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The Macroeconomic Effects of Changes in Barriers to Trade and Capital Flows: A Simulation Analysis *

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Summary

The liberalization of foreign trade and the movement of capital, or what has come to be commonly termed "opening-up" the economy, is a subject that has become of increasing interest to developing countries, including many in the Latin American region. While the longer-run costs and benefits of such a strategy may be well-known and understood, there has hitherto been little systematic study of the short-run effects on the economy as it moves from a relatively closed system to a more outward-oriented one. Analyzing some of the short- to medium-term economic aspects of a policy of reducing barriers to trade and capital flows is the basic focus of this paper.

The short-term issues related to opening-up are handled within the framework of a dynamic general equilibrium model constructed specifically for this purpose. This model, which concentrates on the determination of major macroeconomic variables, has its roots basically in both theoretical and empirical general equilibrium models, as well as the more monetary-oriented models developed to study the macroeconomics of open economies. At the same time care is taken to also explicitly incorporate certain phenomena that have emerged in country experiences with liberalization, such as persistent deviations from the law of one price and interest rate parity. This makes the resulting model more representative of a "typical" Latin American country, although it should be stressed that the model is quite general and does not pretend to be exactly relevant to a particular country. Dynamics are introduced so as to be able to trace out the transition paths of variables such as economic activity, employment, prices, the balance of payments, external indebtedness, interest rates, and the like, from one equilibrium position to another.

Using a representative set of parameter values, the model is simulated for various types of opening-up strategies, including gradual and sudden removal of tariffs and restrictions on capital flows, both separately and simultaneously, and the removal of these barriers in different sequences. It is believed that such experiments cover, in the main, most of the actual types of policies adopted by developing countries that have embarked in the direction of opening up their economies. Briefly, the results indicate that in all cases some transitory costs are incurred. These costs include, inter alia, reductions in growth and employment, current account deficits, declines in fiscal revenues, etc. The overall exercise yielded basically the following important insights. First, it was shown that quite a different picture emerges depending on whether foreign trade or capital flows are liberalized, and that a simultaneous liberalization of both is not simply a linear combination of the two policies implemented separately. Second, the speed with which the reforms are instituted is important. As expected, a shock-type approach has a more pronounced impact at the beginning but the adjustment to equilibrium is faster. Finally, and perhaps most interesting, it is not a matter of indifference as to which type of policy is implemented first if a choice is to be made. Clear trade-offs emerge, leaving the policy-makers to choose the particular strategy that would be consistent with their own overall perspective.

I. Introduction

The issue of "opening-up" of domestic economies to the world economy through the liberalization of trade and capital movements --either across-the-board or selectively--has been of perennial concern to policy-makers in the developing world. In recent years there has been a further renewal of interest in this subject in these countries, including many in the Latin American region. While the reasons for this heightened interest are varied, there are basically three that can be considered of principal importance.

Firstly, there is the "demonstration effect" imparted by the economic performance of a select group of developing countries, particularly in South-East Asia, where the growth of trade has played a major role. A number of studies of individual country experiences that have been recently completed (i.e., Bhagwati and Srinivasan (1979), Balassa (1980), Keesing (1979), Krueger et al. (1981)) have shown that at the broadest level, the countries adopting "outward-looking" development strategies have fared far better in terms of economic growth, employment, economic efficiency, and adjustment to external shocks than those that have engaged in more "inward-looking" strategies. The outward-oriented strategies have been typically characterized by, inter alia: the provision of incentives for export production; the encouragement of import competition for most domestically-produced goods; and the use of the nominal exchange rate for the maintenance of realistic real exchange rates. At the same time, various developing countries have experienced a relative loss of dynamism in their import-substitution based industrialization processes, and thus have had to consider designing new strategies for the external sector much along the lines adopted by the "outward-looking" developing economies.

Secondly, in certain countries there has been a move towards greater stress on the role of market forces in the functioning of the economic system, and this has led to a revival of the propositions associated with the well-known theory of the "gains of trade." Briefly, according to this theory, international trade is believed to contribute to the development process in the following ways: trade allows a country to follow the route indicated by the theory of comparative advantage; offers greater opportunities to exploit economies of scale; increases the supply capacity of the economy through imports of capital goods, raw materials, and other inputs in the production process; and finally, by providing competition for tradable goods, is both a source of stimulus and pressure for domestic production and, depending on the exchange rate policy being pursued, can set limits to the domestic rate of inflation. In a similar vein, insofar as liberalization of capital movements is concerned, proponents argue that capital flows can increase the supply of financial savings, augment the stock of capital, and induce competition and efficiency in the domestic financial system.

In the third place, the generally increasing integration of the world economy, both in the goods markets and capital markets, has meant that countries have been drawn into closer international relationships, whether expressly desired or not. This growing interdependence has also contributed to a re-orientation of thinking and policies in these countries so as to be able to adjust to international developments. 1/

It can clearly be argued that it was a combination of these theoretical and empirical factors that prompted several Latin American countries to move in the direction of opening-up their economies to international competition. The most dramatic shifts in policy occurred in the Southern Cone countries--Argentina, Chile and Uruguay--although other countries in the region also followed this path, albeit in a more restrained and selective fashion. Uruguay started the process around 1974, and the liberalization reforms were instituted around 1975-77 in Argentina and Chile. Venezuela moved to rationalize its protection system in 1978-79, and Colombia, Mexico and Peru also took steps towards freer trade and the liberalizing of capital movements. Moreover, it appears that there are other countries, both within and outside the Latin American region, that are closely watching and judging these experiments.

Nevertheless, a majority of developing countries are reluctant to embark in the direction of liberalizing their trade and exchange systems. If such policies seem so attractive on economic grounds, then it is certainly relevant to ask what the reasons are that underlie this supposed reluctance. The answers, of course, are not clear-cut by any means, but there are several factors that bear on this issue. 2/ At the outset it should be recognized that many government policies, including controls on trade and capital flows, may have been implemented in full-knowledge of their likely adverse effects on resource allocation and efficiency, as measured by market prices. These policies are, however, regarded as having strong implications from the point of view of equity, so that welfare considerations can play a fundamental, if not overriding, role in any decision to alter existing distortions and controls in the foreign sector. The arguments based on externalities created by offering incentives to produce domestically rather than import, and achieving a minimum stage of industrialization, are of no less importance, particularly if it is not known where a country's dynamic comparative advantage lies. Broadly speaking, there may be both long-run economic and social costs that have to be balanced against the long-run economic benefits to be expected from opening-up.

1/ For a detailed study on the effects of the changing international environment on developing countries, see Goldstein and Khan (1982a).

2/ Some of these factors have been covered in the studies by Ayza et. al. (1975), Ffrench-Davis (1979), and Villanueva (1978).

The longer-term factors discussed above can clearly inhibit the opening-up of an economy, but perhaps equally important in this context are the short- and medium-run effects that occur when such a strategy is adopted. Simple casual observation shows that there are serious, even if transitory, costs as the country moves from a relatively closed economy to a more open one. These costs can include, among others, losses in output and employment, current account deficits, a fall in fiscal revenues, increases in external debt, etc. Whatever the long-term effects are in net terms, these short-run costs can provide an effective constraint to a country's desire to embark in the opening-up direction. Some consideration has to be given to these potential shorter-term problems as well. The identification of such costs, both at the macroeconomic and microeconomic levels, and to determine if they are general or country-specific, is therefore of utmost importance and the available evidence on this is extremely scanty. Furthermore, if these costs are general in nature, and thus to be expected whenever liberalization policy is adopted, do they depend on the specific type of liberalization strategy chosen? Opening-up has not, of course, been uniform with respect to the trade and capital accounts, nor has the speed with which these reforms have been implemented in various countries. For example, Argentina and Uruguay eliminated capital controls first and then proceeded slowly towards goods market liberalization. On the other hand, Chile chose the opposite sequence of moving first towards the more rapid removal of trade restrictions and then allowing a greater degree of capital mobility. Mexico and Venezuela had no capital controls to speak of for some time and, therefore, their concentration was exclusively on the trade side. Finally, can the negative aspects associated with opening-up be mitigated or minimized by an appropriate mix of different policies? To our knowledge these issues have not been dealt with in the literature in any generalized and systematic fashion.

Analyzing this latter set of questions, namely relating to the shorter terms aspects of liberalization policy, is the focus of this study. By such an examination it would be possible to shed some light on whether these short-run effects are significant enough to warrant concern. It should be stressed that no explicit attempt is made here to consider the long-run aspects of liberalization, but simply to determine the process of adjustment of the economic system after the new policy has been initiated. While this type of approach does exclude a number of interesting and important issues, it is believed that the exercise does provide useful insights in an area where information is lacking. Furthermore, by restricting the analysis to the short-term enables us to stay clear of difficult welfare-related issues which naturally arise when one looks into the long-term consequences of opening-up of the economy. It was also the express intention to concentrate on the effects of changes in policy on variables such as overall economic activity, prices, the balance of payments, external indebtedness, and interest rates, etc. As such the exercise is exclusively macroeconomic in nature. It is

considered that studying the simultaneous interaction of the main macroeconomic variables, and their initial response to policy stimuli generated in the context of removal of restrictions on trade and capital flows is a necessary first step in properly ascertaining the response of the economic system.

The various short-terms aspects of opening-up are handled within the framework of a dynamic general equilibrium model constructed for this specific purpose. This is a more systematic approach than analyzing the liberalization experiences of individual countries, as for example, has been done by Zahler (1980), Diaz-Alejandro (1981), Gaba (1981), Wonsewer and Sarachaga (1981), Mezzera (1981), and Fernandez and Rodriguez (1982). The model designed has the capability of explaining the more important macroeconomic variables, and the structure is based on well-grounded economic theory. It has its roots in a variety of theoretical and empirical general equilibrium model that have been formulated to deal with issues similar to the ones we are basically interested in, 1/ and also has strong links with the more monetary-oriented models that have been proposed to analyze short-term stabilization policies. 2/ The model does go well beyond the standard monetary models and contains an explicit, albeit simplified, treatment of the real sector, and the interaction of this sector with the monetary sector. Nevertheless, the crucial role played by monetary disequilibrium in the behavior of major macroeconomic variables is stressed in the model, and as such it remains consistent with the basic long-run tenets of the monetary approach to the balance of payments. 3/ In fact, even though the attention is focused exclusively on the short-run path of the economy, considerable care is taken throughout to ensure that long-term conditions that are consistent with general equilibrium theory are satisfied. However, the dynamic aspects are considered crucial since the trajectories of the variables are of great interest to policy-makers, and it is precisely in this area where there is a serious gap in the literature. 4/

The model is taken to be representative of a "typical" Latin American economy, and thus does not pretend to be exactly applicable to any single country. For this reason its structure is quite general in form and aims at covering only the essential features of a broad group of countries. It

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1/ See, for example, the models of Clements (1977), (1980), and Feltenstein (1980).

2/ These include, among others, the models developed by Blejer (1977), Blejer and Fernandez (1980), Knight and Wymer (1978), Aghevli and Khan (1980), and Khan and Knight (1981).

3/ See Frenkel and Johnson (1976) and IMF (1977). For a more recent discussion of the relationship between the monetary and the absorption approaches, see Massad (1980).

4/ Both Clements (1980) and Feltenstein (1980), for example, deal with models in continuous equilibrium.

does not seek to incorporate institutional or other characteristics which would necessarily have to be taken into account to apply the model to any particular country. The economy represented by this model is assumed to be small in relation to the world, and operates under a fixed exchange rate regime. 1/ It is also assumed that the domestic markets are relatively free of direct government control. This last assumption implies that prices are essentially market-determined and that financial reforms liberalizing the domestic financial system have already been implemented.

Nevertheless, even though highly aggregated, the model is sufficiently rich and complex to yield the necessary answers to the relevant questions. It is also, as mentioned previously, dynamic in that it allows for delayed response of variables and can trace out the path of adjustment from one equilibrium position to another. It is obvious that questions of transition definitionally imply the study of the time-path of the variables after there has been some type of shock to the system. The complex and dynamic structure of the model precludes its solution in any simple analytical fashion. Numerical values for the parameters are required and these can be obtained either through econometric estimation, or imposed from outside the system. The latter approach was taken here for two reasons. First, econometric estimation of such a model is quite difficult, and further it was not the intention to apply this model in its present stage to any single country, or group of countries. Second, there was already considerable information available in the literature for a number of relevant parameters, and this could be readily utilized. As such the model is properly described as a "simulation" model, and naturally all the results are conditional on the values of the parameters chosen. 2/ Some sensitivity analysis through the variation of certain key parameters was performed to determine if the basic results were significantly different.

The initial equilibrium, namely the case of the closed economy, was defined as one where there was a uniform tariff on imports, 3/ and capital inflows and outflows were completely restricted. Trade liberalization was defined then as a reduction in the tariff rate to zero, and correspondingly capital account liberalization as the complete removal of the existing restrictions. With the properties of the initial equilibrium

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1/ The exchange rate system could include pegging the nominal exchange rate, crawling peg regimes, preannounced exchange rate schedules, etc.

2/ This is the type of approach taken in the larger computation general equilibrium models. See Feltenstein (1980).

