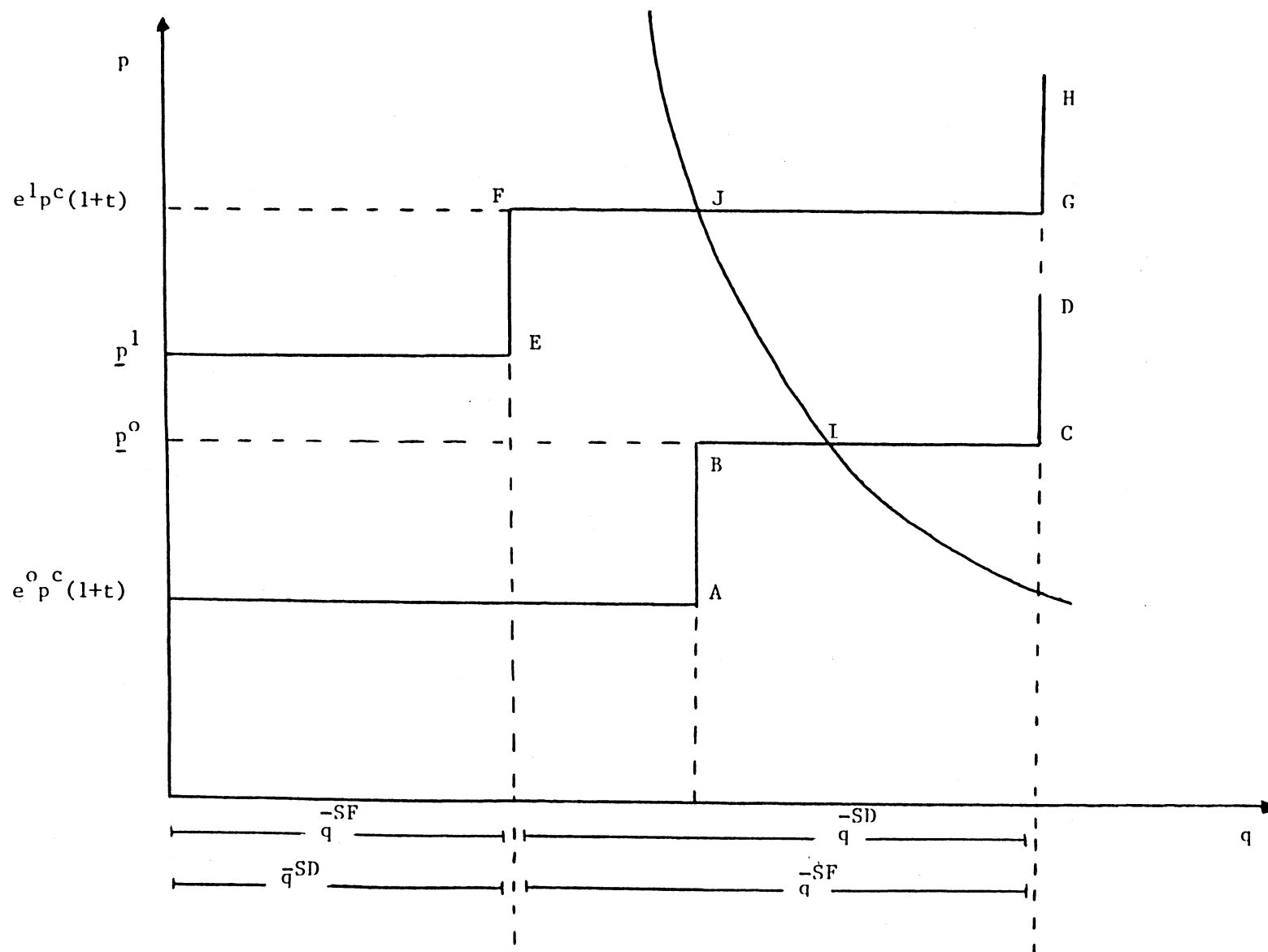
turn affect quantities exported. In panel (a) of graph 10 we depict an initial equilibrium at E for a given foreign demand curve for exports. Thus the initial ruling price is p_i^0 and export quantities d_i^0 (we ignore export quotas for simplicity). The devaluation shifts upwards both costs of production (to p_i^1) and the export demand curve. Since, however, nominal wages have been assumed constant the upward shift of export demand necessarily exceeds that of costs of production and the new equilibrium at D will show higher export quantities at d_i^1. If we assume that for this particular good $\beta_i > 1$, export revenues in foreign currency will have increased as well.[27] Note, at the same time, that at less than full capacity the price increase on an exportable will be smaller than the increase in the nominal exchange rate.

A second possibility is shown in panel (b) of the same graph which shows a product that at the initial exchange rate could not compete in the world market and was therefore not traded. For a sufficiently large devaluation, however, the equilibrium would change to E with exports being promoted and good i becoming traded.
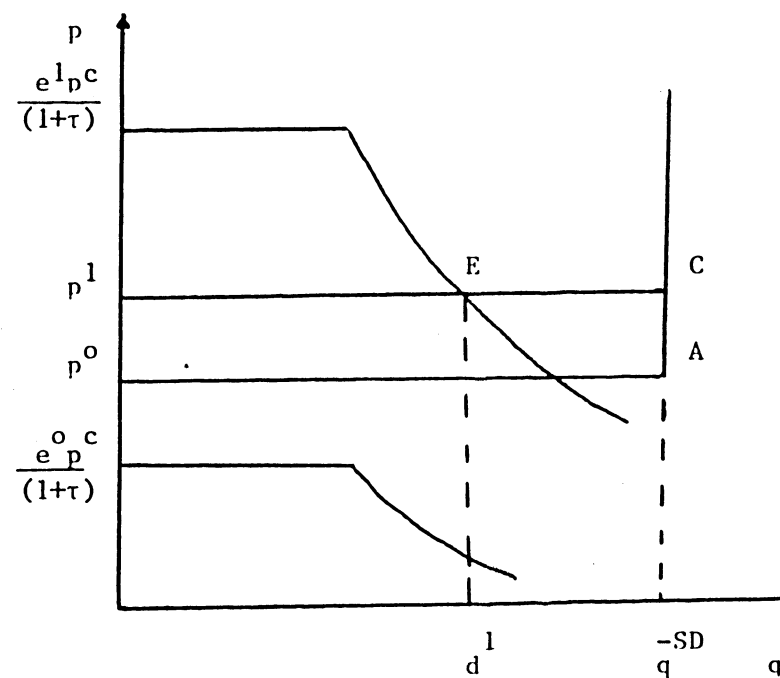
A third possibility, lastly, is depicted in graph 11 where the initial demand curve q_0^D (obtained from adding the export demand to domestic demand) was such that the initial equilibrium at E occurred at full capacity, with price at p_i^0, exports at d_i^0 and domestic consumption equal to

Graph 10

Panel (a)   Panel (b)

Graph 11
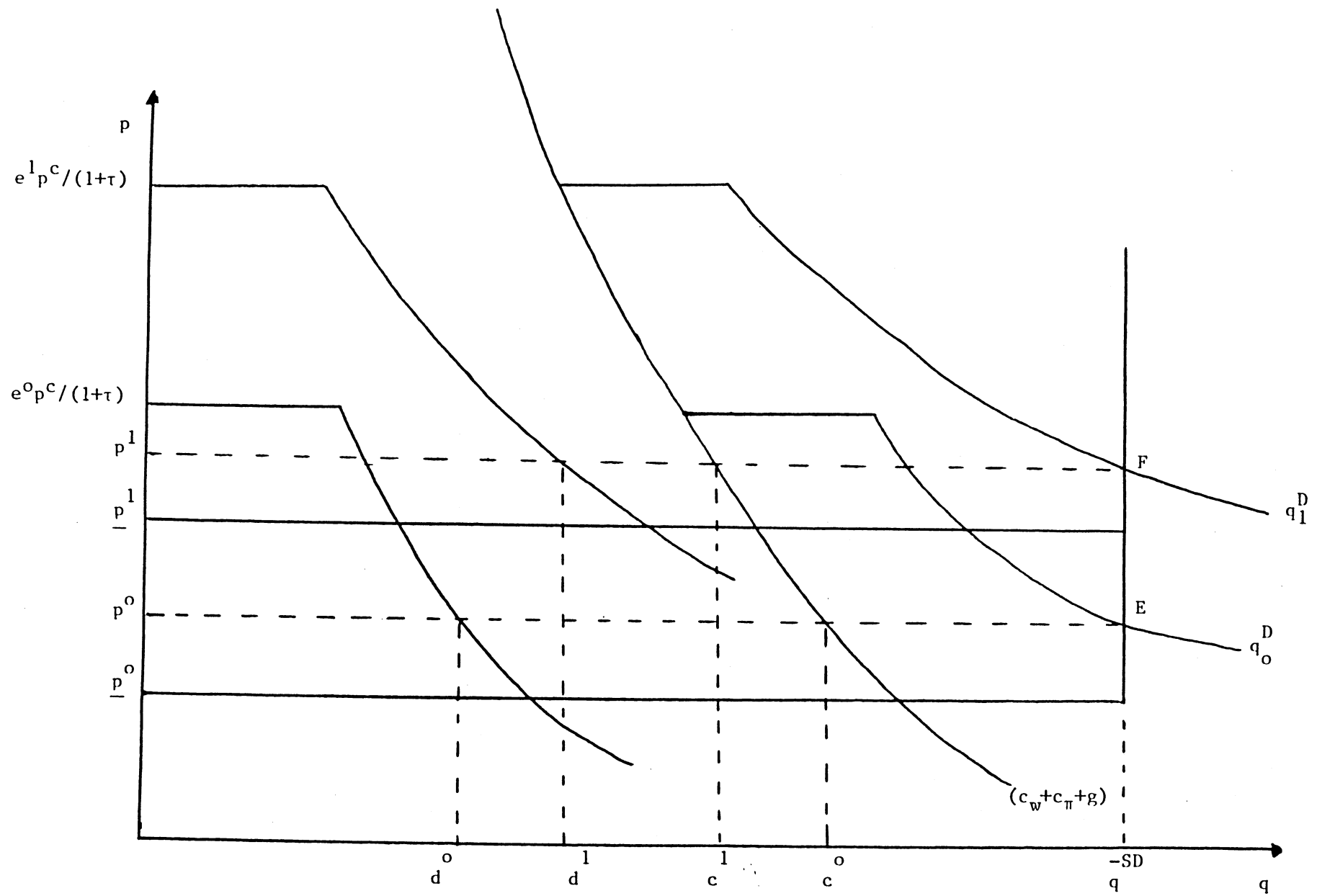
c_i^0.

As before, the devaluation shifts upwards the export demand curve and generates a new equilibrium at F, still at full capacity. In this case the export expansion to d_i^1 can only be obtained by a reduction of domestic consumption (to c_i^1) which is induced by the price increase from p_i^0 to p_i^1. Thus, at full capacity the price of an exportable increases by the full amount of the devaluation.

The cases analyzed above do not exhaust all possibilities. Nevertheless, they are sufficient to show that the "inflationary impact" of the devaluation will not be independent of the initial equilibrium. The point that must be stressed, in particular, is that the location of effective demand in each market together with the structure of relative prices before the devaluation will determine whether there is excess capacity, binding quotas or other combinations. This, in turn, will be crucial in determining how the cost increases and demand shifts associated with the devaluation are passed on into prices and mark-up rates.

Of course, consumption demand by workers and capitalists will also be affected, as relative prices and income levels react to the changes in the exchange rate. For $\Omega = 0$ the real wage rate will decline, but the change in total wage income will

also depend on variations in employment levels. These changes mostly depend on whether the existence of excess capacity and price elasticity of exports generate an expansion in exportables (and import substituting sectors like that of graph 9). Thus, the direction of change in total wage income is difficult to assess. For capitalists income the situation is similar. Mark-up rates will be squeezed in sectors where it was not possible to pass the cost increases into higher prices. Rents derived from import quotas will also contract. But the expansion in exports and import substituting sectors will act in the opposite direction. Rents associated with QR's on exports will also increase. Once again, it is not possible to predict the direction of change of this variable.

At this level of generality, and with so many parameters interacting it appears that the only "safe" conclusions are that the change in the exchange rate will have a positive effect on prices and an ambiguous effect on output and employment with the final result being very much conditioned -it must be emphasized- by the original equilibrium.

An additional complication is introduced if the nominal wage rate reacts to the changes in prices. For positive values of Ω the cost increase associated with the devaluation is strengthened, thus creating a wider gap between p_i^1 and p_i^0 and, for any initial equilibrium, a larger "inflationary

effect". While the drop in the real wage rate will be lower, the opposite will happen to the increase of the real exchange rate. Furthermore, the export expansion and import contraction induced by the devaluation will be weakened. In the limiting case where $\Omega = 1$, all quantity variables will stay at the initial equilibrium, while all price variables will increase by the full amount of the devaluation.

The key question, however, is whether the devaluation can solve the foreign exchange crisis, i.e., whether there exists a value of e satisfying (25). If we assume that the β_i's are large enough such that export quantities and export revenues move in the same direction, then the key factor will be the extent to which the real wage rate can fall in the face of an increase in the level of prices. In graph 12 at the initial value of e, e^0, total imports are at C and total exports at A with the distance AC measuring the initial trade deficit (B^0). Given all other parameters, the shape of the export and import functions will depend on the value of Ω. When $\Omega = 0$ these two functions will be "steep" and the new equilibrium values of exports and imports consistent with B^1 will be found at H and G, respectively, with the required change in the nominal exchange rate measured by the distance $e^1(\Omega = 0)e^0$. For $0 < \Omega < 1$ these functions will be flatter and a larger devaluation -together with a larger increase in the

Graph 12
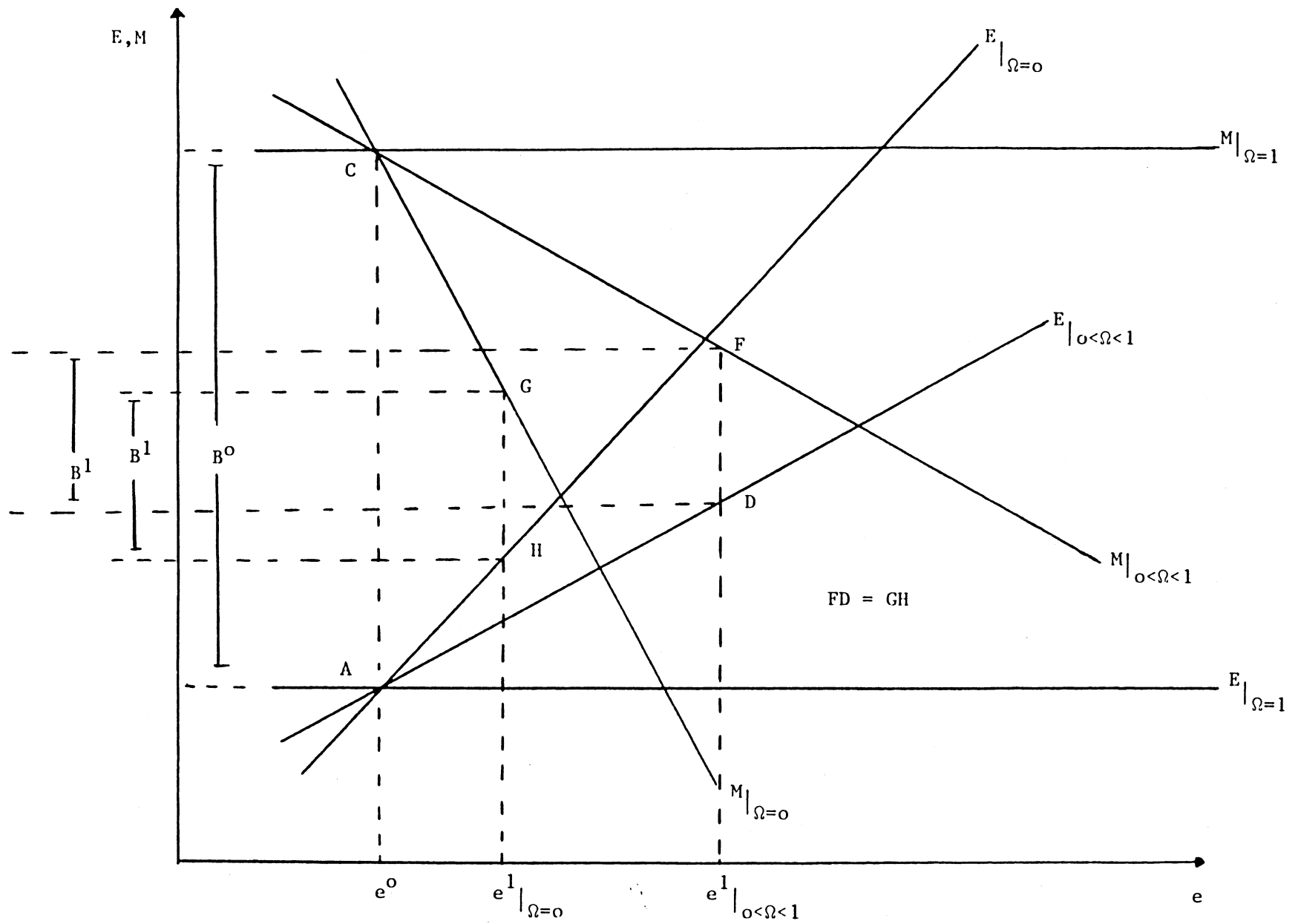
price level- will be required such that exports at D and imports at F (with FD=GH) are consistent with the new flow of foreign exchange at B^1.

When nominal wage rates are fully indexed, however, these two functions will be horizontal such that there will be no value of e satisfying (25). With a fixed real wage changes in the nominal exchange rate are unable to alter relative prices and, regardless of the price elasticities of export demand or the existence of excess capacity, will not change the total value of exports and imports. Thus, under these conditions a devaluation will not be successful in solving the foreign exchange crisis.

III.5 Fiscal Policy

A third possible response to the foreign exchange crisis is the use of fiscal policy either through changes in expenditures or in taxation. Consider first fiscal policy that tries to accomodate the crisis through reductions in government expenditures. Thus, in this scenario it is the exogenous component of final demand that is adjusted to the given level of foreign savings, rather than the exchange rate or the import regime. Formally we are looking for the value of λ such that:

$$(26) \quad E^1(e^0, \lambda^1) \;+\; B^1 \;=\; M^1(e^0, \lambda^1)$$

Reductions in λ will have a negative impact on the level

of employment given the fact that part of government expenditures go directly to the hiring of labor. There will also be some direct savings of foreign exchange as government purchases of non-competitive imports (vector g_v) are reduced as well. If one assumes that these are mostly capital goods, then the cost would be felt in terms of the productive capacity available in future periods and will not show up directly in any of the current indicators of the economy.

The third mechanism through which the cut in government expenditures will affect the economy is through the goods market. Graph 13 describes the effects on a traded good sector. With $\lambda = \lambda^o$, total demand is given by q_0^D, with the initial equilibrium at D. For $\lambda = \lambda^1 < \lambda^o$, equilibrium now settles at E, generating a cut in output (and employment) as well as a reduction in mark-up rates and price. This will in turn reduce effective demand in other sectors, generating savings in foreign exchange mainly through a cut in non-competitive imports used for production (or competitive imports in sectors that were at full capacity).

It is important to note that if there were a large number of sectors operating at full capacity like the one in graph 13, the cut in government expenditures will increase the real wage rate, as prices (and mark-ups) are falling and the nominal wage rate is assumed to be inflexible downwards. Thus, profits will fall (given the drop in output and mark-up rates), and the same

Graph 13
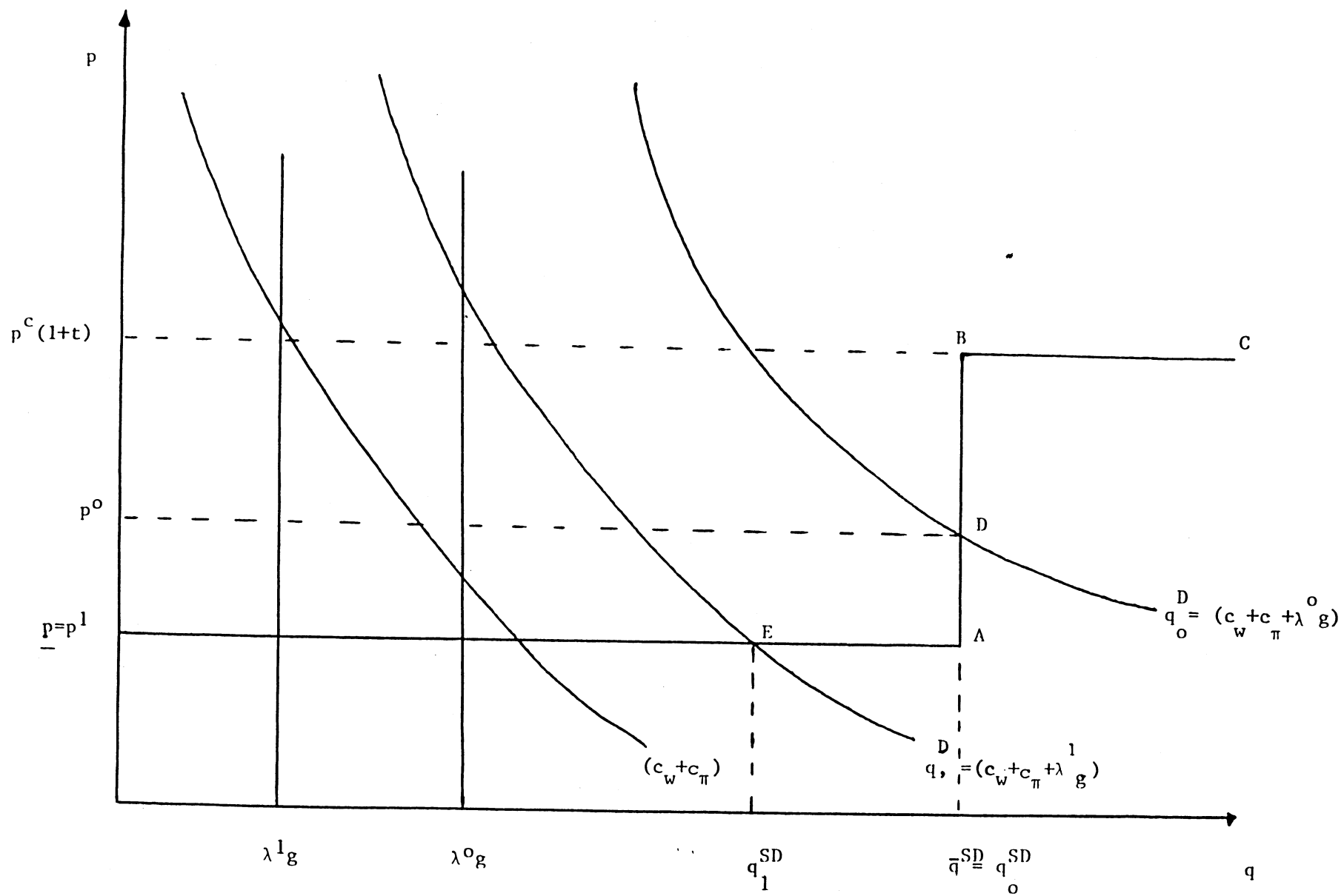
will happen to employment, although the real wage of those that remain employed increases.