3/ The assumption of a uniform tariff does not involve any loss of generality and has been done only for simplicity.

defined, and using a ceteris paribus assumption regarding the international picture and with respect to other domestic policies, 1/ the following simulation experiments were conducted: (a) gradual and sudden removal of trade restrictions; (b) gradual and sudden removal of restrictions on capital movements; (c) simultaneous gradual removal of restrictions on both trade and capital flows; and (d) sequential gradual removal of restrictions on both trade and capital flows. The results from these simulations allow us to evaluate the effects of "gradual versus shock" types of policies, as well as the effects of combination of alternative policies implemented simultaneously, or with differing speeds. The last simulation is particularly interesting since there has been a lively discussion in the literature on whether a country should liberalize its trade account first or its capital account. 2/ Together these four sets of simulations are reasonably comprehensive, and as such are believed to cover most of the actual types of liberalization strategies.

While the model is utilized here only for the study of the effects of opening-up, it can easily be extended to analyze a variety of other issues as well. For example, it can be used to simulate the effects of other domestic policy actions, as well as changes in foreign variables. Furthermore, within the model it is possible to design compensatory stabilization-type policies that operate in conjunction with the opening-up policies. One such experiment is undertaken here to demonstrate this particular capability of the model. Also, even though growth is not explicitly allowed for in the present version of the model, it can easily be introduced exogenously without radically altering the basic structure. What the model is not able to do is handle growth endogenously so that it cannot properly deal with the longer-term aspects of opening-up. Capital formation, labor force participation, transfer of factors, wealth accumulation, etc., have to be introduced if such long-term effects are to be covered adequately. To do so, however, was not the intention in this present study.

The remainder of the paper proceeds as follows. Section II describes the basic structure of the model. The various simulation experiments are considered in Section III, and the principal conclusions of the study are reported in Section IV.

1/ This assumption was made solely for the simulation experiments. The model itself is able to simultaneous handle both domestic policy changes and alternative international scenarios.

2/ See McKinnon (1982) and Frenkel (1982) for a discussion of some of these issues.

II. Specification of the Model

The model consists of 37 equations, of which 17 can be regarded as behavioral, while the remaining are definitions or identities. In a sense, the size of this model represents a compromise between the much larger computational general equilibrium models developed by Feltenstein (1980) and Dervis et al. (1982) among others, on the one hand, and the more aggregated models of Clements (1980), Blejer and Fernandez (1980), and Khan and Knight (1981), on the other. There are basically two reasons for the level of aggregation chosen. First, as it is sought to evaluate the behavior of the main macroeconomic variables of a general rather than specific economy, it is necessary to restrict the complexity of the model and limit it to its essential features. In other words, country-specific institutional details are excluded from consideration. Second, since this is a simulation exercise we require numerical values for the parameters, and the more the model is expanded the greater is the degree of arbitrariness in selection of parameters, thereby possibly increasing the danger of making the results less general.

Essentially this model describes an economy that is "small" in the sense that it takes prices and interest rates in the world markets as given parameters. It assumes a fixed nominal exchange rate, or more strictly, one that is not subject to market forces, but which can be altered by the authorities in whatever manner they choose. Foreign trade, while permitted, is subject to a relatively high uniform tariff on imports that creates a wedge between domestic prices and the price of importable goods. Capital movements, however, are completely restricted. In contrast to the restrictions on trade and capital flows, it is assumed that domestic prices and interest rates respond to market forces. In the case of the latter this implies that reforms affecting the operation of the domestic money and credit markets are assumed to have been carried out. 1/

Potential output, which can be identified as the "transformation curve" of the economy, is assumed to be determined exogenously, that is to say, it is independent of the endogenous evolution of the variables in the system. This means that the productive capacity of the economy is unaffected by the opening-up, even though it could, in principle, be allowed to increase over time. This is a serious assumption and warrants comment, since it implies that in the short-run, capital formation, technical progress, etc., are unaffected by any liberalization policy. While we can legitimately assume the growth of the labor force as exogenous, determined, for example, by population growth, the assumption of no increase in net investment is not as easy to justify, since it necessarily

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1/ Such financial reforms, taking into account the complex interactions between the money and credit markets, distinctions between lending and borrowing rates, and differential reserve requirements, etc. have been analyzed in detail by Mathieson (1979) (1980), Fry (1981), (1982), Zahler (1980), Gaba (1981), and Wonsewer and Sarachaga (1981), for various countries.

implies zero net additional national savings. However, it is well-known that policies of opening-up are usually accompanied to a greater or lesser extent by current account deficits, which constitute external savings. To assume that net savings (and therefore net investment) are constant, it is necessary to impose the condition that changes in external savings are exactly offset by changes in domestic savings. While this is possibly an extreme assumption, there is some empirical evidence that points to partial offsetting in developing countries, in the sense that part of external savings goes into financing consumption. 1/ Basically this overall assumption of a given transformation curve was made to avoid consideration of sectoral production functions which would have greatly complicated the structure of the model.

Actual real output is, of course, endogenously determined so that the model attempts to capture the short-term deviations of output from potential output. The gap between potential and actual output measures resource unemployment, which with limitations and in an indirect manner, can be interpreted as unemployment of labor. 2/ The long-run equilibrium for output is therefore defined as a point on the transformation curve, namely where actual and potential output are equal, allowing for some small level of permanent unemployment of resources.

In line with the current theory of international trade, the model contains three types of goods: importable goods, exportable goods, and nontradable goods. These categories are essentially based on the relative degree of substitution between domestic and foreign goods in consumption and production (reflected basically through price differentials, including transport costs, tariffs and other trade distortions, and any other adjustments). This classification, which is useful for the present purpose, directed as it is towards analysis of the foreign sector, does not incorporate any distinction between consumption goods and investment goods. This omission does constitute a further limitation, since one of the most frequently discussed issues in the process of opening-up is the impact of such a policy on the rate of capital formation. 3/ Neither, for that matter, is there any consideration of intermediate inputs, so that all goods are "final" goods.

1/ See, for example, Weisskopf (1972), Mikesell and Zinser (1973) and Fry (1980).

2/ This requires assuming that at the aggregate level there is a reasonably stable relationship between unemployment and total real output. However, it should be noted that the productivity of labor in different sectors is usually heterogenous, so that changes in the level and structure of production may be quite different with respect to their impact on employment.

3/ This discussion usually involves considerations which are not easy to handle in a model such as the one used here. These include the uneven structure of the protection given to consumption and investment goods, possible initial situations of disequilibrium with respect to stocks of consumption goods (usually associated with an excess demand for such goods), the impact of opening-up on the demand for domestic credit and, in a more general sense, on the evolution of the capital market, etc.

Finally, the model has three important general equilibrium characteristics. First, the quantities produced of each good are limited by the aggregate transformation curve, the position and shape of which is in turn determined by the resource endowment and technology of the economy, and in the long-term the vector of quantities produced satisfy this restriction. Second, the demand equations for these goods satisfy the theoretical conditions of homogeneity, symmetry of substitution effects, and additivity. The last general characteristic of the model is the explicit introduction of budget constraints, both for the government and for the economy as a whole. 1/ The government budget constraint makes it possible to link the balance of payments and the fiscal and monetary sector to domestic expenditures and income. These links are modelled explicitly and, together with the first two elements referred to above, ensure the global and sectoral consistency of the model.

The model contains the following six sectors: (1) production and supply; (2) expenditures; (3) prices and unemployment; (4) money and credit; (5) the balances of payments; and (6) the government sector.

1. Production and supply

The system of equations determining "desired" aggregate supply for the three types of goods, importables (Is*), exportables (Xs*) and non-tradables (Ns*), is derived in a manner outlined by Clements (1980) in the framework of a multiproduct supply model. This involves the maximization of the value of the national product subject to the restriction represented by the transformation curve, and the respective prices of the three goods, Pi, Px, and Pn. The shape of the transformation curve describes the technological possibilities of transformation of one good with another, and its distance from the origin represents the available resource endownment, given by the potential real output y*. Assuming that the technology is characterized by a quadratic transformation function, the producers problem can be formally described as:

$$\text{Maximize} \quad P'Z$$

$$\text{Subject to} \quad Z'\Lambda Z = y^{*2}$$

where P is a price vector, [Pi, Px, Pn], Z is the quantity vector, [Is*, Xs*, Ns*], and $\Lambda = \text{diag}\,[\gamma_1, \gamma_2, \gamma_3]$. 2/ The γ_i are the price

1/ Namely that government spending is constrained by fiscal revenues and borrowing, and the current account of the balance of payments is equal to the excess of absorption over income (Alexander (1952)).

2/ In general Λ is a positive definite symmetrical matrix of parameters, but for simplicity it has been assumed to be diagonal.

parameters of supply of importables, exportables, and non-tradables, respectively. Also y* is a positive scalar which determines the distance of the transformation surface from the origin and represents the total endowment of resources. For the present study it has been assumed constant, i.e.:

$$(1) \quad y^* = \bar{y}^*$$

The solution to the maximization problem is given by:

$$(2) \quad Z = \frac{y^*}{(P' \Lambda^{-1} P)^{1/2}} \Lambda^{-1} P$$

so that the desired supplies of importable, exportable, and non-tradable goods depend exclusively on the relative prices of the three goods, the technical conditions of transformation of one good into another, and the resource endowment. The system of equations, Z, is homogeneous of degree zero in prices, the cross-price effects are symmetrical, and the weighted sum of the price effects across equations is zero. 1/ The specific desired supply equations for the three goods are as follows:

$$(2a) \quad I_t^{s*} = \left[\frac{\gamma_2 \gamma_3 \, y_t^{*2} \, Pi_t^2}{D} \right]^{1/2}$$

$$(2b) \quad X_t^{s*} = \left[\frac{(\gamma_1^2 \gamma_3 / \gamma_2) y_t^{*2} \, Px_t^2}{D} \right]^{1/2}$$

and,

$$(2c) \quad N_t^{s*} = \left[\frac{(\gamma_1^2 \gamma_2 / \gamma_3) y_t^{*2} \, Pn_t^2}{D} \right]^{1/2}$$

where,

$$D = \gamma_1 \gamma_2 \gamma_3 \, Pi_t^2 + \gamma_1^2 \gamma_3 \, Px_t^2 + \gamma_1^2 \gamma^2 \, Pn_t^2$$

Dynamics in the supply of tradable goods is introduced by allowing for the actual supplies of importables and exportables to respond gradually to any changes in relative prices or the resource endowment. This is modelled in a simple way by specifying partial adjustment mechanisms, whereby actual supplies adjust to the difference between current desired supply and the supply in the previous period in the following manner:

1/ Gross-substitutability has been assumed.

$$(3a)\quad \Delta I_t^s = \lambda_1[I_t^{s*} - I_{t-1}^s] \qquad 0 \leq \lambda_1 \leq 1$$

$$(3b)\quad \Delta X_t^s = \lambda_2[X_t^{s*} - X_{t-1}^s] \qquad 0 \leq \lambda_2 \leq 1$$

The λ_1 and λ_2 are coefficients of adjustment and Δ is a first-difference operator, $\Delta I_t^s = I_t^s - I_{t-1}^s$. Substituting from (2a) and (2b), we obtain the actual supply equations for importable and exportable goods:

$$(4a)\quad I_t^s = \lambda_1\left[\frac{\gamma_2\gamma_3 y^{*2}_t \, Pi_t^2}{D}\right]^{1/2} + (1-\lambda_1)I_{t-1}^s$$

$$(4b)\quad X_t^s = \lambda_2\left[\frac{(\gamma_1^2\gamma_3/\gamma_2)y^{*2}_t \, Px_t^2}{D}\right]^{1/2} + (1-\lambda_2)X_{t-1}^s$$

The supply of non-tradable goods is determined in a somewhat different manner, on the grounds that disequilibrium in this market leads to changes in both prices and quantities. 1/ The specification is as follows:

$$(5)\quad \log N_t^s = \log N_t^{s*} + \lambda_3[\log N_t^d - \log N_t^{s*}]$$

Equation (5) states that supply will equal the desired supply only if the demand for non-tradables (N^d) is equal to the desired supply. If at the prevailing price there is excess demand (supply) with respect to desired supply, the supply of non-tradables will be larger (smaller) than desired supply. The second term, therefore, can be viewed as representing variations in inventories. The purpose of formulating this type of equation was to have a direct link between the demand for non-tradable goods and the supply of such goods, other than through variations in the price of non-tradable goods. 2/ With $\lambda_3 = 0$ the aggregate supply of non-tradable goods is totally independent of aggregate demand in quantity terms, and with $\lambda_3 = 1$ the adjustment of supply takes place along the demand function. 3/

Given the values of I^s, X^s, and N^s we can obtain real output (y) by the equation: 4/

1/ For tradable goods, quantity adjustments take place via the foreign sector.

2/ The link via prices is discussed later.

3/ In a sense allowing for both price and quantity adjustments is a generalization of the Clements (1980) model in which prices clear instantaneously to keep supply and demand for non-tradable goods in continuous equilibrium.

4/ The assumption of a quadratic form of the transformation function yields the equation for real output in this form.

$$(6) \quad y_t = [\gamma_1 I_t^{s2} + \gamma_2 X_t^{s2} + \gamma_3 N_t^{s2}]^{1/2}$$

The level of nominal income in turn is given by the identity:

$$(7) \quad Y_t = Pi_t I_t^s + Px_t X_t^s + Pn_t N_t^s + \varepsilon_t \cdot \tau_t \cdot Pf_t \cdot I_t$$

where Y is national income, ε is the exchange rate (defined in terms of units of domestic currency per unit of foreign currency), τ is the uniform tariff rate on imports, and I is the level of imports in foreign currency. In nominal income we have to add tariff revenues because this corresponds to income generated, although it accrues in this case to the government rather than producers. Disposable nominal income (YD) is simply calculated by deducting tax revenues (T) and tariff revenues from (9), i.e.:

$$(8) \quad YD_t = Y_t - T_t - \varepsilon_t \cdot \tau_t \cdot Pf_t \cdot I_t$$

2. Expenditures

The desired level of private nominal expenditures (including consumption and investment expenditures) are specified following the approach outlined by Dornbusch and Mussa (1975) with respect to savings. Here private expenditures are related to disposable nominal income, the nominal excess supply of money, and the rate of interest: 1/

$$(9) \quad \log EPRD_t^d = \gamma_4 \log YD_t + \gamma_5(\log M_t - \log M_t^d) - \gamma_6 \, rd_t$$

where $EPRD^d$ is the desired level of private expenditures, YD is the disposable income, M and M^d are respectively the stock of money and the nominal demand for money, and rd is the domestic interest rate.