A similar phenomenon occurs to the real exchange rate. With the nominal exchange rate constant and some prices falling, it will increase pari passu with the real wage. Moreover, if the drop in prices occurs in sectors producing inputs for exportables, the cut in government expenditures might be accompanied by an increase in exports. This is illustrated in panel (a) of graph 14, where the shut-down price falls to $\underline{p}^1$, equilibrium shifts from A to B and exports increase from d^o to d^1.

From the preceding analysis it is clear that the adjustment through cuts in government expenditures produces quite different results compared to the use of import controls and/or devaluation. Import controls increase prices, reduce the real wage and increase mark-up rates. The real exchange rate is lowered together with the volume of exports.

Devaluation, on the other hand, will reduce the real wage rate but will increase the real exchange rate (as long as the indexing factor for nominal wages is less than unity). Thus, contrary to the import control scenario, the adjustment to the crisis is partly through a cut in imports and partly through an increase in exports. Mark-up rates might decrease in some sectors while the change in output and employment will be ambiguous.

Cuts in government expenditures, as just seen, will

Graph 14

Panel (a)
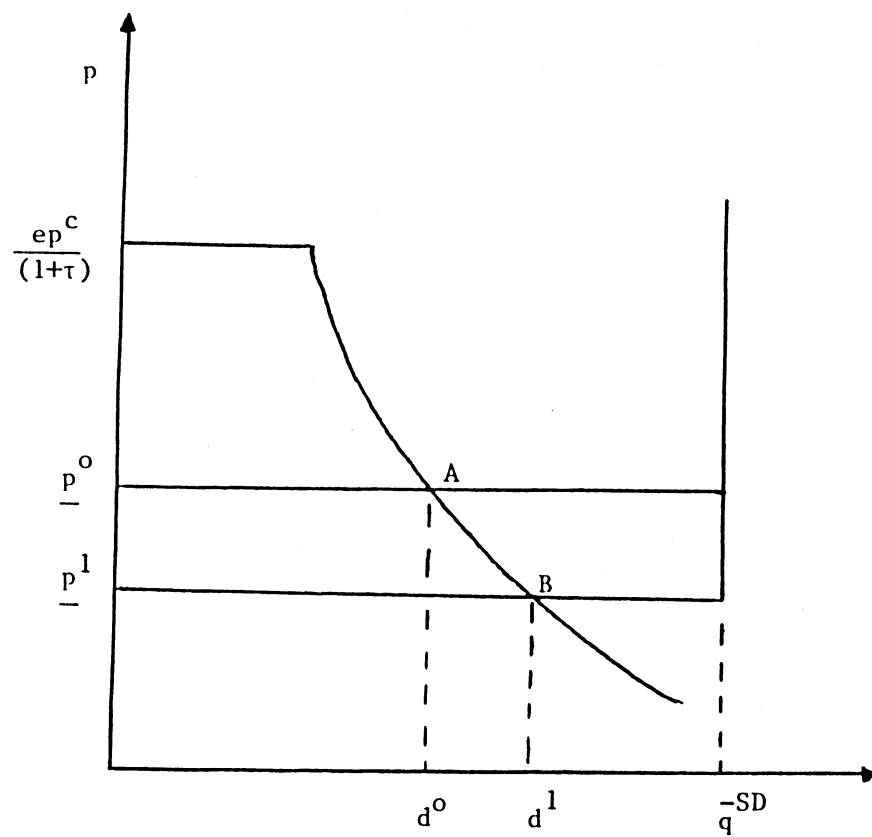
Panel (b)
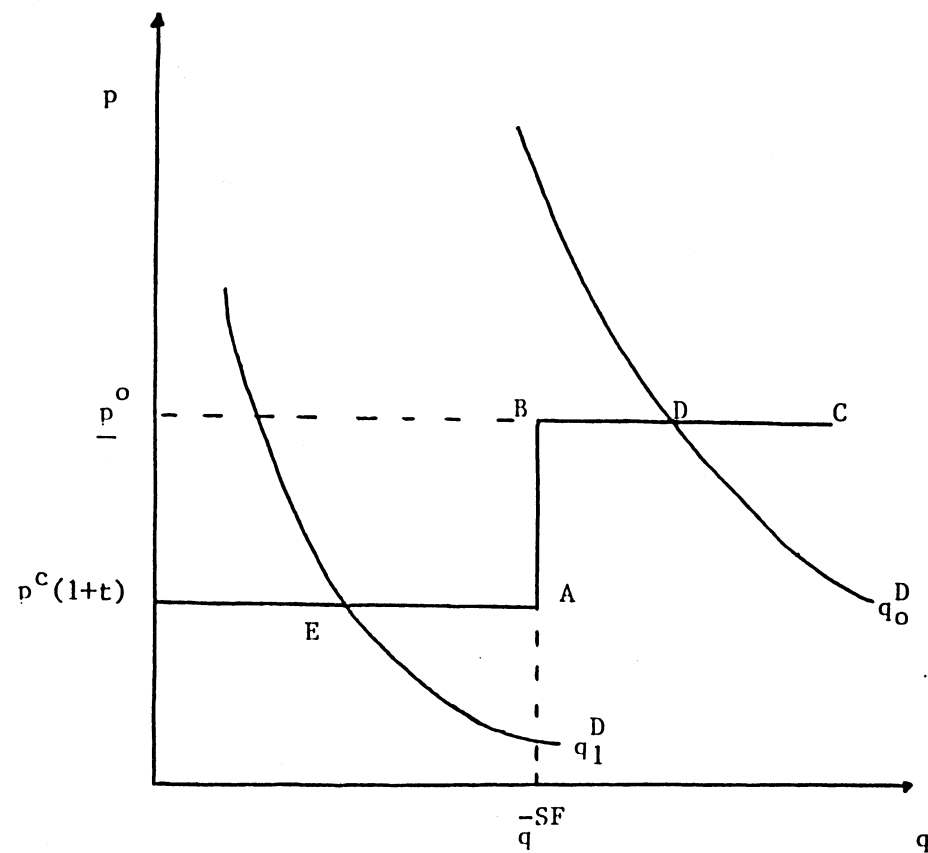
increase both the real wage and exchange rate but there will be an unambiguous drop in the level of output and employment.[28] The adjustment here works mostly through quantities and thus will not be crucially dependent on the value of Ω, as is the case with devaluation.

Interestingly, high values for the price elasticity of exports, βi, make the adjustment easier in the case of devaluation and cuts in government expenditures, but actually play a negative role in the case of import contols (for a given input structure of exports).

Of course, fiscal policy need not work only through reductions in government expenditures. Changes in indirect taxes (either in tariff rates or value added tax rates) could also be used, with their effects being different from the cut in expenditures (as they mostly work through price changes). Rather than studying these instruments in detail, however, we can consider the use of export subsidies as tools to accomodate the shortage of foreign exchange.

The case of an exportable product is depicted in graph 15. With $\tau = \tau^o$, the initial demand curve is q_o^D, with equilibrium at A and export quantities equal to d^o. With a higher export subsidy the demand curve for exports shifts up and when added to the other components of final demand generates the total demand curve q_1^D with equilibrium at B and an increase in export quantities from d^o to d^1.

Graph 15
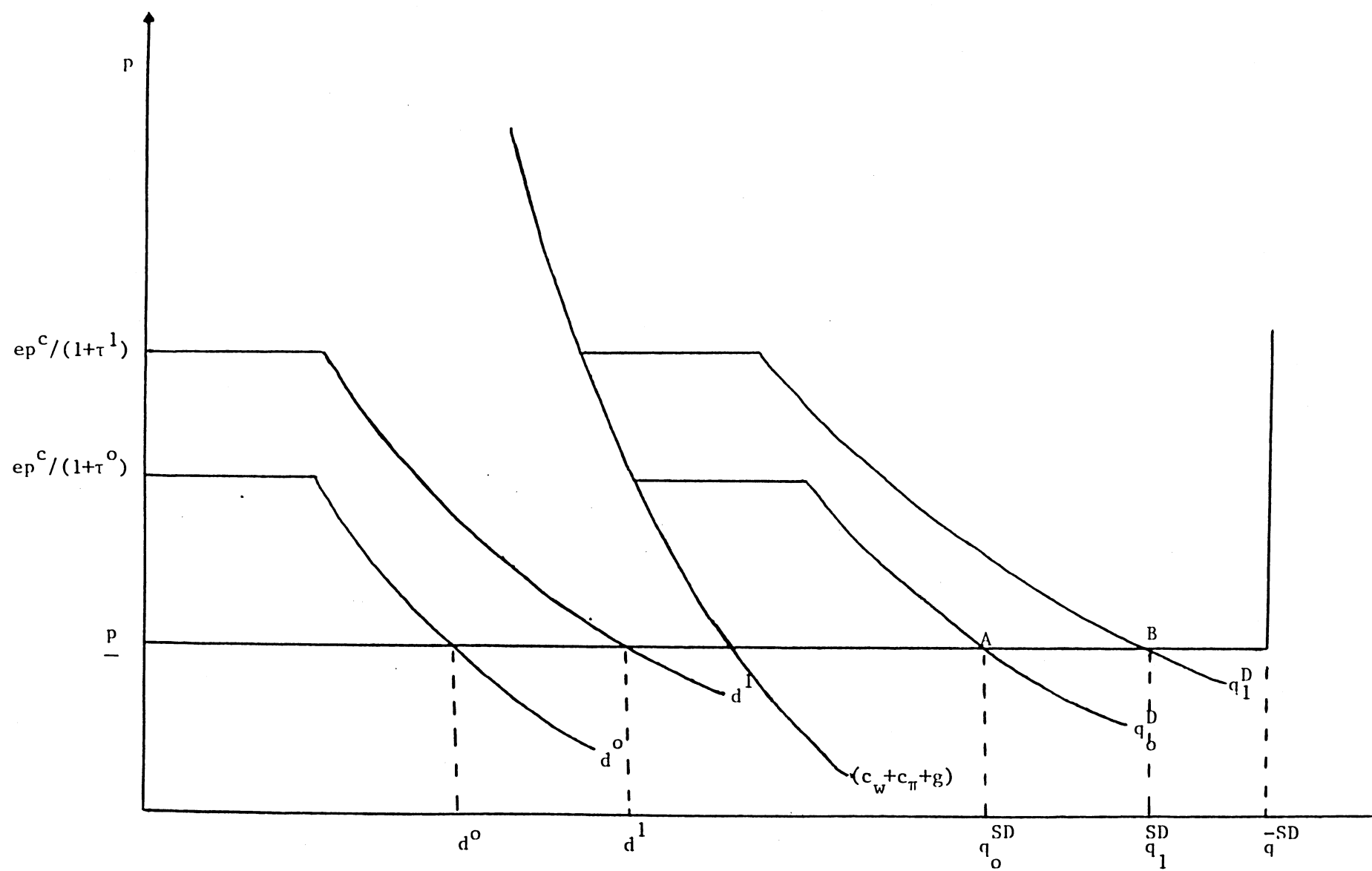
The increase in exports will be associated with an increase in total export revenues if $\beta_i > 1$, i.e., if demand curves for exports are elastic. Clearly, if price elasticities of demand for exports are less than unity export subsidies will be counterproductive, as export revenues in foreign currency will fall as subsidies increase. On the other hand, the higher the values of β_i, the more effective will export subsidies be, as export revenues will increase more for a given value of τ.

The case depicted in graph 15 is one where the initial equilibrium shows excess capacity such that the increase in export quantities can take place without displacing domestic consumption via higher prices and a lower real wage. Thus, export subsidies will be most effective when there is significant slack in the economy-- particularly in the export sectors and their suppliers-- as well as high elasticities of demand for exports. It should be pointed out, however, that the higher the values of β_i the less likely it will be that in the original equilibrium exportable sectors show excess capacity. This is clearly so since high values for β_i generate flatter market demand curves, increasing the likelihood of initial equilibriums at full capacity output.

The key question at this point, nevertheless, concerns the effects of export subsidies on the trade balance. Since for a given nominal exchange rate the change in the trade balance equals the change in the fiscal balance, the question can best be

tackled by focusing on the government accounts. More concretely, given that export subsidies increase the government deficit directly, one requires that the additional tax collections associated with the higher level of output more than offset the direct expenditure on subsidies.[29] Once the problem is framed in this way it is clear that, in general, export subsidies will not improve the balance of trade and, by themselves, will not be able to solve the foreign exchange crisis.

III.6 Mixed Policies

The preceding sections have focused on the use of only one instrument at a time to face the foreign exchange crisis. The purpose of this has been to isolate the effects of each policy and trace the way in which they affect the different variables of the economy. One could, of course, consider policy mixes like a devaluation together with a decrease in government expenditures and/or any other combinations. Moreover, the experience of the early 1980's in Latin America shows that few countries rely only on one instrument.[30]

It is clear, nevertheless, that the qualitative analysis of mixed policies would be difficult to undertake, as too many variables would be changing at the same time. In these cases the final result will depend not only on the values of the different parameters but also on the size of the change of the various policy instruments (i.e., the size of the devaluation vis-a-vis

the magnitude of the cut in government expenditures, etc.). As a result of this, the analysis of mixed policies will be carried out only through numerical simulations, with the results being presented in section V.

IV. Calibration of the Model

IV.1 Data.

The model developed in sections II and III was applied to an economy that produces 10 goods, out of which 2 are primary goods, 6 are manufactured products and 2 are non-tradeables. The technology matrices for this economy (A,l,V) as well as the vectors of government expenditures (g,g_l,g_v) and consumption shares (η_w, η_π) were taken from the Mexican input/output table for 1975 that was aggregated to 10 sectors. No attempt was made to reproduce the actual values of the Mexican economy in 1975, however, as there are some important features of this economy that were not included in the model.[31] Rather, we decided to create a "stylized" economy that shared many characteristics of the Mexican and other similar Latin American economies.[32]

Table 1 lists the sectors included in the model as well as the values of the main parameters. The following observations are in order:

(i) Consumption shares for capitalists and workers are assumed to be the same. On average, 54% of disposable income is spent on non-tradeable goods, with the remaining 46% spent on

Table 1

Parameter Values for General Equilibrium Model

PARAMETER / SECTOR	(1) η	(2) ρ	(3) β	(4) τ	(5) $\bar{d}$	(6) t	(7) $\bar{q}^{SF}$	(8) $\underline{\gamma}$	(9) α	(10) p^c	(11) g	(12) $\bar{q}^{SD}$
1. Agriculture	.0780	3.2	1.5	0	*	.25	*	1.146	.055	1.0	11.2	151.3
2. Mining & Oil	.0002	17.9	0.9	0	35	.18	*	.517	.171	2.5	0.76	56.7
3. Food & Beverage	.2222	7.4	1.5	-.10	0	.25	*	.257	.154	1.0	3.00	286.6
4. Textiles	.0637	4.0	2.5	-.20	*	.25	0	.225	.107	1.45	1.99	134.9
5. Chemicals	.0373	2.6	2.5	0	*	.33	*	.235	.201	1.3	15.25	91.9
6 Glass & Cement	.0041	.67	2.5	0	*	.35	*	.281	.100	.85	0.85	36.5
7. Metals & Machinery	.0362	4.05	2.5	-.10	*	.35	*	.183	.100	.85	45.4	196.0
8. Other Manufactures	.0219	1.25	2.0	-.10	*	.15	10	.239	.106	.5	3.64	72.6
9. Electricity & Transport	.0738	–	–	–	0	–	0	.325	.104	–	7.17	106.4
10. Services	.4626	–	–	–	0	–	0	.417	.135	–	226.2	1250.7

* Unbounded from above

Other parameter values: $p^{nc} = 1.1$; $g_\ell = 40.1$; $g_v = 27.8$; $(t_\pi \ t_w) = (.20 \ .12)$

$t_{nc} = 0.13$

tradeable goods. Out of this last amount, 22% is spent on food and beverages.

(ii) The trade regime is characteristic of Latin American economies. Export subsidies are only granted for manufactured goods (considered non-traditional exports) with the export subsidy on textiles exceeding the rest of the sectors. An export prohibition is introduced for food and beverages together with an export quota on mining and oil (considered to be the traditional export). The export quota on mining and oil can either reflect an international agreement or a desire to limit exports below installed capacity in the sector.

(iii) With regards to imports, tariffs escalate a little. The average tariff rate on manufactures (28%) exceeds that on primary goods (21.5%). Non-competitive imports are assumed to pay a lower tariff rate of 13%. On the other hand, we assume that imports of textiles are prohibited and that an import quota is imposed on Other Manufactured Goods. Remaining sectors are assumed to be affected only by tariffs.

(iv) Minimum mark-up rates are not equal across sectors. On average, they are higher in primary sectors than on non-tradeables, with the lowest values observed in industry.

(v) Value added tax rates-- column 9-- are also supposed to be different across sectors, with the highest rate applied on chemicals (a sector which includes oil refining) and the lowest on agriculture.

(vi) Finally, the vectors of world prices and maximum domestic capacity output were manipulated such that at the original equilibrium the economy operated with excess capacity in manufacturing and one non-tradeable sector and had exports of primary goods and some manufactured products.

IV.2 Benchmark Equilibrium

As mentioned in section III.1, the values of the nominal wage and exchange rates as well as the size of government expenditures are the key to determine a particular equilibrium. For the benchmark equilibrium these parameters were all set at unity, i.e., the values implicit in the 1975 national accounts of Mexico. The resulting equilibrium is described in tables 2,3, and 4.

The basic macroeconomic aggregates are listed in table 2. Income and expenditure differ by .00003%, indicating that the solution algorithm is indeed very precise. This small discrepancy between income and expenditure is, of course, also found between the fiscal deficit and the trade deficit. With the nominal exchange rate set at unity, these two values are exactly the same.

Rather than discussing the absolute magnitudes, however, it seems more fruitful to look at the underlying structure of the economy. This can be seen from the macroeconomic ratios presented in table 3.

Table 2

Macroeconomic Aggregates

Income Accounts	
Total Wage Bill	$463.54
Total Profits	562.70
Rents on Exports	0.00
Rents on Imports	4.27
Value Added Tax	124.41
Tariffs on Competitive Imports	12.35
Tariffs on Non-Competitive Imports	6.93
(GNP) = TOTAL INCOME	$1,174.20

Expenditure Accounts	
Worker's Consumption	$426.46
Capitalist's Consumption	453.58
Government Expenditures	360.55
Export Subsidies	3.32
Exports	56.55
(-) Competitive Imports	42.29
(-) Non-Competitive Imports	83.93
TOTAL EXPENDITURE	$1,174.24

Government Accounts	
Government Purchases of Goods	$289.87
Government Wage Bill	40.10
Government Imports	30.58
Export Subsidies	3.32
(-) Direct Taxes	150.47
(-) Indirect Taxes	143.69
FISCAL DEFICIT	$69.71

Trade Accounts	
Traditional Exports	$43.25
Non-Traditional Exports	13.30
(-) Competitive Imports	42.29
(-) Non-Competitive Imports	83.93
TRADE DEFICIT	$69.67

Table 3

Macroeconomic Ratios

1. Income Distribution

    Wages / GNP = .395
    Rents / GNP = .004
    Profits / GNP = .479
    Indirect Taxes / GNP = .122

2. Trade Accounts

    Exports / GNP = .051
    Traditional Exports / Exports = .760
    Non-Traditional Exports / Exports = .240
    Imports / GNP = .107
    Non-Competitive Imports / Imports = .660
    Competitive Imports / Imports = .340

3. Fiscal Accounts

    Government Spending / GNP = .307
    Budget Deficit / GNP = .059
    Indirect Taxes / GNP = .122
    Total Taxes / GNP = .251
    Subsidies / GNP = .003
    Direct Taxes / GNP = .128

4. Structure of Output

    Tradeable Output / Total Output = .552
    Manufacturing Output / Total Output = .402
    Primary Output / Total Output = .150
    Non-Tradeable Output / Total Output = .448

5. Structure of Employment

    Primary Employment / Total Employment = .087
    Manufacturing Employment / Total Employment = .209
    Non-Tradeable Employment / Total Employment = .618
    Government Employment / Total Employment = .086

The economy under study resembles one at an advanced stage of import substitution industrialization. Shares of profits and wages in total income are similar to the ones observed in Mexico in 1975. The same is true of the share of exports and imports in total income.[33] Non-competitive imports account for 66% of total imports, while traditional exports (mining and oil) account for 76% of total exports. Thus, this economy mostly requires imported goods for intermediate use and pays for them with exports of a primary good.