Residents of the country are assumed to be able to spend more or less than their disposable income depending on whether they are running down or accumulating cash balances. This latter term represents, in other words, a "hoarding" effect that is related to the wealth effect on private expenditures. A rise in the domestic interest rate is assumed to have a depressing effect on private nominal expenditures through presumably the reduction of the investment component of such expenditures. 2/

Actual private expenditures are assumed to adjust to the difference between the current desired level and the actual level in the previous period:

1/ See Aghevli and Khan (1980), Clements (1980), and Knight and Mathieson (1982) for similar formulations.

2/ In fact consumption expenditures could very well decline as well. However here, as mentioned before, we do not make any distinction between the two types of expenditures.

$$(10)\quad \Delta \log EPRD_t = \lambda_4[\log EPRD_t^d - \log EPRD_{t-1}] \qquad 0 \leq \lambda_4 \leq 1$$

Substituting for $EPRD^d$ from (9) we obtain the dynamic version of the nominal private expenditures equation:

$$(11)\quad \log EPRD_t = \lambda_4[\gamma_4 \log YD_t + \gamma_5(\log M_t - \log M_t^d) - \gamma_6 rd_t] + (1-\lambda_4)\log EPRD_{t-1}$$

Equation (11) represents total private expenditures including both spending on goods and non-financial services, and expenditures associated with interest payments on foreign debt. Private expenditures on goods alone requires the latter be substracted out from EPRD, i.e.:

$$(12)\quad EP_t = EPRD_t - rd_t . Bf_t$$

where EP is private expenditures on goods and Bf is the stock of foreign debt. Obviously in an economy with total restrictions on capital movements in the past, private foreign debt would be zero, but this variable is bound to become quantitatively important as the opening-up policy is instituted. 1/

Total expenditures (E) in the economy are the sum of private expenditures (EP) and government expenditures (G):

$$(13)\quad E_t = EP_t + G_t$$

Once total expenditures are given, the distribution between importable, exportable and non-tradable goods is determined by a process of maximization subject to the budget constraint represented by total nominal expenditures. Such an approach assumes strict separability, implying a unidirectional causal relationship running from total expenditures towards its components. 2/ Since we are dealing with total expenditures we are also making the explicit assumption the government expenditures are allocated between the three goods on the same basis as are private expenditures. 3/

Consequently the problem consists of maximizing the utility function f(Q) subject to the constraint that

$$P'Q = E$$

1/ It does not make any important difference to assume either a zero or positive initial stock of foreign debt.

2/ This is standard in studies of demand systems. See, for example, the survey by Brown and Deaton (1972)

3/ This is done for simplicity.

where P = [Pi, Px, Pn] and Q is the vector of quantities demanded of the three goods, $[I^d, X^d, N^d]$. E corresponds to the nominal expenditure on goods ($E = PiI^d + PxX^d + PnN^d$), and f(Q) represents a general utility function. 1/ The solution to the maximization problem yields the demand equations for importable, exportable, and non-tradable goods, respectively: 2/

$$\begin{aligned}
(14a)\quad \Delta\log(PiI^d)_t &= \Delta\log E_t + \Delta\log Pi_t + (1/w_i^d)[-\gamma_7\Delta\log Pi_t \\
&\quad + (w_n^d + (\gamma_7 + \gamma_8 - \gamma_9 - 1)/2)\Delta\log Px_t \\
&\quad + (w_x^d + (\gamma_7 - \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pn_t] \\
(14b)\quad \Delta\log(PxX^d)_t &= \Delta\log E_t + \Delta\log Px_t + (1/w_x^d)[w_n^d \\
&\quad + (\gamma_7 + \gamma_8 - \gamma_9 - 1)/2)\Delta\log Pi_t - \gamma_8\,\Delta\log Px_t \\
&\quad + (w_n^d + (-\gamma_7 + \gamma_8 + \gamma_9 - 1)/2)\,\Delta\log Pn_t] \\
(14c)\quad \Delta\log(PnN^d)_t &= \Delta\log E_t + \Delta\log Pn_t + (1/w_n^d)[w_x^d \\
&\quad + (\gamma_7 - \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pi_t \\
&\quad + (w_i^d + (1 - \gamma_7 + \gamma_8 + \gamma_9 - 1)/2)\Delta\log Px_t - \gamma_9\,\Delta\log Pn_t]
\end{aligned}$$

where γ_7, γ_8, and γ_9 are the respective price parameters of demand for importable, exportable, and non-tradable goods, and the proportion of total expenditures on each type of good is given by the (variable) weights w_i^d, w_x^d, and w_n^d. The corresponding price elasticities, therefore, are γ_7/w_i^d, γ_8/w_x^d, and γ_9/w_n^d. The demand equations are homogeneous of degree zero in prices, the matrix $(\partial Q/\partial P')$ is symmetrical, and the property of additivity is satisfied.

1/ The use of this function was considered more general than the specific forms associated with the linear expenditure system (Stone (1954)). This was possible because we are not actually estimating the system, and do not have to be overly concerned with the complexity of the form.

2/ Because we are working with a general utility function, unlike in the case of the supply equations, the variables are in rates of change rather than levels.

3. Prices and unemployment

In equilibrium the price of importable goods is defined as equal to an index of foreign prices (Pf), 1/ adjusted by the exchange rate (ε) and the level of tariff protection ($\bar{\tau}$). 2/ In log-linear terms this can be expressed as:

$$(15) \quad \log\bar{Pi}_t = \log Pf_t + \log\varepsilon_t + \log(1+\tau_t)$$

where the $\bar{Pi}$ represents the equilibrium price of importables. Since it is often observed that the actual price of importables does not adjust immediately to changes in the right-hand side variables, 3/ we specify a partial-adjustment function for the actual price of importables:

$$(16) \quad \Delta\log Pi_t = \lambda_5[\log\bar{Pi}_t - \log Pi_{t-1}] \qquad 0 \leq \lambda_5 \leq 1$$

Substituting (15) into (16) and solving for the price of importable goods yields:

$$(17) \quad \log Pi_t = \lambda_5[\log Pf_t + \log\varepsilon_t + \log(1+\tau_t)] + (1-\lambda_5)\log Pi_{t-1}$$

The price of exportable goods is definitionally equal to the product of the foreign price level and the exchange rate:

$$(18) \quad \log Px_t = \log Pf_t + \log\varepsilon_t$$

Non-tradable goods prices are assumed to be essentially demand-determined, and therefore the specification abstracts from all types of cost factors. In other words, these prices respond to excess real demand for non-tradable goods, and in the absence of any disequilibrium, will be changing according to the variation in the price of tradable (importable) goods. The influence of tradable goods prices can be rationalized on two basic grounds. First, it can be argued that this

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1/ It is assumed that there is a single index of foreign prices relevant to both importables and exportables alike. This does not introduce any loss of generality, since if it were desired to study, for example, the impact of variations in the terms of trade, two different foreign price indexes could be employed.

2/ Actually the variable τ is assumed to include all types of imperfections and distortions, such as transport costs, etc., that keep the domestic price of importables different from the foreign price index adjusted for the exchange rate.

3/ Indeed it is frequently argued that opening-up by lowering tariffs does not lead to an immediate fall in Pi, thus allowing importers to obtain as profits the revenues that previously accrued to the government.

term captures expectations, and second, for long-run consistency all prices should move in line in the steady-state. 1/ This yields the equation:

$$(19)\quad \Delta \log Pn_t = \lambda_6[\log N_t^d - \log N_t^s] + \lambda_7 \Delta \log Pi_t$$

We would generally expect that both λ_6 and λ_7 would be positive. A small value of λ_6 would imply slow clearance of the non-tradable goods market, and continuous equilibrium would require $\lambda_6 \to \infty$. 2/ The movements in quantity and prices of non-tradable goods when there is disequilibrium in this market would obviously depend on the relative values of λ_6 and λ_3, the parameter in the non-tradable goods supply equation. Also in the long-run we would expect that the parameter λ_7 would tend to unity.

The general price index is specified as a Divisia index, where the percentage change in prices is a weighted average of the percentage changes in the prices of importable, exportable, and non-tradable goods, with the weights being the shares of the expenditures on each of the three goods:

$$(20)\quad \Delta \log P_t = w_i^d \Delta \log Pi_t + w_x^d \Delta \log Px_t + w_n^d \Delta \log Pn_t$$

As we will require a measure of expected inflation, we utilize the adaptive-expectations model of Cagan (1956) to generate this. In this context, expectations are revised proportionally according to the difference between the actual rate of inflation and the rate that was expected in the previous period:

$$(21)\quad \Delta \Pi_t = \lambda_8[\Delta \log P_t - \Pi_{t-1}]$$

where Π is the expected rate of inflation, and λ_8 measures the extent to which the revision of expectations responds to the error, $0 \leq \lambda_8 \leq 1$.

The unemployment of resources is modelled as a simple function of the difference between potential and actual output, namely the so-called output gap:

$$(22)\quad U_t = U_0 + \gamma_{10}\ (\log y_t^* - \log y_t)$$

where U is the level of unemployment, and U_0 represents some level of "normal" underutilization of resources. If the relation between the labor force and the level of aggregate output is stable, then equation (22) can be interpreted as an equation for labor unemployment. 3/ In general, however, one has to exercise caution when dealing with distinct

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1/ For a rationale of this formulation see Khan and Knight (1981), Appendix II.

2/ A large value for λ_6 yields instantaneous equilibrium, as in the model of Clements (1980).

3/ Resources engaged in reallocation between sectors also are viewed here as unemployment.

sectors, which may, for example, have differing factor intensities, to make such an assumption.

4. Money and credit

The monetary sector, which is crucial to the operation of the model, is formulated in a fairly straight-forward manner. The nominal demand for money is specified as a function of a scale variable, in this case nominal income, and the opportunity costs of holding financial assets in monetary form. Since the public can hold real assets (goods) as well as financial assets, these opportunity costs are the expected rate of inflation (Π) and the domestic interest rate (rd). Formally, the function for nominal demand for broad money can be written in log-linear terms as: 1/

$$(23) \quad \log M^d = \alpha_1 + \gamma_{11} \log Y_t - \gamma_{12} \Pi_t - \gamma_{13} rd_t$$

Obviously more general formulations can be considered which could include, among other variables, the "own" rate of interest, or if residents hold wealth in the form of foreign financial assets, the foreign interest rate and the expected change in the exchange rate. For the moment it is assumed that money pays no interest, 2/ and that residents hold only domestic financial assets.

The supply of money (equal to the actual stock)--broadly defined to include currency, demand deposits, and time and savings deposits--is equal to the stock of international reserves (in domestic currency terms) and the level of domestic credit extended by the banking system. This definition allows changes in the money supply to be brought about by variations in the balance of payments, and this phenomenon is the central element of the monetary approach to the balance of payments. 3/ Domestic credit, which is the basic monetary tool, is made up of credit to the government and credit to the private sector. In the absence of sterilization, monetary policy in this framework is essentially passive. Using these distinctions, the identity for the money supply can be expressed as:

$$(24) \quad M_t = CRG_t + CRP_t + R_t$$

where CRG and CRP are credit to the government and the private sector respectively, and R is the stock of international reserves (in domestic currency terms).

1/ Note that as long as γ_{11} is unity this function is exactly the same as an equation specified in real terms.

2/ Or alternatively the net effect of a change in, say, deposit interest rates, on broad money is zero as some components of the money stock rise while others fall. For a discussion of this issue see Mathieson (1981), (1982).

3/ See Frenkel and Johnson (1976) and IMF (1977).

Since it has been assumed that the domestic financial system has already been liberalized, the domestic interest is free to adjust to market forces. The formulation chosen here relates the changes in the interest rate to monetary disequilibrium as follows:

$$(25) \quad \Delta rd_t = \gamma_{14}[\log M_t^d - \log M_t]$$

An excess demand for money can be expected to raise the interest rate, and vice versa, so that the parameter γ_{14} would be positive. Its size would naturally determine the speed at which the interest rate moves to equilibrate the money market. 1/ The nominal rate, as determined from equation (25), feeds back into the rest of the model, although the real interest rate, however defined, does not.

5. Balance of payments

Imports (I), valued in foreign currency terms, are defined as the difference between domestic demand and domestic supply for importables: 2/

$$(26) \quad I_t = Pf_t[I_t^d - I_t^s]$$

Similarly, exports (X) are equal to domestic excess supply of exportables:

$$(27) \quad X_t = Pf_t[X_t^s - X_t^d]$$

and the current account (in domestic currency terms) is equal to the difference between exports and imports less the interest payments on foreign debt:

$$(28) \quad CA_t = \varepsilon_t[X_t - I_t] - rd_t.Bf_t$$

The equation for capital movements is derived on the basis that, apart from some autonomous components, capital flows respond to the differential between domestic and foreign interest rates, adjusted for expected exchange rate changes and other factors such as country-risk, differences in reserve requirements, etc. In the absence of controls the function determining capital movements could be specified as:

$$(29) \quad DK_t = \lambda_9 \varepsilon_t + \gamma_{15}(rd_t - rf_t - \rho_t - \Delta\log\varepsilon_t)$$

1/ Strictly speaking it is the combination of γ_{14} and the interest elasticity of the demand for money, γ_{13}, that determine how quickly the interest rate moves to eliminate disequilibrium in the monetary sector.