Government expenditures account for 31% of GNP. With tax collections being only 25% of total income, the original equilibrium is characterized by a budget deficit of 6% of GNP. Note that indirect taxes account for about half of total taxes and consist mostly of collections from the value added tax (see also table 2).

The structure of output also corresponds to that of a semi-industrialized LDC. Primary sector output accounts for only 15% of GNP, while manufacturing output takes 40%. The remaining 45% corresponds to output of non-tradeable sectors. Note, on the other hand, that non-tradeable sectors account for 62% of all employment, while tradeable sectors absorb only 32% of total employment. Thus, as is generally the case, average labor productivity is higher in the tradeable sectors of the economy. (The remaining 8% of employment takes place in non-productive sectors and is directly tied to the size of government

expenditures).

The equilibrium values of prices and quantities for each sector are found in table 4. As can be seen from columns (1), (2), and (3), for Agriculture and Chemicals the equilibrium price is given by the world price (plus tariff) and is associated also with levels of imports that are strictly less than the import quotas. For Other Manufactures (sector 8), on the other hand, the equilibrium price exceeds the world price (plus tariff) but the import quota is binding, generating positive rents for importers of about .5% of GNP (see table 3). For the remaining tradeable sectors the equilibrium price is below the world price (plus tariff) indicating the existence of 'water in the tariff' in these sectors and zero competitive imports.

Excess capacity is found in six sectors of the economy. In these sectors (3,4,6,7,8, and 10) the equilibrium price is equal to the shutdown price and hence equilibrium mark-up rates coincide with the exogenously given minimum mark-up rates. The remaining four sectors of the economy (the two primary sectors, Chemicals and Electricity and Transport) are operating at full capacity with the equilibrium price exceeding the associated shut-down price and mark-up rates above the minimum bounds.

Only two sectors show positive exports in the initial equilibrium: Mining and Oil and Textiles (column (11)). Out of these two, however, only Textiles shows excess capacity such that additional exports can occur with no variations in prices. As

Table 4

Sectoral Equilibrium Values

VARIABLE / SECTOR	PRICES							QUANTITIES					
	(1) p	(2) $\underline{p}$	(3) $ep^c(1+t)$	(4) $\bar{p}$	(5) $\tilde{p}$	(6) p_e^c	(7) γ	(8) q^{SD}	(9) q^{SF}	(10) q^D	(11) d	(12) $q_i^{SD}/\bar{q}_i^{SD}$	(13) N_i/N
1. Agriculture	1.25	1.17	1.25	–	1.25	–	1.269	151.3	8.8	160.1	0	1.0	0.06
2. Mining & Oil	1.78	0.87	2.95	1.78	1.78	1.78	1.559	56.7	0	56.7	24.3	1.0	0.03
3. Food & Beverage	1.15	1.15	1.25	–	1.04	–	0.257	217.6	0	217.6	0	0.76	0.04
4. Textiles	1.04	1.04	1.81	1.04	0.83	0.83	0.225	106.6	0	106.6	15.9	0.79	0.04
5. Chemicals	1.73	1.21	1.73	–	1.73	–	0.561	91.9	21.9	113.8	0	1.0	0.03
6. Glass & Cement	1.05	1.05	1.15	–	1.05	–	0.282	29.6	0	29.6	0	0.81	0.02
7. Metals & Machinery	1.07	1.07	1.15	–	0.96	–	0.183	161.2	0	161.2	0	0.82	0.07
8. Other Manufactures	1.00	1.00	0.58	–	0.90	–	0.239	60.5	10	60.5	0	0.69	0.02
9. Electricity & Transport	1.18	0.96	–	–	–	–	0.599	106.4	0	106.4	0	1.0	0.07
10. Services	0.80	0.80	–	–	–	–	0.417	922.8	0	922.8	0	0.74	0.55

N_i = Sectoral employment;   N= Total employment

occurs in many LDC's, the primary sector that produces exportables operates at full capacity. Note that exports of both goods are below the respective export quotas, such that no quota rents from exports are generated. As a result of this, prices received by exporters in domestic currency (column (4)) coincide with prices ruling in the domestic market (column (1)).

On the other hand, note that exports of both goods are larger than those for which the economy would be small in the world market (see column 2 of table 1). In consequence, the foreign currency prices received by the economy for these goods-- column 6-- are below the respective world prices (column 10 of table 1). For all other sectors, the foreign currency price of exports--column 5-- exceeds the given world price and hence no exports take place.

To sum up: the benchmark equilibrium depicts a semi-industrialized LDC with excess capacity in manufacturing and services and full capacity in the primary sectors and a key non-tradeable. Manufacturing production takes place behind high tariff rates that generate water in the tariff. Exports consist mostly of primary products and imports of non-competitive goods used as intermediates and/or for investment.

Given the size of government expenditures and the nominal wage and exchange rate, the economy is running a trade deficit of 6% of GNP. This is equivalent to a transfer of 69.7 units of foreign exchange from the rest of the world to this economy (see

table 1).

Consider now a foreign exchange crisis. In particular, assume that the rest of the world is now only willing to transfer to this economy 34.8 units of foreign exchange. In what follows we will explore how the economy adjusts to a new equilibrium where $B^1 = 1/2\ B^0$, i.e., a situation where the trade deficit must be halved.

V. Numerical Results

An attempt was made to adjust the economy to the foreign exchange crisis using first each policy on its own and, secondly, policy packages consisting of two or more instruments. A policy package was considered successful if it satisfied the objective of halving the trade deficit. By this criteria import controls and export subsidies were not successful as, by themselves, they either worsened the balance of trade or failed to improve it by the required amount. The opposite was true of cuts in government expenditure or devaluations.

Consider first the situations where the policy objective was achieved (i.e., $B^1 = 1/2\ B^0$). Seven different simulations were considered, to name:

Simulation #1. The economy adjusts by changing only the nominal exchange rate. Under the assumption that $\Omega = 0.0$, i.e., that

nominal wages are not indexed to the price level, the devaluation necessary to halve the trade deficit is 180%.

Simulation #2. The adjustment takes place by reductions in government expenditures, with no changes in the exchange rate or the trade regime. Government expenditures must be reduced by 20.5% to achieve the desired objective.

Simulation #3. The policy objective is reached with a combination of devaluation and reduction in government expenditures. Assuming that the latter are cut by 10% the nominal exchange rate must be devalued by 55%, once again assuming that $\Omega = 0.0$.

Simulation #4. The adjustment takes place with a combination of cuts in government expenditures, higher tariffs for competitive imports together with increases in export subsidies. In particular, if government expenditures are cut by 10% then average tariff rates must increase from 30% in the original equilibrium to 150%. At the same time export subsidy rates must be increased from an average of 25 to 75%, assuming, as in previous cases, that $\Omega = 0.0$.

Simulation #5. A cut of government expenditures of 20.5% (as in simulation #2) is now accompanied by the highest possible increase in export subsidy rates (from an average of 25% in the

original equilibrium to 80%) consistent with the policy objective.

Simulations #6 and #7. The same policy packages as in simulations #1 and #3, respectively, with the exception that $\Omega = 0.6$, i.e., that nominal wages are indexed by 60% to changes in the price level. In simulation #6 the devaluation required to reach the objective is 19,900%. In simulation #7, on the other hand, the necessary devaluation is on the order of 100%.

The macroeconomic impact of these policies can be seen in tables 5 and 6 (for the sake of brevity sectoral results will not be discussed in detail).

Consider the policy of pure devaluation (simulation #1). Notice first that real GNP contracts (by 4.6%) while there is a substantial increase in the price level (69%). The drop in real GNP, however, is associated with a 5.4% increase in the level of employment. This result is of importance. When relative prices are endogenous employment and real income need not move in the same direction. This is particularly so with a devaluation which, when the economy is small, must deteriorate the terms of trade to be able to sell a larger volume of exports. Thus, the increase in employment is associated with a 41% decrease of the real wage rate (brought about by the 69% increase in the price level).

At the same time, the devaluation causes a 66% increase in the real exchange rate as well as a 33% increase in the ratio of

Table 5

Macroeconomic Impact of Halving the Trade Deficit

(% Deviations from Benchmark Equilibrium)

VARIABLE \ SIMULATION	1	2	3	4	5	6	7
Real GNP	-4.6	-9.4	-5.3	-4.7	-4.0	-4.3	-5.4
Nominal GNP	61.4	-13.8	12.8	21.71	-4.5	116.0	46.9
Price Level	68.9	-4.8	19.1	27.8	-0.5	121.3	55.3
Employment	5.4	-11.7	-2.5	-1.3	-5.8	5.4	-2.3
Real Wage Rate	-40.8	5.1	-16.0	-21.6	0.5	-39.7	-14.2
Nominal Wage Rate	0	0	0	0	0	72.7	33.2
Real Exchange Rate	65.7	5.1	30.1	-21.6	0.5	63.6	28.7
Nominal Exchange Rate	180.0	0	55.0	0	0	19,900.0	100.0
Value of Exports *	37.7	0.3	23.7	17.2	28.0	37.8	22.0
Value of Imports *	-10.7	-38.1	-17.8	-20.1	-15.5	-10.6	-18.0
P^T / P^{NT} **	33.2	0.1	14.5	19.8	3.5	32.2	13.1
Real Wage Income	-37.6	-7.2	-18.1	-22.8	-5.3	-32.1	-16.8
Real Profit Income	20.9	-4.6	5.0	6.7	-2.6	19.4	3.6
Real Rent Income	-81.1	-1.1	-35.7	-45.9	-0.4	-78.5	-33.6

* In foreign currency;   ** Ratio of prices of tradeable to non-tradeable goods

Table 6

Structural Impact of Halving the Trade Deficit

RATIOS TO GNP OF:	Benchmark Equilibrium	SIMULATION						
		1	2	3	4	5	6	7
(1) Exports	.051	.125	.059	.088	.070	.091	.123	.086
(2) Imports	.107	.166	.090	.121	.071	.095	.164	.120
(3) Wage Bill	.395	.258	.404	.341	.320	.389	.262	.347
(4) Profits	.479	.607	.472	.531	.537	.486	.604	.525
(5) Rents	.004	.001	.004	.002	.002	.004	.001	.003
(6) Primary Output	.150	.179	.157	.168	.140	.153	.179	.165
(7) Manufacturing Output	.402	.450	.411	.426	.458	.424	.448	.426
(8) Tradeable Output	.552	.629	.567	.594	.598	.577	.627	.591
(9) Non-Tradeable Output	.448	.371	.433	.406	.402	.423	.373	.409
(10) Taxes	.251	.276	.247	.259	.274	.250	.275	.258
(11) Fiscal Deficit	.059	.051	.034	.039	.024	.031	.051	.042
(12) Gov. Spending	.307	.317	.278	.292	.274	.254	.317	.294
(13) Export Subsidies	.003	.010	.003	.006	.024	.027	.010	.006

prices of tradeable to non-tradeable goods. This, in turn, is associated with a strong expansion of exports (38%) and some contraction of total imports (of 11%).