2/ This formulation corresponds to the so-called perfect substitutes model of import behavior. See Goldstein and Khan (1982b).

where DK is the flow of capital, rf is the foreign interest rate, and ρ is the risk premium. 1/ The first term simply gives the domestic currency value of autonomous capital flows, and it is assumed that the expected change in the exchange rate can be represented by the actual percentage change in the rate, $\Delta \log \varepsilon_t$.

The value of γ_{15} measures the degree of response of capital flows to interest rate differentials, and to the extent there are controls or restrictions on capital mobility this parameter will be smaller. As such, we re-defined equation (29) in the following way to be able to take into account various degrees of capital account opening-up:

$$(29a) \quad DK_t = \lambda_9 \varepsilon_t + \beta[\gamma_{15}(rd_t - rf_t - \rho_t - \Delta \log \varepsilon_t)]$$

In this formulation by varying β we can control the degree of restrictions on movements of capital. If $\beta = 0$ then the economy is totally closed to international capital flows, whereas $\beta = 1$ implies complete liberalization. Values between zero and unity do not necessarily reflect varying degrees of restrictions, but mainly whether the response of capital flows is slow as rapid. It should be noted that gradual opening-up of the capital account can be represented in two alternative ways. First, β can be allowed to go from zero to unity gradually, or second, it can be fixed at some positive value. Both methods, although not strictly equivalent, yield broadly similar results in the simulations performed. For the purpose of the exercise here it was decided to work with the second of the two alternatives. 2/

The overall balance of payments (BP) is given by the identity:

$$(30) \quad BP_t = CA_t + DK_t$$

and the stock of international reserves (in domestic currency terms) by:

$$(31) \quad R_t = R_{t-1} + BP_t$$

It is worth noting the way in which foreign indebtedness is incorporated in the model. It is assumed that foreign residents acquire (sell) in the home country, domestic financial assets issued only by the private sector and that there are no government bonds. 3/

1/ Equation (29) corresponds to what has been termed in the literature as the "stock" specification for international capital flows.

2/ To be precise, gradual opening-up in the simulation experiments is defined as changing β from zero to one half.

3/ For the present we have not taken into consideration the issue of government bonds, because of the complexities involved in the possible "net wealth effects", the effects this would have on the government budget constraint, and the problems involved in modelling market segmentation of private and government bonds.

There is an initial stock of private bonds and no new issues are assumed to take place. 1/ External debt is given by:

$$(32)\quad Bf_t = \sum_{i=0}^{\infty} DK_{t-i}$$

The risk premium is assumed to have a constant component, ρ_0, and a variable component related to the ratio of foreign debt to total income, i.e.:

$$(33)\quad \rho_t = \rho_0 + \gamma_{16}(Bf/Y)_t$$

This function basically assumes that the supply curve of international capital to the country is not infinity elastic, and the relevant cost, that is the foreign interest rate adjusted for exchange rate changes and the risk premium, rises as more external debt is contracted. It is assumed here arbitrarily that when the ratio of foreign debt to income reaches a certain level, say 25 per cent, domestic and foreign interest rates (including the now larger risk premium) will be equalized. 2/ As foreign debt rises beyond this point capital outflows will be generated and the domestic interest rate will have to rise.

6. Government sector

The model incorporates the fiscal sector in a very rudimentary fashion since the purpose is solely to introduce an explicit government budget constraint into the framework. Government expenditure in nominal terms, G, is defined as the sum of taxes, tariff revenues, and the public sector deficit:

1/ Relaxing these rather restrictive assumptions greatly complicates the structure of the model. To properly handle these issues we would have to formulate a complete portfolio model, which is not our intention here.

2/ This approach has been adopted because the equilibrium properties of the model related to the fixed transformation curve require that the rate of interest return to its original level eventually. Therefore, any capital account liberalization will lower the domestic interest rate, but as ρ rises this rate is pushed back up. Note that in the original equilibrium we have

$$rd > rf + \rho + \Delta \log \varepsilon$$

but in the final equilibrium, because ρ has increased we have interest parity:

$$rd = rf + \rho + \Delta \log \varepsilon$$

$$(34) \quad G_t = T_t + \varepsilon_t \cdot \tau_t \cdot Pf_t \cdot I_t + GD_t$$

where GD is the government deficit.

Taxes are related in a linear fashion to the level of nominal income:

$$(35) \quad T_t = t_0 + \gamma_{17} Y_t$$

where γ_{17} is the marginal tax rate.

Finally, it is assumed that all public sector deficits are financed through variations in Central Bank credit to the government, i.e.:

$$(36) \quad \Delta CRG_t = GD_t$$

The linkage between fiscal policy, as represented by GD, and monetary policy is immediate, and stems from the fact that no other forms of financing public expenditure, such as borrowing from the non-bank public, have been modelled. 1/

For purposes of convenience the complete model, including both the behavioral equations as well as identities and definitional equations, are presented in Appendix I.

III. Simulation Experiments

Utilizing the values for the parameters (shown in Appendix II), the complete model can be simulated for various types of changes related to the opening-up process. To begin with, following conventional analysis, the economy was assumed to be in initial equilibrium, and this may appear to be a rather arbitrary starting point, given that the implementation of a liberalization strategy generally presupposes the existence of some disequilibria in the economy. Nevertheless, any attempt to begin the analysis from a disequilibrium position would pose three problems. First, the main features of the disequilibrium cannot be chosen arbitrarily since this would probably violate the internal consistency of the model. In other words, if we start from a position of a particular current account deficit, this implies specific values for other variables in the system, so that all of these must be taken into consideration. Second, if the analysis were begun from a position of disequilibrium, it would be quite difficult to distinguish those changes that occurred as a result of discretionary policy actions from those that would have occurred in any

1/ For a model of this type see Aghevli and Khan (1978).

case, owing to the automatic processes that tend to adjust, for example, the balance of payments and the domestic inflation rate in a small open economy. Finally, the time-path of the variables during the transition period, and indeed the transition period itself, is not independent of the initial conditions. As such it would be hard to determine whether the behavior of a variable during transition was due to the policy or simply due to the position it started from. For these reasons, we start the simulations in full equilibrium, not with any intention of realism, but in order to be exactly aware of how the adjustment process operates within the context of our model.

The initial equilibrium was defined as one where the economy is protected by a uniform tariff of 100 per cent (τ=1.0) on all imports, and is closed to international capital movements (β =0). The economy is assumed to be on its transformation curve (assuming 5 per cent normal unemployment) so that actual and potential output are the same, and all desired quantities are equal to their actual levels. Prices are assumed to be in equilibrium for a fixed exchange rate, (ε = 1.0), the current account, capital account and overall balance of payments are in balance, and the level of international reserves and the stock of money are constant. In the context of the simulations, trade liberalization corresponds to a lowering of the tariff rate (τ) to zero, and opening-up the capital account means increasing the value of β. 1/

Given these initial conditions, and the further assumptions of an unchanging international environment, 2/ and no variation in other policies, 3/ the following simulation experiments were conducted: (1) gradual and sudden reduction in tariffs; (2) gradual and sudden removal of restrictions on capital movements; (3) simultaneous gradual removal of restrictions on both trade and capital flows; and, (4) sequential gradual removal of restrictions on both trade and capital flows. These four sets of experiments are believed to cover most of the liberalization scenarios one has observed. In addition, for purely illustrative purposes, we conduct a "compensatory" policy simulation in which monetary policy is used to keep the current account from deteriorating when tariffs are lowered. The purpose of this particular simulation is to demonstrate the capability of the model in handling this type of question, and further to highlight the kind of trade-offs that emerge when it is desired to stabilize certain variables in the context of opening-up.

The effects of the policy changes are naturally traced out for all the endogenous variables, although we report and discuss only the results for a select few that are regarded as being of central interest.

1/ See Section II.

2/ This amounts to assuming that the foreign price level and foreign interest rate are constant.

3/ This is a strong simplifying assumption since in actual fact liberalization policies in most cases have been typically accompanied by stabilization programs. See, for example, Diaz-Alejandro (1981).

1. Gradual and sudden reduction in tariffs

Assuming that the level of restrictions on capital flows are maintained ($\beta = 0$), but that the tariff rate is lowered from its 100 per cent original level to zero in two specific ways. In the first case the reduction takes place gradually over four periods starting in period 3, and in the second in a sudden fashion, also in period 3. 1/ The effects of these two types of policy changes on the level of prices (in logarithms), the domestic interest rate, the current account and the level of international reserves, and the gap between potential output and actual output (unemployment of resources), are shown in Charts A1 to A4.

Considering the case of the gradual tariff reductions first, we can observe that there is a fall in the overall price index (Chart A1). This is a consequence of both the direct effect of the fall in the price of importable goods, as well as the effect of the decline in the price of non-tradables. Non-tradable goods prices face downward pressure on two counts. First, the percentage change in the price of importables enters the equation for the percentage change in the price of non-tradable goods, measured by the parameter λ_7, and second, the change in relative prices leads to a transfer of resources towards the production of non-tradable (and exportable) goods, and at the same time diverts demand from these two sectors towards the market for importables. 2/ As a result of this, an excess supply for non-tradable goods is created and this results in a decline in the price of non-tradables and the overall price level.

The fall in prices, by lowering the nominal demand for money, creates an excess supply of money which manifests itself in both the financial sector and in expenditures. The rate of interest drops temporarily (the "liquidity effect") for about six periods after the policy of tariff reduction is initiated, 3/ and then starts to rise as the monetary disequilibrium is steadily eliminated (Chart A2). After approximately 14 periods the rate of interest stabilizes at its original level.

1/ Although the unit of observation is not defined explicitly, the parameters utilized are either independent of time, or correspond to yearly data. The first two periods in all the simulations correspond to the initial equilibrium, so that all policy changes are assumed to occur in the third period.

2/ These effects indicate that the reduction in tariffs would lead to an increase in imports and exports.

3/ While the nominal interest rate declines, nevertheless as the decline in expected inflation is greater, the real rate of interest actually rises during the process.

The combination of the excess supply of money and the change in relative prices results in a current account deficit that persists for 14 periods or so (Chart A3). There is a steady loss of international reserves until they reach about one-third of their original level. In fact it is this loss of reserves, together with the initial decline in the rate of interest, that eventually brings about equilibrium in the money market.

Finally, as adjustment in the tradable goods market is not instantaneous, and more specifically importable goods are assumed to adjust more rapidly than exportable goods, ($\lambda_1 > \lambda_2$), the resources released by the importables sector are not absorbed by the other sectors and unemployment results (Chart A4). 1/ The gap between potential and actual real output rises by over 3 percentage points and then declines to the original 5 per cent level of "normal" unemployment. It can be observed that the unemployment created by the policy of tariff reduction tends to persist for a considerable period of time. 2/ Both the extent and duration of this unemployment depends crucially on the relative values of the adjustment parameters in the supply equations, λ_1, λ_2, and λ_3. In the case where adjustment is instantaneous in both the importable and exportable goods markets, and further that $\lambda_3 = 0$, we would observe that trade liberalization has basically the same effects on the time-paths of the other variables in the system, but that the resources gap turns out to be zero. However, instantaneous adjustment is clearly an extreme assumption, and our choice of parameters appears more realistic.

When tariffs are reduced in a "shock" fashion, that is they are immediately reduced to zero in the first period, there is essentially no qualitative difference in the results; see Charts A1-A4. Clearly the effects of such a policy result in a more pronounced movement in the initial periods, and that the transition path is generally less "smooth". Given the different time paths of the excess supply of money in this simulation, the initial fall in prices and the rate of interest is sharper, but in the case of the latter variable it can be seen that it starts to rise back to its original level earlier. It is interesting to note that the accumulated current account deficit (loss of international reserves) does not differ according to whether the opening-up is gradual or sudden. What is evident is that these deficits are originally larger and then later smaller when the policy is implemented suddenly (Chart A3).

1/ It should be noted that we are working with the assumption that the demand for non-tradable goods does not have a direct impact on the supply ($\lambda_3 = 0$). If λ_3 were positive, then as there is initially an excess supply in the non-tradables market, the magnitude of the unemployment of resources would be greater.

2/ The creation and duration of unemployment has been one of the main aspects of a trade liberalization strategy that has been the subject of criticism.

REDUCTION IN TARIFFS

CHART A1

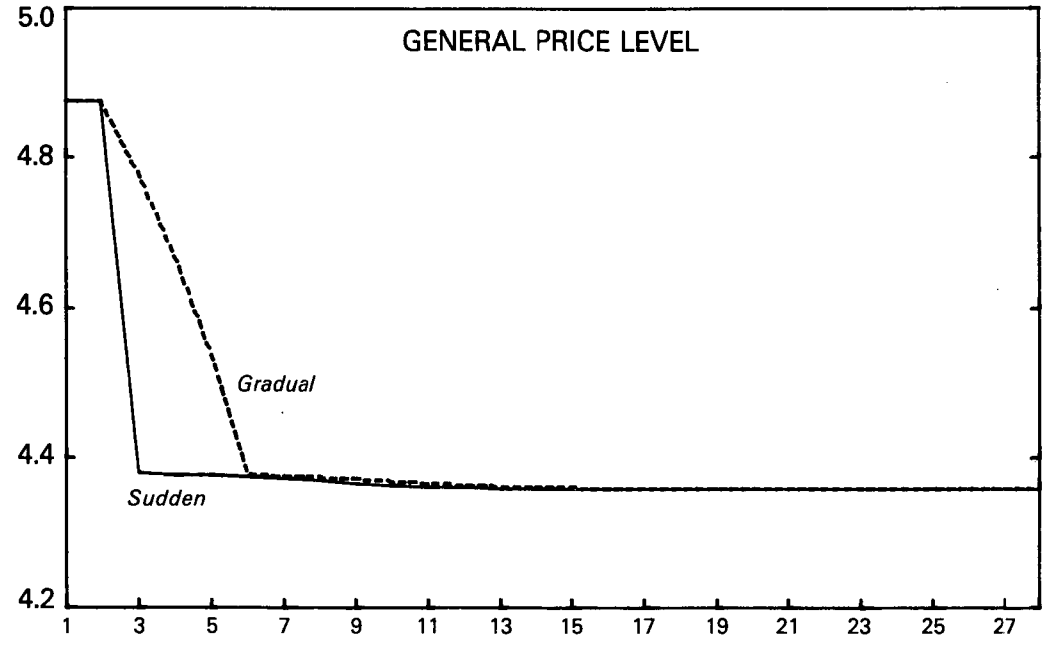
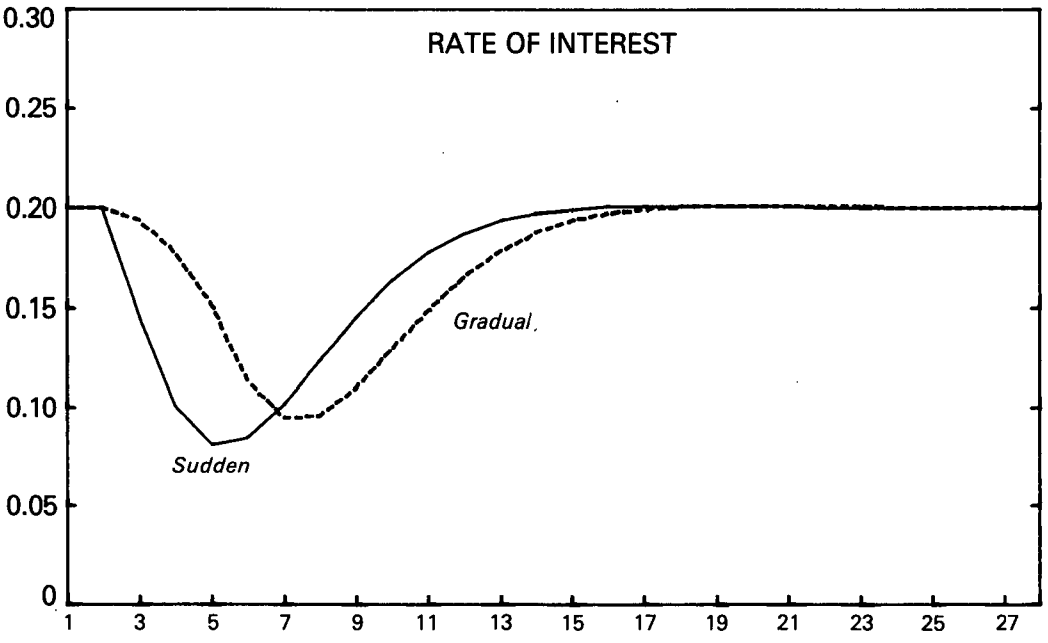
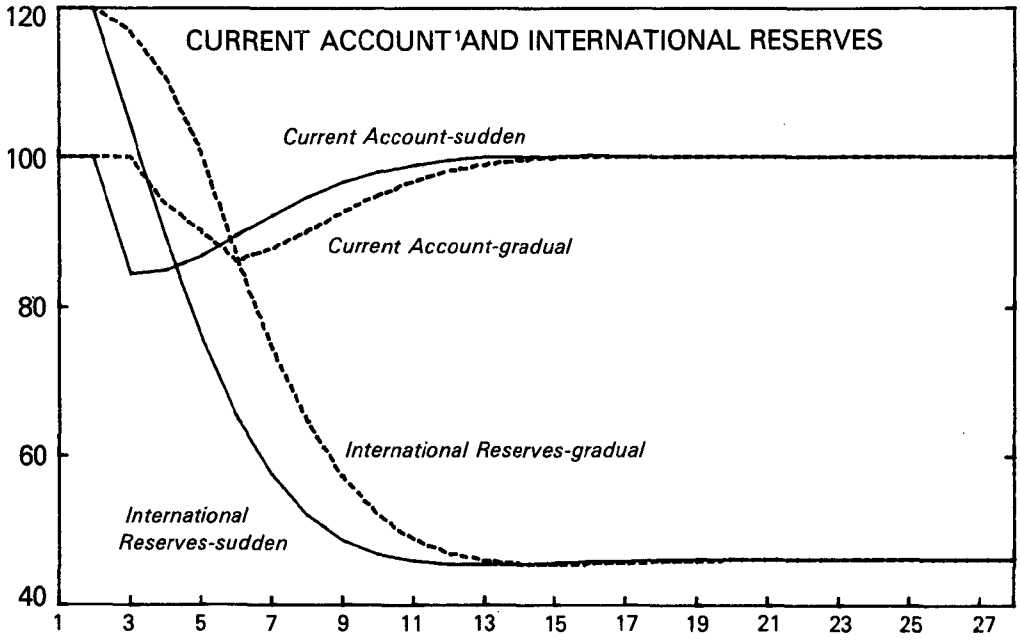


CHART A2



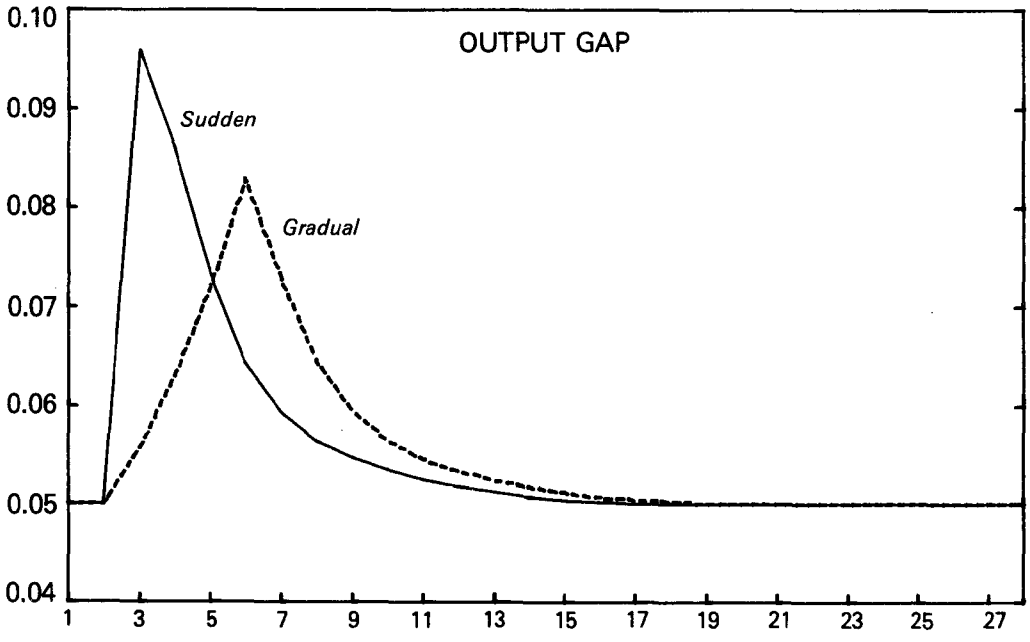
REDUCTION IN TARIFFS

CHART A3



[1]Current account base = 100.

CHART A4



A similar pattern is evident in the behavior of the gap between potential and actual output, but to properly compare the areas under the curves in Chart A4 one would have to calculate the present values using some type of social rate of discount. The difference observed between the cases of the shock and gradual opening-up is not so much related to the time during which output remains below "full" employment, but rather that in the former case the peak of unemployment is higher, and that the distribution of the resource gap is more asymmetrical than in the gradual opening-up scenario.

2. Gradual and sudden removal of restrictions on capital movements

These experiments start with the assumption that there is a 100 per cent tariff on imports and capital movements are completely restricted. Maintaining the tariff and eliminating the restrictions of capital flows, both gradually and suddenly, i.e., by varying β, gives a picture of what would be expected if only the capital account were liberalized. The results of this experiment on the various important macroeconomic variables are shown in Charts B1 to B5. 1/

The immediate effect of removing restrictions on the capital account is an inflow of capital as the domestic interest rate is above the corresponding foreign interest rate. This positive differential in favor of the domestic economy is a phenomenon typically observed in a number of developing countries that have previously liberalized their domestic financial markets and removed capital controls. 2/ The inflow of capital creates an excess supply of money which in turn has an expansionary effect on aggregate demand, and is reflected in an initial rise in prices (Chart B1) and a worsening of the current account (Chart B3). The excess supply of money, as expected, also lowers the domestic interest rate (Chart B2). In theory the interest rate move should persist until interest-parity is established, which in this specific case implies that the rate shouuld fall initially and then rise to its equilibrium level. 3/ How fast this occurs depends on the size of the response of capital flows to the interest rate differential, γ_{15}, and the effect on the rate of interest of monetary disequilibrium, measured by γ_{14}. The values chosen for these parameters imply fairly slow adjustment of the interest rate, so that even though it initially falls, it nevertheless starts to rise slowly as the stock of external debt increases and pushes up the risk premium. This slow adjustment would seem to accord with actual experience, and it

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1/ Recall that the change in policy is always assumed to take place in the third period.

2/ See Mathieson (1979), (1980), Zahler (1980), and Fernandez and Rodriguez (1982).

3/ That is, the foreign interest rate plus the increased risk premium.

has been hypothesized that factors such as market segmentation, non-tradable assets, and other rigidities prevent the emergence of instantaneous interest-parity. 1/ While we have not modelled these factors explicitly, our choice of parameters does yield a rough approximation to this type of behavior.

Moreover, as long as equality between interest rates does not exist, foreign debt will continue to increase (Chart B4) and this means that the economy must generate a trade surplus in order to cover the rising interest payments. 2/ In this process there is a slight increase in the share of tradable goods, and a corresponding fall in the proportion of non-tradable goods in total output, because of the need to depress aggregate demand so as to generate the resources for the payment of interest on external debt. This causes a small decline in the price of non-tradable goods, and the general price level, after the temporary rise that occurred due to the initial excess supply of money (Chart B1).

Inspite of the surplus on the trade account, a sustained deficit in the current account can be noted, although its size decreases gradually as the economy moves towards equilibrium. Given the values of the parameters, the current account deficit is, however, more than compensated for by the inflow of capital (Chart B3), so that there is an increase in international reserves in the beginning. The higher initial level of reserves reflects the increased demand for money that results from the decline in the rate of interest; of course, at the same time, the stock of foreign debt is also larger. (Chart B4).

In contrast to the simulations related to trade liberalization, the opening-up of the capital account has a very small impact on the resource gap. After a slight increase in output due to the initial excess supply of money, the gap between potential and actual output reaches a peak that is only about 0.4 percentage points above the equilibrium level of full employment (Chart B5).

The main differences between the gradual and sudden policies with respect to the opening-up of the capital account lie in the distribution of the variables in question. The time-path of the variables in the gradual opening-up scenario are generally smoother than when β is set to unity in one period. It should be noted that in the shock case external indebtedness towards the end is larger, and further, while the initial decline in the resource gap is greater, the eventual rise in unemployment is somewhat higher.

In short, capital account liberalization, unlike trade liberalization, does not significantly affect relative prices, the level of domestic

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1/ See, for example, Blejer (1982).

2/ We assume that interest payments on foreign debt begin immediately, and that international reserves earn no interest so that we abstract from the concept of "net" interest payments.

REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART B1

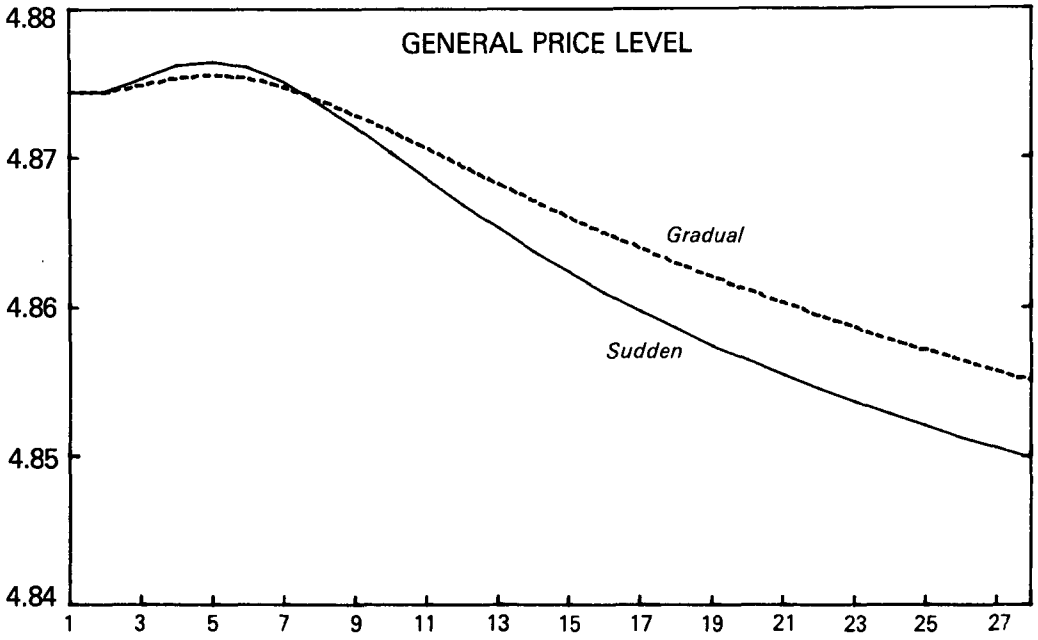
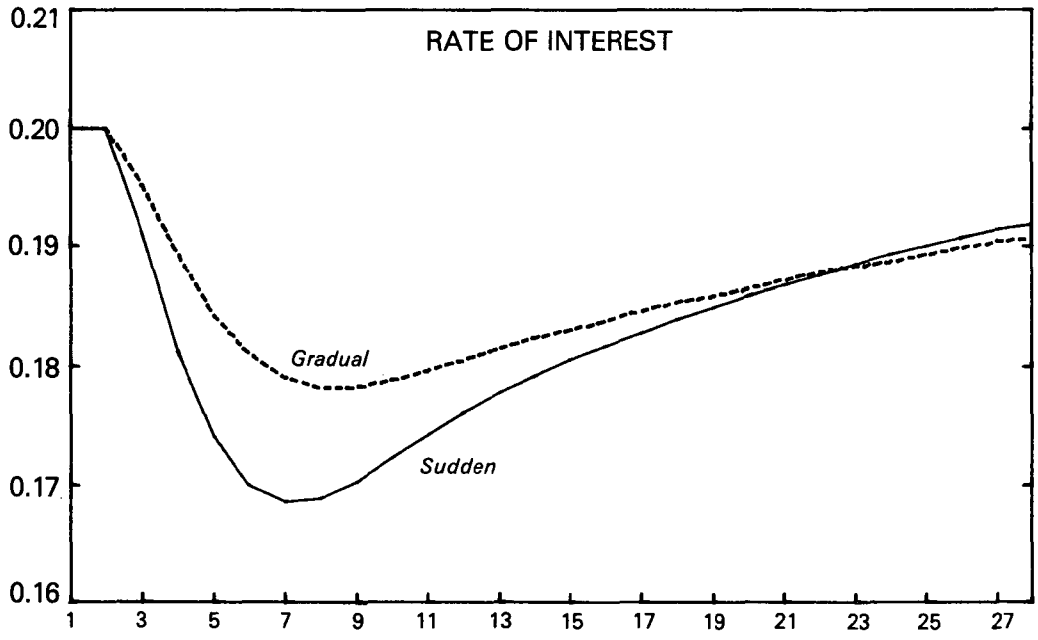


CHART B2



REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART B3

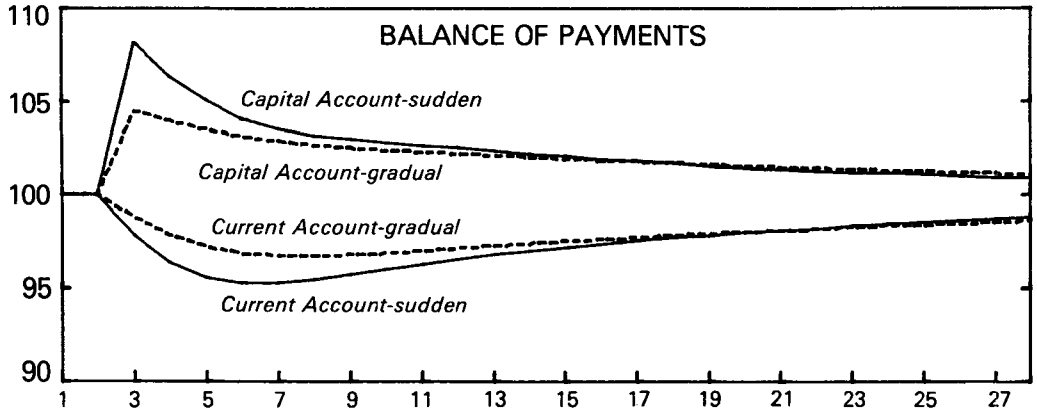


CHART B4

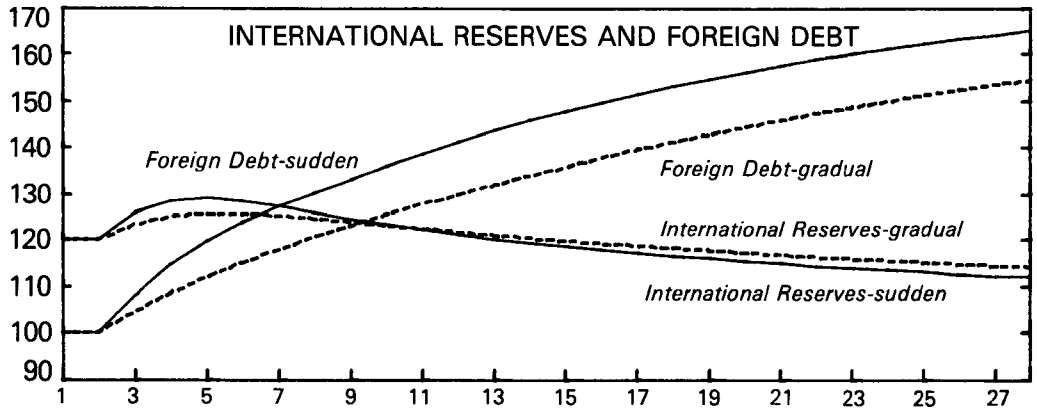
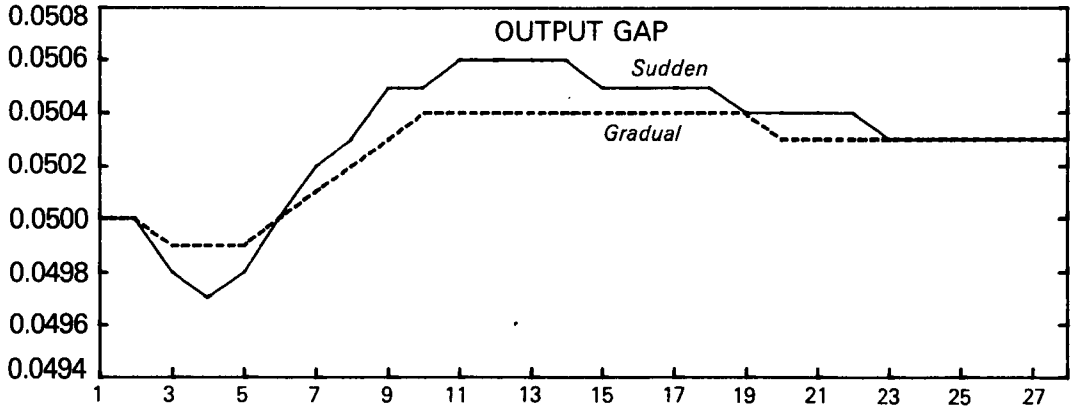


CHART B5



prices, or resource unemployment; 1/ nor is there a significant loss of international reserves, but rather an initial gain. There is, however, a process of growing external indebtedness associated with this policy that involves a continuing current account deficit that is due to the need to make interest payments on the foreign debt. Finally, there is a temporary decline in both the nominal and the real rate of interest.

3. Simultaneous gradual removal of restrictions on both trade and capital flows

Assume that the authorities undertake to liberalize both the trade and capital accounts simultaneously, rather than separately. In this case the tariff rate (τ) is reduced to zero and the coefficient measuring the degree of restrictions (β) is raised to one-half, and both policies are implemented gradually. 2/ That is, τ is reduced to zero in four periods and β is set at equal to 0.5 in the third period. The results of this simulation experiment are shown in Charts C1 to C5.

In the first place, the combined effect of such policies is to bring about a greater degree of monetary disequilibrium in the economy as compared to the case of each of the two policies considered separately. There is a fall in the nominal demand for money as a consequence of the drop in the price level resulting from the tariff reduction, and an increase in the supply of money due to the inflow of international capital. In net terms it would appear that there is a larger excess supply of money initially, and this causes the price level and the interest rate to fall relatively more than was observed in the two previous two simulations (Charts C1 and C2). The rate of interest falls rather sharply in the beginning, and even when it begins to rise again it remains below the time path followed when only the capital account was opened-up.

The initial excess supply of money creates a current account deficit that is also larger than when the two policies were undertaken individually. The deterioration caused by the tariff reduction is reinforced by the further small worsening that results from opening-up the capital account (Chart C3). The time-path of the trade balance lies between the corresponding paths of the two previous simulations, following initially (for about 10 periods) the direction of the trade balance picture emerging from trade liberalization, but later begining to mimic the behavior of the trade balance that resulted from the capital account liberalization. This is because a surplus has to be continually generated to be able to finance interest payments on the growing external debt.

1/ This no doubt reflects the relative speeds at which the goods and financial markets clear.

2/ The results for the shock scenario are very similar, so that we have chosen to report only the results for the gradual opening-up.

The final level of international reserves is about the same as was observed in the case of the trade liberalization, although during the transition the paths of reserves do deviate from one another (Chart C4). It is readily apparent that the capital inflows generated by the policy of removing the relevant restrictions are not sufficient to cover the current account deficits, so that the country will lose reserves. The stock of external debt has a somewhat different path than in the simulation experiments related to capital account liberalization (Chart C4). There is an initial rise, but then a fall for a few periods and later a smooth increase. This gyration is a direct consequence of the cyclical way the rate of interest behaves in this particular simulation.

Finally, the structure of production and the resource gap behave in a very similar way to the case of trade liberalization, which can be explained by the small impact of capital account liberalization on relative prices (Chart C5). Even though there is initially a greater excess supply of money, this appear to be reflected more in a current account deficit, rather than affecting the real sector through a change in relative prices. Unemployment rises by a little over 3 percentage points above its long-run equilibrium level.

To sum up, it may be concluded that the simultaneous application of the two types of opening-up policies is not simply the same as the sum of each of them considered separately. Although the structure of production and resource unemployment, together with prices, tend broadly to reproduce the situation observed in the case of reduction in tariffs, the financial and foreign sector variables behave in a different manner from that resulting from the two policies considered individually. This shows up, in particular, in a lower level of external indebtedness, a smaller surplus in the trade balance (but with larger imports than in the initial situation), and a different time-path of the rate of interest in comparison with capital account liberalization alone.

4. Sequential gradual removal of restrictions on both trade and capital flows

Much of the discussion recently regarding opening-up strategies has focused on the sequence in which these reforms ought to be implemented, namely whether the trade account should be liberalized first and then the capital account, or vice versa. 1/ Since theory provides limited guidance on the issue of sequencing, the arguments have been based on essentially casual empiricism. Without going into the discussion of which sequence is better or more likely to be successful, we can, in the context of our model, outline the consequences of two alternative types of strategies. First, the trade account is liberalized

1/ See McKinnon (1982) and Frenkel (1982).

SIMULTANEOUS REDUCTION IN TARIFFS AND REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART C1

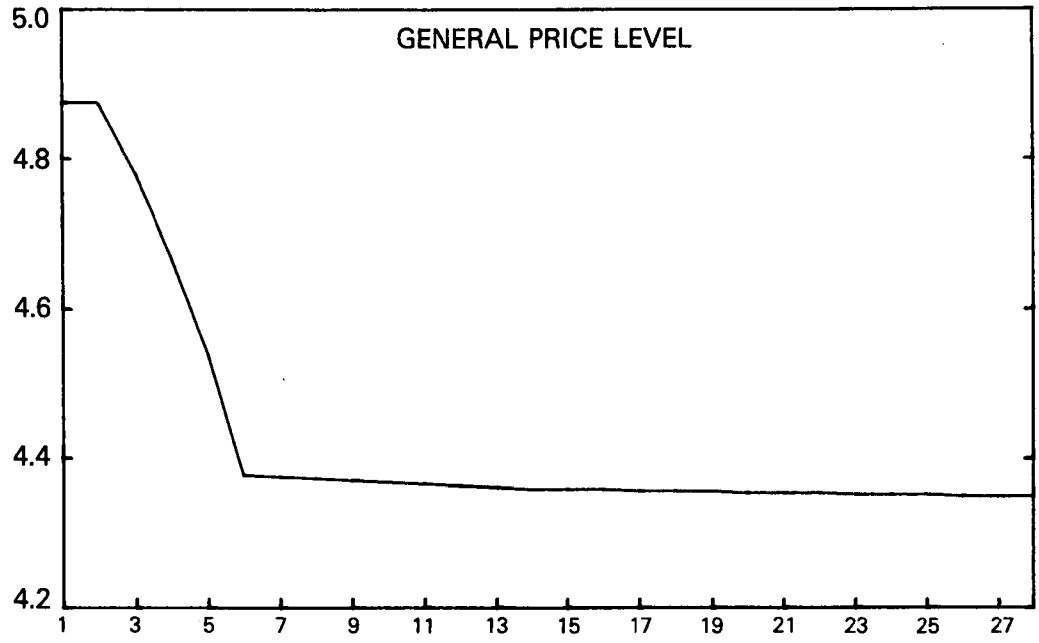
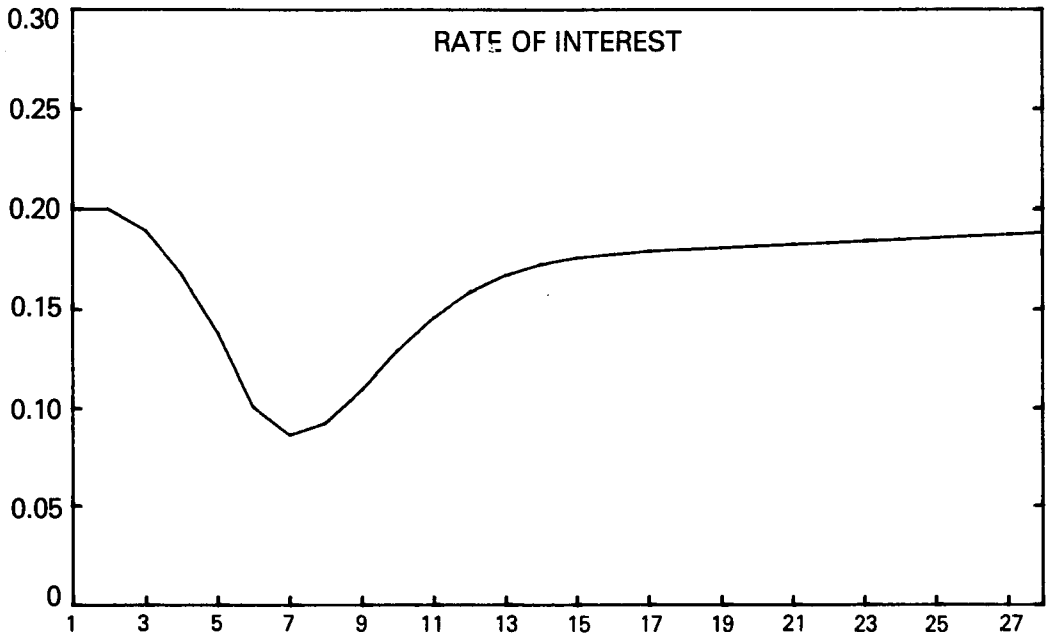