The impact of this adjustment policy on income distribution is quite severe. Although employment increases, the lower real wage generates a 38% drop in total real income going to wages. On the other hand, real income of profit receivers increases by 21%.

The devaluation more than doubles the share of exports in GNP (from 5 to 12%). It also increases the share of imports (from 11 to 16.6%). Thus, the economy becomes more open compared to the benchmark equilibrium.

The strong shift in relative prices induced by the devaluation is associated with changes in the composition of output. The share of tradeable sectors in GNP increases from 55 to 63%. With the capital stock fixed in the short run this implies a decrease in profitability of non-tradeable production.

The lower real wage rate also generates an important shift of income shares in GNP, with the share of wages decreasing from 39 to 26%, while the share of profits increases from 48 to 61%. On the other hand, since only rents associated with imports were present in the original equilibrium their share in GNP decreases from 0.4 to 0.1%.

The adjustment to the crisis by cuts in government expenditures produces strikingly different results (simulation #2). The drop in real GNP is larger and is associated also with a

12% decrease in the level of employment. On the other hand, the policy is mildly deflationary, with the price level dropping by 4.8% producing a 5% increase in the real wage and real exchange rate.

Exports, however, stay almost constant. In consequence, most of the adjustment comes from a 38% contraction of imports. With real (and nominal) GNP falling the share of exports in GNP increases somewhat (from 5.1% to 5.9%) while the share of imports falls from 11 to 9%. Thus, as opposed to the devaluation this policy does not produce strong changes in the degree of openness of the economy.

The reduction of government expenditures does not have strong effects on relative prices either. The ratio of prices of tradeable to non-tradeable goods stays almost constant, and the same happens to the structure of output as there is only a small increase in the share of tradeable sectors in GNP (from 55.2% to 56.7%). Put differently, in this scenario the economy adjusts mostly by quantity changes, without any of the structural shifts that accompanied the devaluation.

While, as just mentioned, real GNP drops more than the devaluation case, the costs of adjustment are spread more evenly among income classes. Real income going to all three groups decreases, while shares of each group in GNP are almost the same as those ruling in the initial equilibrium.

On the other hand, even though government expenditures were

reduced by 20.5%, the fiscal deficit/GNP ratio falls by only 2.5% of GNP. This, clearly, results from the fact that real GNP itself contracted by 9.5%. In the devaluation scenario, however, the fiscal deficit only falls by 0.8% of GNP. Thus, depending on the adjustment policy different values of the fiscal deficit/GNP ratio are consistent with the same reduction of the trade deficit.[34]

The scenarios analyzed above constitute two 'polar' cases where the adjustment is brought about with the use of one instrument only. When the two instruments are combined as in simulation #3 (with a 10% cut in government expenditures and a 55% devaluation) the results are, as expected, between the two extremes. There is still a contraction of output and employment, although less severe than the case where there is no devaluation. On the other hand, there is still a 20% increase in the price level, a 16% drop in the real wage rate together with a shift in income shares from wage to profit receivers (with real wage income contracting by 18% and profit income increasing by 5%).

Turn now to the situation where the same 10% cut in government expenditures is accompanied by increases in import tariffs and export subsidy rates (simulation #4). The first thing to notice is that the result is not exactly symmetrical with the devaluation cum cut in government expenditures case (simulation #3). This is so since the increase in import tariffs applies to competitive imports only, while the devaluation increases the

domestic currency price of non-competitive intermediate inputs as well. As a result, costs of production are not directly affected in this case, requiring larger increases in import tariffs to bring about the necessary adjustment.

Secondly, note that in this case the real exchange rate drops (given a higher price level and a constant nominal exchange rate) while the ratio of prices of tradeable to non-tradeable goods increases. At the same time, there is a 17% expansion of exports together with a 20% cut in imports. Clearly, in a situation where trade taxes are modified changes in the nominal exchange rate need not be correlated with the direction of change in exports and imports. Under these conditions changes in the real exchange rate are not so important for the behavior of the trade balance.

On the whole, however, simulations #3 and #4 produce quite similar results in terms of the way the economy adjusts to the crisis. In particular, the direction of change of all relevant variables is the same. This is not surprising, as the same basic mechanisms are at work in both cases. Interestingly enough, nevertheless, neither policy package dominates the other. Inflation is slightly lower in the devaluation case (simulation #3), generating a less severe fall in the real wage and, as a result, a less pronounced shift in income distribution. On the other hand, the tariff cum export subsidy package (simulation #4) performs better in terms of employment and real GNP loss.

The contraction of government expenditures considered in simulation #2 generates additional excess capacity in the economy vis-a-vis the benchmark equilibrium.[35] In simulation #5 we take advantage of that excess capacity by considering the same 20.5% cut in government expenditures accompanied, however, by the largest increase in export subsidy rates. consistent with the policy goal.

This scenario produces the smallest drop in real GNP accompanied by almost no change in the price level and the real wage rate (the former drops by 0.5% while the latter increases by the same amount). With the real wage rate almost constant the drop in real income is distributed evenly between wages, profits, and rents. At the same time, given that there is no inflation nor changes in either the nominal wage or exchange rates, there is no significant change in relative prices either. Thus, the ratio of prices of tradeable to non-tradeable goods increases by only 3.5%. This, in turn, implies no strong change in the share of tradeable sectors in total GNP (increasing only from 55.2 to 57.7%).

One can think of this package as a situation where the cut in government expenditures releases resources that can then be used in production for exports, hence minimizing the fall in employment. As a result, the adjustment does not work only through a cut in imports (given the contraction in effective demand) but also through an increase in exports. Moreover, the

excess capacity created by the cut in government expenditures allows the export increase to occur without any significant changes in the price level. In this way the drop in real wages associated with the devaluation or tariff cum export subsidy scenarios is avoided. On the other hand, however, the export expansion is not sufficient to absorb all the unemployment generated by the cut in government expenditures, generating a drop in employment that exceeds the one observed in the other scenarios (except, of course, that of simulation #2).

In all previous simulations we have assumed no reaction of the nominal wage rate to the change in the price level. Simulations #6 and #7 consider the same policy packages as in simulations #1 and #3, assuming, however, an indexation coefficient of 60%. As the policy goal is the same in all cases the numerical results for simulations #1 and #6 are almost the same, as is the case with the results for simulations #3 and #7. The key difference, of course, is that nominal magnitudes are significantly affected. Thus, in simulation #6 one requires a 19,900% devaluation together with a more than doubling of the price level and a 73% increase of the nominal wage rate. With $\Omega =$ 0.0, on the other hand, a 180% devaluation and a 69% inflation was sufficient to reach the policy goal (see graph 12 and the discussion therein).

When government expenditures are cut by 10%, however, the devaluation rate falls to 100% with the price level increasing by

55.3%. These changes in nominal magnitudes are about double the ones required in the absence of wage indexation (with the devaluation rate being 55% and the price level increasing by only 19%).

We turn now to analyze the impact of import controls and export subsidies even though, as mentioned before, they are unable --by themselves-- to reach the policy objective. The results of imposing import quotas on competitive imports are presented in table 7 under two alternatives. In the first one (case A) import quotas are assumed to apply to all sectors while in the second one (case B) we exempt imports of sector 5, Chemicals and Oils, from any QR's. This second alternative was considered, given that Chemicals and Oils --being a key intermediate input-- turned out to play a central role in the analysis.

Consider first case A. As import quotas are reduced (with Φ_c, the proportion by which competitive imports are cut, going from 1 to 0) the same happens to effective supply. With aggregate demand still at its original level (given that government expenditures are constant) the result is a sharp increase in the level of prices, along with a reduction of the real wage rate. Rents on imports also increase quite substantially up to the point where $\Phi_c = 0$ when, of course, they are completely eliminated. Note, at the same time, a slight increase in employment. This is associated with an expansion of output in

Table 7

Impact of Import Quotas on Some Macroeconomic Aggregates

Φc	TRADE DEFICIT *		EXPORTS *		IMPORTS *		EMPLOYMENT **		REAL WAGE **		REAL GNP **		RENTS ON IMPORTS **		PRICE LEVEL **	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1.0	69.7	69.7	56.5	56.5	126.2	126.2	–	–	–	–	–	–	–	–	–	–
0.80	63.4	67.9	55.0	56.4	118.4	124.4	0.8	0.4	-6.3	-1.1	-0.3	0.0	67.4	-13.0	6.6	1.0
0.40	58.4	64.3	43.3	56.3	101.8	120.5	2.3	1.3	-39.6	-3.3	-7.3	-0.1	605.7	-48.8	65.5	3.3
0.20	48.7	62.4	44.0	56.1	92.7	118.5	2.7	1.8	-68.8	-4.5	-16.3	-0.3	483.8	-72.5	219.9	4.7
0.10	87.0	61.5	0	56.1	87.0	117.6	2.2	2.0	-91.9	-5.1	-23.7	-0.3	279.5	-85.8	1143.0	5.2
0.00	82.1	60.5	0	56.0	82.1	116.6	0.7	2.3	-95.0	-5.6	-26.4	-0.4	-100	-100	1908.9	5.8

* In foreign currency
** % Deviation from Benchmark Equilibrium ($\Phi c = 1.0$)
A = Quotas on all sectors
B = Excludes Quotas on Chemicals & Oil (Sector 5)

sector 8 where, as mentioned in section IV.2, supra, $\min(ep^C(1+t), \underline{p}) = ep^C(1+t)$ was satisfied in the original equilibrium, with imports preceding domestic supply (see table 4). As import quotas are reduced domestic output substitutes for competitive imports with a concomitant increase in employment.

The most striking result, nevertheless, is the behavior of the balance of trade. As Φ_C drops from 1.0 to 0.2 there is a steady improvement in the balance of trade resulting mostly from a reduction of imports. Note that exports also fall, however, given that with a constant nominal exchange rate and a higher price level the competitiveness of the economy diminishes. When Φ_C drops from 0.2 to 0.1, on the other hand, the balance of trade worsens. This, quite clearly, is associated with the fact that exports are reduced to zero as the price level increases substantially to accomodate the lower effective supply. Interestingly enough the trade deficit at $\Phi_C = 0.1$ is higher than in the original equilibrium (= 69.7). This shows quite conclusively that import quotas can actually worsen the trade deficit.

It follows from table 7 that the value of Φ_C* --i.e., the import quota that minimizes the trade deficit-- is approximately 0.20. This trade deficit, however, is higher than the policy target of 34.9 (= 1/2 B^O) thus indicating that, in this situation, import quotas are unable to solve the foreign exchange crisis.

Note, furthermore, that as QR's on imports are reduced further (with Φ_c going from 0.1 to 0.0) the balance of trade improves once again. This results from the fact that at $\bar{\Phi}_c = 0.1$ exports have been already shut-out such that the only further effect is a reduction of imports. From this we can conclude that the function $B = B(\Phi_c)$ is not only not monotonically decreasing in Φ_c but might actually have more than one turning point (see graph 5).

When Chemicals and Oils are excluded from the QR's the situation is quite different, however (case B). In this scenario there is a slight increase in the price level with a concomitant decrease in the real wage. Exports, however, are almost constant. Thus, the role played by sector 5 as a supplier of a key intermediate input is highlighted and points out that a policy of differentiated import quotas is indeed superior to that of proportional reduction in all imports. Moreover, with selective import quotas the function $B(\Phi_c)$ is modified, turning out to be in this case strictly decreasing in Φ_c.

Even when selective import quotas are implemented, nevertheless, the trade deficit of 60.5 is higher than the desired target of 34.9. Thus, following the discussion of section III.3, a system of rationing of foreign exchange for non-competitive imports must be introduced.

Table 8 presents the results obtained when all competitive imports (except those of Chemicals and Oils) are prohibited

Table 8

Impact of Foreign Exchange Rationing for Non-Competitive Imports [@]

	TRADE DEFICIT [*]	EXPORTS [*]	IMPORTS [*]	EMPLOYMENT [**]	REAL WAGE [**]	REAL INCOME [**]	PRICE LEVEL [**]
Benchmark Equilibrium	69.7	56.5	126.2	–	–	–	–
$\Phi_c = 0$; $\Phi_{nc} = 1$	60.5	56.0	116.6	2.3	-5.6	-0.4	5.8
$\Phi_c = 0$; $\Phi_{nc} = .95$	60.8	53.9	114.8	-2.3	-23.4	-4.0	30.5
$\Phi_c = 0$; $\Phi_{nc} = .90$	65.8	51.4	117.2	-6.8	-43.5	-7.8	77.1

@ Excludes Chemicals + Oils (Sector 5) from QR's and rationing
* In foreign currency
** % Deviations from Benchmark Equilibrium

together with a 5 and 10% reduction in foreign exchange allocated to each sector for the purchase of non-competitive imports. (Recall that Φ_{nc} is the proportion of desired foreign exchange for non-competitive imports allocated to each sector). We should note, however, that for sector 5, Chemicals and Oils, the foreign exchange necessary for it to operate at full capacity is allocated.[36]

A 5% reduction in foreign exchange allocation for non-competitive intermediate imports generates a 30% increase in the price level, a 23.4% decrease in the real wage together with a reduction in employment and real GNP (of 2.3 and 4.0%, respectively). Thus, even if the nominal wage and exchange rate as well as the size of government expenditures are all kept constant, the outcome is a "stagflationary" situation.

The key result, nevertheless, is that the trade balance worsens. The reduction in exports associated with the higher price level and lower output capacity outweighs the savings in foreign exchange on the import side. Furthermore, with a more stringent rationing policy (with Φ_{nc} going from 0.95 to 0.90) the trade deficit is increased while the stagflationary results mentioned above are strengthened. Moreover, note that in this situation imports actually increase. This result, which at first sight might appear paradoxical, is actually quite consistent. With imports prohibited in all sectors except Chemicals and Oils the relative price of this sector drops as supplies are

restricted in the rest of the economy as a consequence of the foreign exchange rationing. Given this, there is a switch in consumption generating higher imports of this sector which, in turn, wipes out the foreign exchange saved by the rationing policy. On the other hand, if imports of this sector were not allowed the associated price increase would eliminate exports of other sectors (see table 7 above).

Once exports are shut-out further rationing of non-competitive intermediate imports would improve the trade balance. This, however, is not feasible. For values of Φ_{nc} lower than 0.9 the set of feasible vectors of government expenditures, G, contracts (see equation (16) and section II.4). With government expenditures still at their original level we generate a situation where $\overline{\lambda}(\Phi_{nc}) < \lambda^o$, that is to say, the maximum allowed vector of real government expenditures is smaller than the observed one. Put differently, with effective supply reduced by the import prohibitions and rationing of foreign exchange policy while the exogenous component of demand is constant there is no possibility of finding a vector of prices at which excess demands disappear in all sectors. If we only consider price induced equilibriums --as is the case in this analysis-- then the rationing policy will have a lower bound at $\Phi_{nc} = 0.9$. We thus conclude that, in this case, import controls fail to achieve the policy goal.

Consider, finally, export subsidies. While they do not

achieve the policy goal either, they do not have such strong negative consequences on output and employment. Table 9 presents the results obtained when, starting from the benchmark equilibrium, the export subsidy rate is progressively increased. The fundamental result is, of course, that there is no improvement of the trade balance associated with the pure export promotion policy.[37] The basic reason for this result is that as the economy expands in reaction to the higher export subsidies, imports increase, particularly competitive imports of the two sectors that were operating at full capacity in the original equilibrium (Agriculture and Chemicals & Oils). Thus, an important part of the expansion is leaked into the balance of trade, although the price level increases only slightly. (Note, for instance, that when the subsidy rate increases to 60% real output expands by 5.3% with only a 4.3% increase in the price level).

Import quotas could, of course, stop the growth in competitive imports associated with the export promotion policy and thus avoid the worsening of the balance of trade. Table 10 presents the results of introducing import prohibitions in all sectors (except Chemicals and Oils) at the same time that the export subsidy rate is increased.

When import prohibitions are present there is-- for a range of values of the subsidy rate-- a slight improvement in the trade balance, although not sufficient to reach the policy goal of

Table 9

Impact of Export Subsidies on Some Macroeconomic Aggregates

τ	TRADE DEFICIT *	EXPORTS *	IMPORTS *	EMPLOYMENT **	REAL WAGE **	REAL INCOME **	PRICE LEVEL **
0.20 ***	69.7	56.5	126.2	-	-	-	-
0.40	71.68	63.64	135.32	2.1	-0.7	2.0	0.6
0.60	77.03	72.59	149.63	5.2	-4.1	5.3	4.3
0.80	104.08	78.17	182.24	11.7	-13.6	11.8	15.6

* In foreign currency
** % Deviations from Benchmark Equilibrium
*** Original value of Export Subsidy Rate

Table 10

@

Impact of Export Subsidies Under Import Prohibitions

τ	TRADE DEFICIT **	EXPORTS **	IMPORTS **	EMPLOYMENT ***	REAL WAGE ***	REAL INCOME ***	PRICE LEVEL ***
0.20 *	60.54	56.06	116.6	2.3	-5.6	-0.4	5.8
0.40	59.31	62.57	121.9	4.7	-8.2	0.8	8.9
0.60	58.35	71.42	129.8	8.7	-14.7	3.1	17.2
0.80	68.10	76.85	144.95	17.1	-29.4	6.5	41.5

* Original value of Export Subsidy rate
** In foreign currency
*** (%) Deviations from Benchmark Equilibrium
@ Except for Imports of Chemicals & Oils (Sector 5)

B^1= 34.8. Moreover, the expansion in employment is larger than the situation where imports are not prohibited. At the same time, nevertheless, there is a stronger increase in the price level together with a more pronounced decrease of the real wage rate. Thus, unfortunately, one is faced with a choice between a higher price level and a lower real wage vis-a-vis an improved balance of trade. From this point of view the combination of export subsidies and import prohibitions is qualitatively no different from the pure devaluation scenario.

We should note, on the other hand, that there is no steady improvement of balance of trade as the subsidy rate is progressively increased.[38] Thus for τ = 80% the trade deficit grows once again. Clearly, at this value of τ, with government expenditures still at their original level a large number of sectors reach full capacity and the higher export subisidies are absorbed mostly by higher imports and a higher price level (particularly imports of Chemicals and Oils that are not subject to the import prohibition such that its nominal price is constant throughout).

The preceding results were obtained in a scenario where nominal wages did not react to the inflation associated with the export subsidies. Table 11 presents the results of the same policy package (i.e., export subsidies with selective import prohibitions) assuming, however, that Ω = 0.6. In this case there is no improvement of the trade balance as the export subsidy rate

Table 11

Impact of Export Subsidies Under Import Prohibitions and Wage Indexation

τ	TRADE DEFICIT *	EXPORTS *	IMPORTS *	EMPLOYMENT **	REAL WAGE **	REAL INCOME **	PRICE LEVEL **	NOMINAL WAGE **
0.20	62.59	55.3	117.91	2.2	-4.0	-0.1	10.8	6.5
0.40	62.27	60.97	123.25	4.3	-5.6	1.1	16.1	9.7
0.60	63.36	69.57	132.94	8.1	-9.4	3.5	30.4	18.3
0.80	77.13	73.85	150.98	13.8	-16.9	6.6	72.7	43.6

@ Indexation coefficient is 0.6; no input prohibition is applied on Chemicals & Oil (Sector 5)
* In foreign currency
** % Deviations from Benchmark Equilibrium

increases while the price level, as expected, is higher. Put differently, wage indexation, in this case, eliminates completely the effectiveness of export subsidies.

To sum up: Export subsidies, by themselves, worsen the balance of trade. This result can be reversed, however, with selective import prohibitions even though the improvement is not sufficient to achieve the policy goal. Furthermore, for larger values of the export subsidy rate the trade balance worsens again, while the price level increases and the real wage is lowered. On the other hand, if nominal wages are indexed to changes in the price level one obtains no improvement of the trade balance even in the range where exportable sectors operate with excess capacity.

VI. Summary and Conclusions

We have constructed a CGE model that incorporates some short run features observed in Latin American economies. In particular, QR's on exports and imports have been introduced and quota derived rents have been included as a source of income. Furthermore, the economy has been assumed small only on the import side, such that export prices are endogenous. A distinction between traded and tradeable goods has been introduced, together with the possibility of "water on the tariff". Thus, the law of one price need not hold.

Another key feature has been the modelling of supply with unutilized capacity. Thus, excess demands clear by price change, output adjustments or imports depending on the degree of capacity utilization, the tradeability of the good and the trade regime. At the same time, the possibility of nominal wages tied to changes in the level of prices has been considered, with a variable degree of real wage rigidity.

The model was used to analyze the mechanisms by which the economy could adjust to a foreign exchange crisis. Four basic responces were considered: (a) import controls, (b) devaluation, (c) cuts in government expenditures and (d) export subsidization.

The impact of QR's on competitive imports, on the real wage and the distribution of income was modelled. At the same time, the effects of import quotas on exports, via prices, was captured. It was then shown that the import quota which minimizes the trade deficit need not be zero.

Furthermore, foreign exchange rationing for non-competitive imports was also modelled as a possible response to the foreign exchange crisis. In this case domestic capacity output became an endogenous variable, depending on the rationing rules. We then obtained a situation where output contracts while the price level increases even if there is excess capacity in the economy and there is no change in either the nominal wage or exchange rate.

When devaluation is used as a policy tool to face the crisis the response of output is ambiguous, while there is an

important shift in relative prices and income distribution. Nevertheless, it is not always true that a devaluation, by increasing the cost of non-competitive intermediate imports will increase price. Whether this is the case or not depends on the characteristics of each sector and in some cases rather than observing a price increase a contraction of mark-up rates turned out to be the outcome. As is the case in other models, however, the effectiveness of the devaluation depended crucially on the extent to which the real wage could be lowered.