CHART C2



SIMULTANEOUS REDUCTION IN TARIFFS AND REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART C3

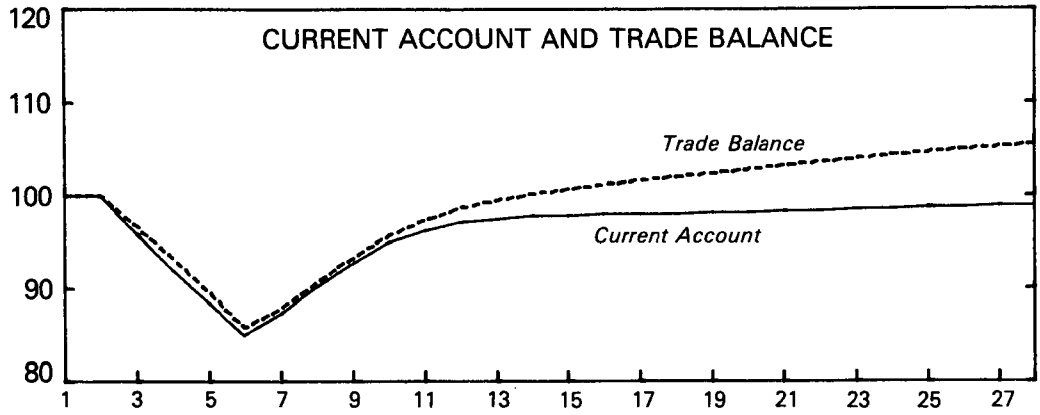


CHART C4

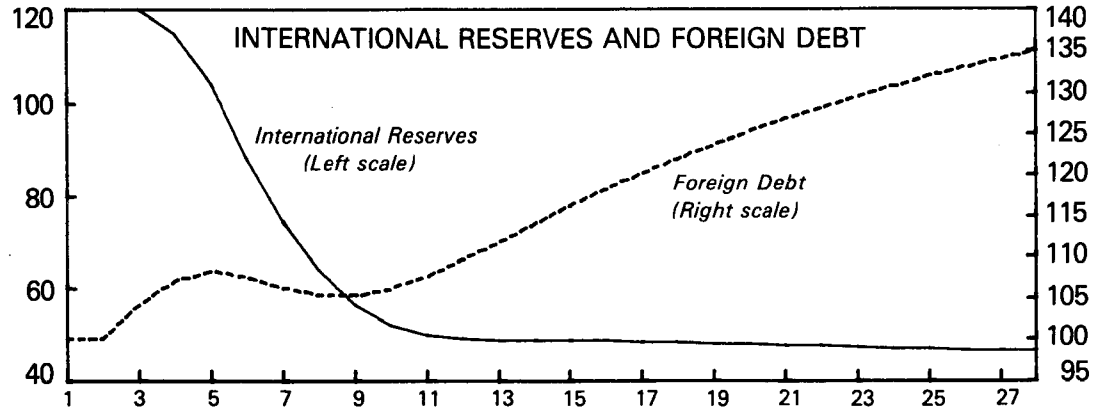
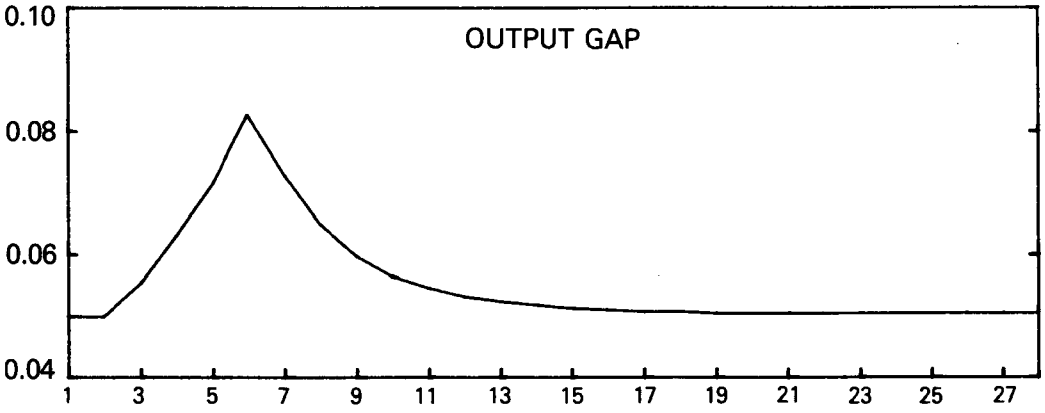


CHART C5



(gradually) in period 3 and then after the subsequent four periods the restrictions on capital account are removed, also gradually. 1/ In the second stage the sequence is reversed, with the capital restrictions removed first, and then again after four periods have elapsed, the tariff rate is gradually lowered to zero. The results of this particular experiment are reported in Charts D1 to D5. 2/

It appears to be a matter of indifference as to sequence of policies adopted insofar as the level of prices is concerned (Chart D1). Prices decline by approximately as much in the two cases, except that when the trade account is liberalized first the effect occurs earlier. Since it has been shown in the previous experiments that the effect of opening-up of the capital account on prices is negligible, this result is not too surprising.

The effect on the rate of interest is slightly different depending on the chosen sequence. When the capital account is liberalized first, the rate of interest declines more slowly initially, but then the fall is accelerated as tariffs are removed (Chart D2). This is because the excess supply of money generated by the fall in prices due to the reduction in tariffs is greater than the excess supply of money created by the inflow of capital. The overall decline in the interest rate turns out also be to somewhat greater in this particular sequence of reforms.

The trade balance and current account pictures are, however, quite different. If the capital account is liberalized initially, for a few periods there is a slight worsening of the trade balance (Chart D3B). The tariff adjustment pushes the trade balance into further deficit, but the cumulative deficit turns out to be smaller than would be the case if tariff reductions had been introduced first. The payment of interest on foreign debt also makes the path of the current account somewhat different (Chart D3A). In the case of this variable, the deficit is smaller in the beginning when the capital account is liberalized first, but later the deficit turns out to be larger than when the opposite sequence is implemented.

The behavior of international reserves and the foreign debt are also interesting. As capital restrictions are removed there is an immediate inflow of capital and both reserves and the stock of foreign debt rise (Chart D4). However, as the tariff reduction lowers the demand for money which further reduces the interest rate, this process is temporarily reversed, and both stock of foreign reserves and debt fall. Eventually as the system stabilizes, the level of international

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1/ The four periods correspond to the complete implementation of the gradual tariff reduction.

2/ In the charts the label "Trade Account-Capital Account" indicates the liberalization of the trade account first, and vice versa.

reserves is approximately the same in both scenarios and the level of external indebtedness is slightly higher when the capital account is opened-up initially.

As the liberalization of the capital account has a negligible effect on the output gap, there is no noticeable difference when different sequences of policies are adopted (Chart D5). All that we observe is that the unemployment is generated later when the sequence has the capital account opening-up instituted first. Other than that, the time-paths of unemployment are exactly the same.

In summary, as in the case of the simultaneous liberalization experiments, we find little difference in the effects on prices and the real sector. The only question that can be raised in relation to the latter is whether unemployment is preferred now or later. The main differences arise in the financial and foreign sectors, where the decline in the interest rates, the deterioration in the current account, and the loss of international reserves is initially less if capital flows are liberalized before any trade reforms initiated, than if the opposite sequence is followed. At the same time, however, the stock of external debt will be smaller in the long-run if the trade account is liberalized first. Therefore our results do not indicate clear-cut support for the propositions made by McKinnon (1982) and Frenkel (1982) that tariff reforms should necessarily take place prior to policy changes affecting capital movements. Explicit trade-offs are evident and the issue cannot be resolved on a priori theoretical grounds.

5. Compensatory policies

It is evident from the analysis of the various simulations that opening-up policies are generally accompanied by transitory effects (of varying duration) which may be considered undesirable by the policy-makers. The effects can include current account deficits, loss of international reserves and/or greater external indebtedness, increases in the real rate of interest, and resource unemployment. Each of the strategies tends to yield some combination of these "costs". Of course, the authorities could in principle use compensatory demand management policies, such as monetary and fiscal, or exchange-rate policy, to minimize some of these costs. The present model allows one to design such policies, and purely for illustrative purposes we describe one such experiment. 1/

In the context of trade liberalization alone it is clear from all of our experiments that the current account deteriorates in the short-run. Suppose that the authorities wish to prevent this and are prepared to use monetary policy to this end. In order to avoid a current account deficit and, given that capital movements are not allowed, a consequent

1/ For experiments of this type see Khan and Knight (1981).

SEQUENTIAL REDUCTION IN TARIFFS AND REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART D1

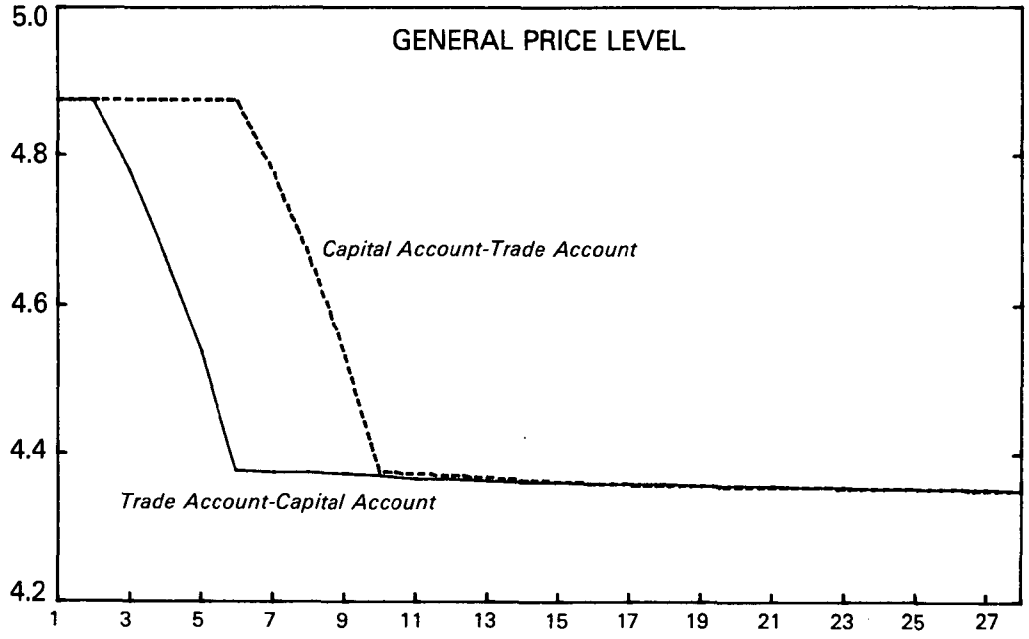
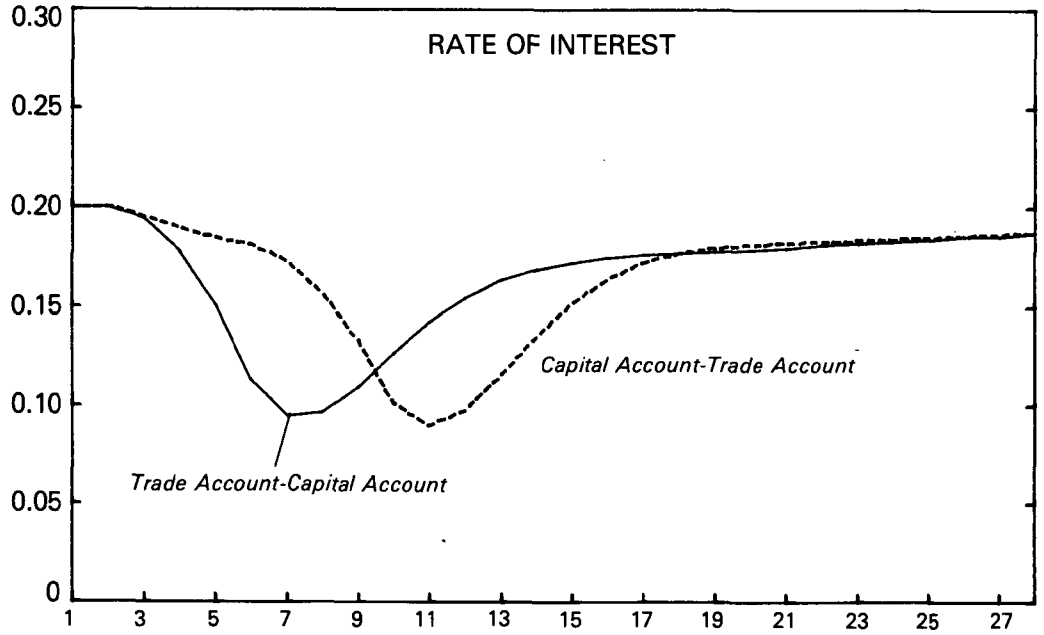