Cuts in government expenditure were also used to respond to the foreign exchange crisis. In this case the adjustment worked basically through the quantity side of the economy producing a contraction of output and employment. At the same time, a deflationary effect could be observed with the result being a simultaneous increase in the real wage and the real exchange rate, as these two nominal variables were assumed to be inflexible downwards.

Export subsidies, finally, were shown to be most effective when there was excess capacity in exportable sectors as well as their suppliers, together with high price elasticity of demand for exports. However, even in these cases one required that the additional tax collections associated with the output expansion exceeded the direct expenditures on export subsidies. If this was not the case the net effect would be a worsening of the balance of trade, although at a higher level of output and employment.

The model was calibrated to an economy that produced 2 primary goods, 6 manufactured goods and 2 non-tradeables. The underlying data for the economy came from the Mexican National Accounts for 1975. However, no claim was made that the model replicated the behavior of the Mexican economy, as there are some crucial features of this economy that were not incorporated in the model. In particular, price controls --which are central to the mechanism of relative price formation and the behavior of the fiscal budget in Mexico-- were left out of the analysis.

Thus, the benchmark equilibrium was best seen as a "stylized" semi-industrialized LDC with a series of characteristics that are typical of some Latin American economies. More concretely, the basic macroeconomic ratios (in terms of exports/GNP, taxes/GNP, etc.) the structure of output (share of primary, manufacturing and non-tradeable sectors in GNP) as well as the distribution of income (shares of wages, profits and rents in GNP) were quite similar to those of economies at an advanced stage of import substitution like Mexico or Brazil.

Given the benchmark equilibrium, a foreign exchange crisis was considered. This was interpreted as a situation where, for some exogenous reasons, the flow of foreign exchange coming from abroad was reduced. In particular, we assumed that the economy had to reach a new equilibrium where the balance of trade deficit was reduced by 50%.

Of the four policies considered only two-- devaluation and cuts in government expenditures-- were able, by themselves, to adjust the economy to the foreign exchange crisis. Policy mixes, involving two or more instruments at a time were also condidered, and some were also able to reach the policy goal.

Perhaps the fundamental numerical result was the absence of any policy package that could adjust the economy to the crisis without a reduction in real GNP. However, the policy implemented did matter, as the drop in real GNP required to reach the desired objective ranged from -4.0% to -9.4%.

A second key result was that no adjustment mechanism was uniformly better than the rest in terms of the behavior of the main variables analyzed. Moreover, the various adjustment mechanisms did indeed have quite a different impact on the level of prices, the structure of output, the level of employment, the behavior of the real wage rate and the shares of wages, profits and rents in total income. We thus conclude that in the absence of additional information concerning the relative importance attached to these variables it cannot be claimed that a particular response to a foreign exchange crisis is superior than others.

The numerical results obtained are, quite clearly, dependent on the type of economy analyzed as well as on the characteristics of the benchmark equilibrium. In fact, and as was strongly emphasized in section III, the degree (and sectoral

dispersion) of excess capacity together with the structure of relative prices ruling in the initial equilibrium is critical in determining the response of the economy to a particular adjustment policy --given the set of exogenous parameters (elasticities, technology, etc.). Thus, one cannot claim, without further numerical analysis, that the same qualitative results would hold for a different benchmark equilibrium.

It is thus of the essence for policy purposes to carefully characterize the equilibrium ruling at the time of a foreign exchange crisis. It would be quite surprising indeed if the same adjustment policy turned out to be the best one for the same economy in different initial equilibriums or for different types of economies.

While maybe a subset of policies is always effective in bringing about the necessary adjustments, the costs in terms of employment, output and income distribution are quite different in each case. The model developed in this paper appears to be flexible enough to analyze this issue. It thus appears that further research should concentrate on analyzing adjustment policies for economies with different benchmark equilibriums and/or set of exogenous parameters. The outcome of such research would provide a more detailed description of the options open to effectively respond to a foreign exchange crisis.

Footnotes

*   I would like to express my gratitude to Roberto Bonifaz for his excellent work as research assistant.

1. See Lysy & Taylor (1979) for a discussion of different "closure rules" in CGE models.

2. As will be shown below, the introduction of QR's greatly facilitates the modelling of non-tradeable goods and of import and export prohibitions.

3. Schydlowsky (1979) and Winston (1984) present documentation on unused capacity in many Latin American economies.

4. This problem is not present in CGE models that assume full utilization of the capital stock. Under these conditions the marginal product of labor will be decreasing, generating in turn a positively sloped supply function. Prices then result from the interaction of supply and demand and payments to capital (or quasi-rents) are a residual obtained from substracting wages and intermediate costs from product price (cf. Dervis et. al. (1983)).

5. Taylor (1983) also develops a model for a one sector economy where the mark-up rate is exogenous as long as there is unused capacity.

6. In Dervis, et. al. (1983) a government sector is included, but it is assumed that it behaves as any other consumer and satisfies its budget constraint.

7. The parenthesis immediately after a variable denotes its dimension.

8. Note that in (2) and (3) the expenditure shares summed over the set of domestically produced commodities equal unity, thus implying no consumption of non-competitive imports. Of course one can have for each group $\sum \eta_i < 1$, with the difference being allocated to non-competitive imports. Although this adds realism to the model, it is not essential to any of the following results and thus will not be considered.

9. Note that while the export functions are not differentiable, they are nonetheless continuous.

10. Alternatively, we can call $\underline{p}_i$ the "shut-down" price.

11. The bar below matrix A indicates that its main diagonal has

been deleted.

12. Obviously, when $p_i = ep^c_i(1+t_i)$ the solution is indeterminate. In this case, however, we will assume that domestic suppliers will come first and treat this possibility under (10).

13. Unless, of course, $\tau_i > t_i/(1+t_i)$. In what follows, however, we will rule out this situation.

14. Therefore, althouth the QR "protects" by allowing a domestic price higher than the world price just as the tariff does, its effects on output and employment are quite different.

15. Note that if distance $ep^c/(1+\tau).D$ -the range of the export demand function for which the economy is small- had been larger, the market demand function would have been q^D_3 with equilibrium at F and price equal to $ep^c/(1+\tau)$. Thus, we would obtain as a special case the standard result of the small economy for which the price of an exportable is given by the world price modified by the export tax/subsidy.

16. Note that when $d_i = \rho_i(ep^c_i/p_i(1+\tau_i))^{\beta_i} > 0$ such that exports are positive but the quota is not binding, we will obtain from (14) that $\bar{p}_i = p_i$. Thus, in this

case, production for exports and for the domestic market will receive the same price.

17. Other CGE models that include government spending treat it analogous to consumer demand and therefore make vector g sensitive to relative prices. (Dervis, et. al. (1983)). While this avoids a requirement like (16), it is not, in our opinion, a very realistic formulation.

18. Note that λ is also bounded from above, since any vector λg must belong to set G by (16). We shall denote this upper bound on by $\bar{\lambda}$.

19. An appendix with a description of the algorithm used to solve the model is available upon request.

20. We ignore changes in international reserves held by the country.

21. This can result from an exogenous reduction in the supply of foreign credit, capital flight, an increase of the interest rate on the country's outstanding foreign debt or some combination thereof. Diaz-Alejandro (1984) presents data on this phenomenon for the main Latin American economies.

22. Note that with $\Phi_c = 0$, there are no markets for importables.

23. Note that this function is not linear, as we have assumed that the economy is not always "small" on the export side.

24. Note that import controls reduce the size of set G in (16), while vector λ^o_g remains fixed.

25. Note that the change from $e^o p^c_i(1+t_i)$ to $e^1 p_i{}^c(1+t_i)$ exceeds the change from $\underline{p}_i{}^o$ to $\underline{p}^1_i$. This follows from the fact that $\Omega < 1$ such that costs of production do not increase by the full amount of the devaluation.

26. Note that if a good was subject to a binding import quota (with $q^D = q^D_5$ in graph 8 and price at p^5), the devaluation will not affect prices but rather reduce quota rents (from BCGF to RFGQ) -assuming that the quota remains binding after the devaluation.

27. Note that the higher the value of β_i, the flatter the export demand curve, such that export quantities are more responsive to a given devaluation.

28. In some cases, the adjustment might actually force some sectors to shut down completely. This is illustrated in panel (b) of graph 14, where the original equilibrium satisfied $\min(ep^C(1+t), \underline{p}) = ep^C(1+t)$. The cut in effective demand shifts the equilibrium from D to E, with domestic output equal to zero and a cut in competitive imports from A to E. (Note that quota rents will also be eliminated).

29. If the additional tax collections exactly match the export subsidies the trade balance will remain unchanged from its original level (although output and employment will be higher).

30. For instance, the 1982-1984 crisis in Mexico was tackled with a sharp devaluation, a reduction in government expenditures as well as an increase in indirect taxes (particularly the value added tax rates).

31. Of course, we could have manipulated the data such that the benchmark equilibrium exactly reproduced the Mexican economy in 1975. The point is, however, that the behavioral equations underlying the model miss some features that, in our opinion, are critical in the Mexican case. Thus, the responses to different adjustment policies that will be simulated in section V would not be an accurate description of the way in

which some markets in Mexico adjust to exogenous shocks. This is particularly important in the case of price controls which play an important role in Mexico and are vital to a full understanding of the budget deficit/surplus. It should be noted that other CGE models that have been built for Mexico (Serra Puche (1984), Gibson, et. al., (1982)) also miss this crucial element in the mechanism of relative price determination. Thus, one should use great care in applying the conclusions derived from these models-- including the present one-- to the Mexican economy.

32. In particular, the macroeconomic ratios found in table 2 are typical of a semi-industrialized economy like Mexico or Brazil in terms of the size of the government sector, structure of trade and taxation, share of industry in GNP, income shares and other parameters. For a full discussion of "stylized parameters" of developing economies, see Chenery and Syrquin(1975).

33. In 1975, wages accounted for 39% of GNP, while profits were 50.6%. At the same time, exports were 5% of total income and imports were 8%.

34. It follows from this that if the policy objective is to reduce the magnitude of the trade deficit one should not set

policy goals in terms of the fiscal deficit/GNP ratio (as is common practice). This can be seen clearly in the devaluation scenario where this ratio falls by less than 1% even though the trade deficit is indeed halved. Pursuing a lower fiscal deficit/GNP ratio through a higher devaluation would have resulted in an "over-fulfillment" of the policy objective, with the costs of adjustments being higher than necessary.

35. In particular, the simple average of capacity utilization rates drops from 86 to 80%.

36. If foreign exchange for intermediate imports was rationed to this sector while no import quota is imposed there would be a net loss of foreign exchange, as imports would fill in for the reduced output of the sector (this assumes, of course, that value added at world prices in this sector is positive).

37. This despite the fact that the price elasticity of exports has been assumed to be 2.5 for almost all manufactured goods (see table 1).

38. An alternative way of stating this result is that the function $B(\tau)$, as was the case with $B(\bar{\phi}_c)$, need not be monotonic.

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