CHART D2



SEQUENTIAL REDUCTION IN TARIFFS AND REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART D3A

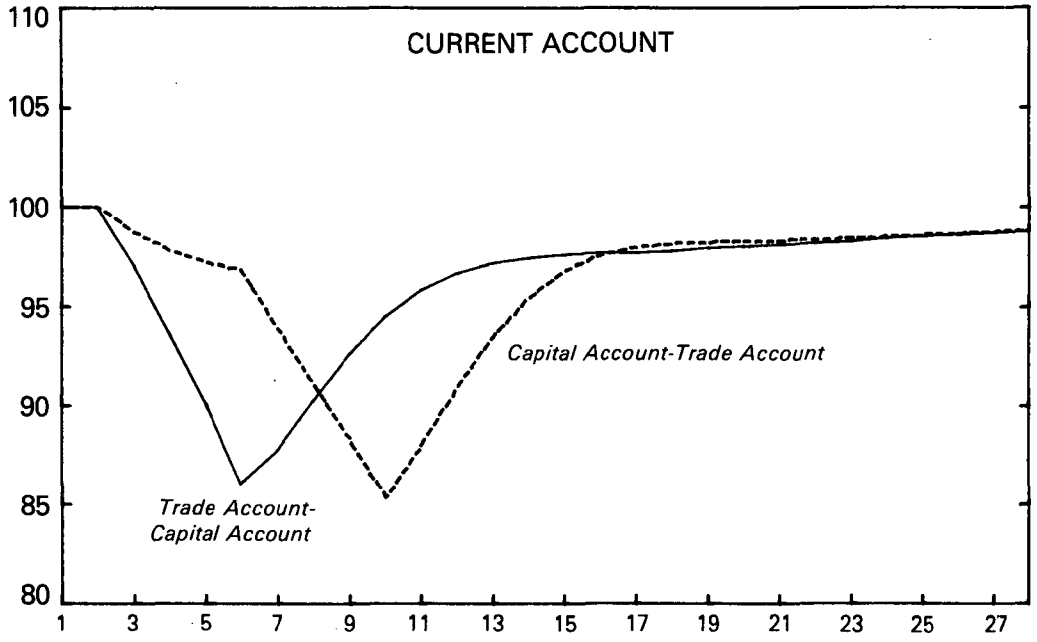
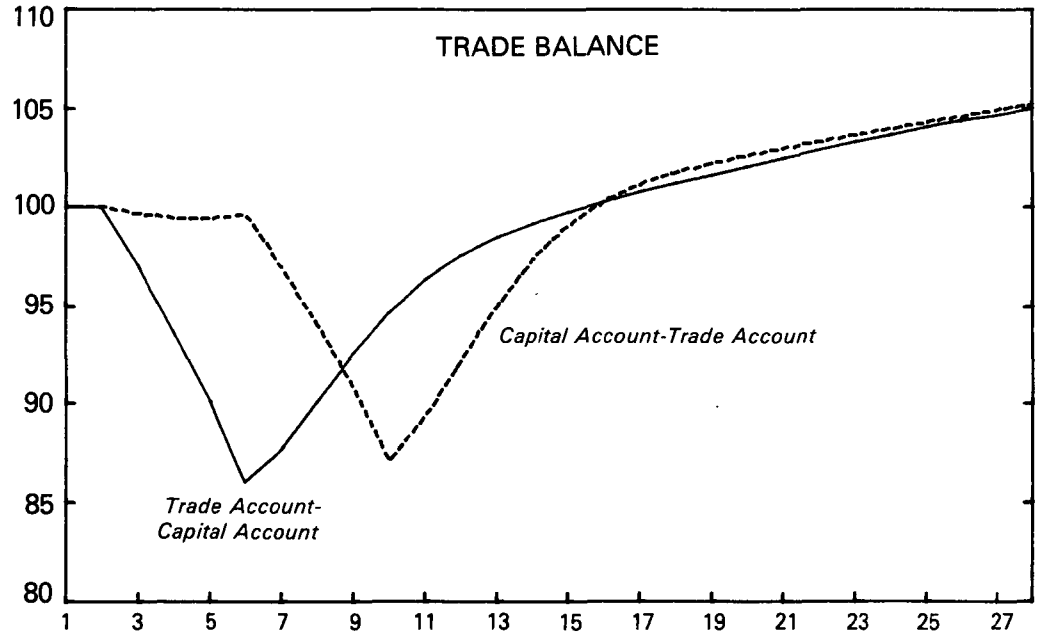


CHART D3B



SEQUENTIAL REDUCTION IN TARIFFS AND REMOVAL OF RESTRICTIONS ON CAPITAL FLOWS

CHART D4

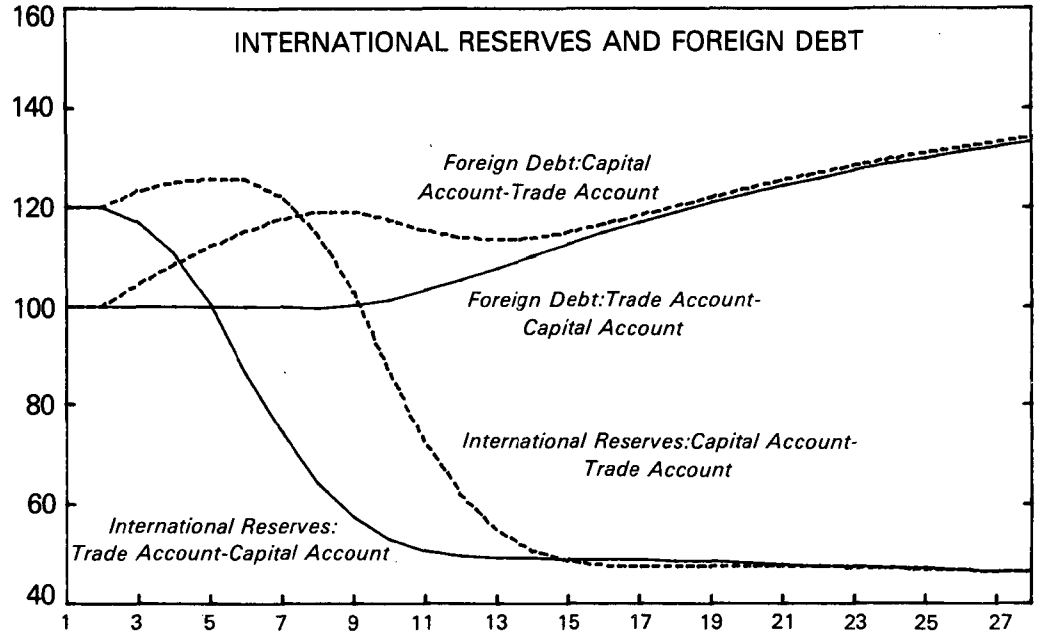
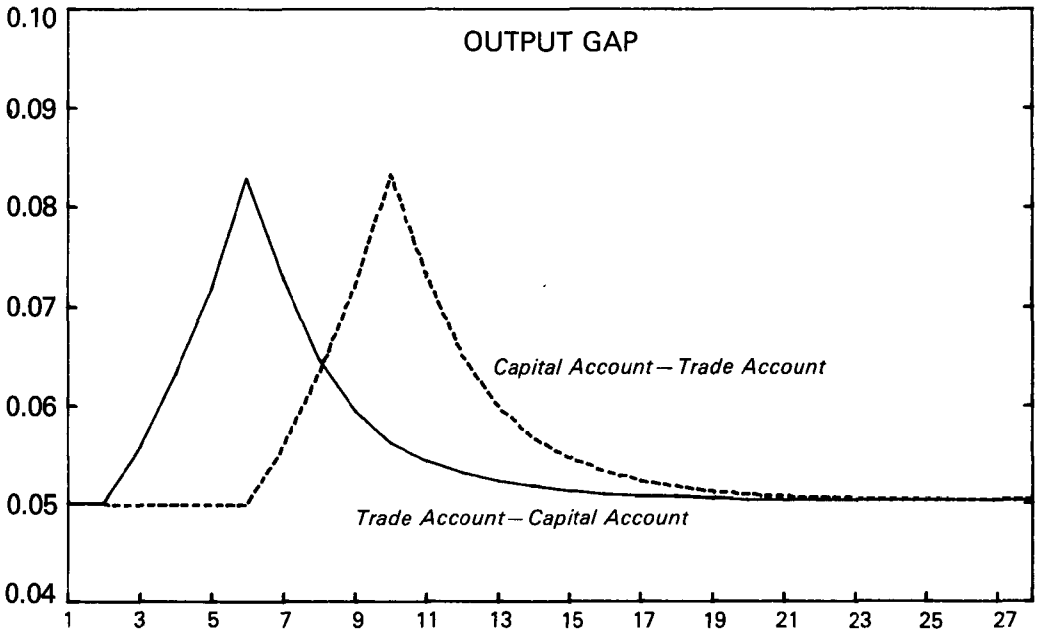


CHART D5



loss of international reserves, it would be necessary to implement a restrictive monetary policy consisting of reducing domestic credit--in this case credit to the private sector (CRP)--so as not to generate the excess supply of money that typically emerges when tariffs are reduced. Chart E1 describes the magnitude and time path that domestic credit must follow in the attempt to secure permanent equilibrium in the monetary sector when trade is opened-up gradually. For purposes of comparison we have plotted the (constant) path of domestic credit when trade was liberalized gradually without any change in monetary policy. It can be seen that a strong contraction in domestic credit would be necessary, being more pronounced in the initial periods and subsequently less marked.

The paths of the international reserves and current account as a consequence of this restrictive monetary policy are shown in Charts E2 and E3, where again we have plotted the results in the absence of monetary policy changes. International reserves fall very slightly, and the reason why they do not remain unchanged is that guaranteeing equilibrium in the monetary sector alone is not sufficient for this. In addition, as the adjustment in the exportable goods market is slower than in the importable goods market, the change in relative prices creates an asymmetrical response in the two markets, thereby generating a current account deficit in the first few periods. 1/

While the level of international reserves can be stabilized by a suitable tightening of monetary policy, this policy can itself have obvious adverse effects on other variables in the system. For example, in Chart E4 we show what happens to private expenditures as a consequence of such policy. For several periods private expenditures are lowered below the rate witnessed when tariffs were reduced without any variation in monetary policy. Although not shown here, we also observe a relatively larger rise in the real rate of interest and some further lowering of inflation and growth.

The basic exercise here has pointed out that designing an "optimal" mix of policies necessarily involves trade-offs, and it is up to the authorities to decide the weights they assign to the various effects. It appears quite evident that there is no easy escape from choosing between alternative combinations of transitory effects.

1/ Even though there is no excess demand.

IV. Conclusions

This study, while focusing on the narrow issue of the characteristics of the short- and medium-run adjustment path of some main macroeconmic variables as a consequence of opening-up the economy to the free flow of goods and financial capital has yielded, nonetheless, some important insights which can now be summarized. The main results are presented for convenience in Table 1 below. The simulation exercises produced a number of interesting and plausible results. It should be stressed that these results are based on a representative set of parameters. There are, of course, combinations of parameters that could produce

Table 1. Summary of Short-Run Effects on Selected Economic Variables of Liberalization of Trade and Capital Movements

Policy	Price Level	Current Account	International Reserves	Real Output	External Debt
1. Trade liberalization 1/	Lowered	Deficit	Lowered	Lowered	--
2. Capital account liberalization 2/	Unchanged	Deficit	Initially Increased	Unchanged	Increased
3. Simultaneous liberalization	Lowered	Deficit	Lowered	Lowered	Increased
4. Sequential liberalization 3/	Lowered	Deficit	Lowered	Lowered	Increased

1/ Capital controls retained.
2/ Tariff barriers retained.
3/ This simulation corresponds to the case where tariff barriers are removed gradually and then capital controls eliminated, and vice versa. While the overall effects of the two sequences are similar, as reported in this table, the time-paths of the variables do differ in the two cases.

somewhat counter-intuitive results, but it seems that the values needed for the coefficients would be fairly unrealistic and only of possible academic interest.

1. Briefly, we obtained the following principal results:

(a) It was demonstrated that the effects of trade liberalization are quite different from those resulting from the opening-up of the capital account. The former type of policy results in significant

COMPENSATORY MONETARY POLICY FOR GRADUAL REDUCTION IN TARIFFS

CHART E1

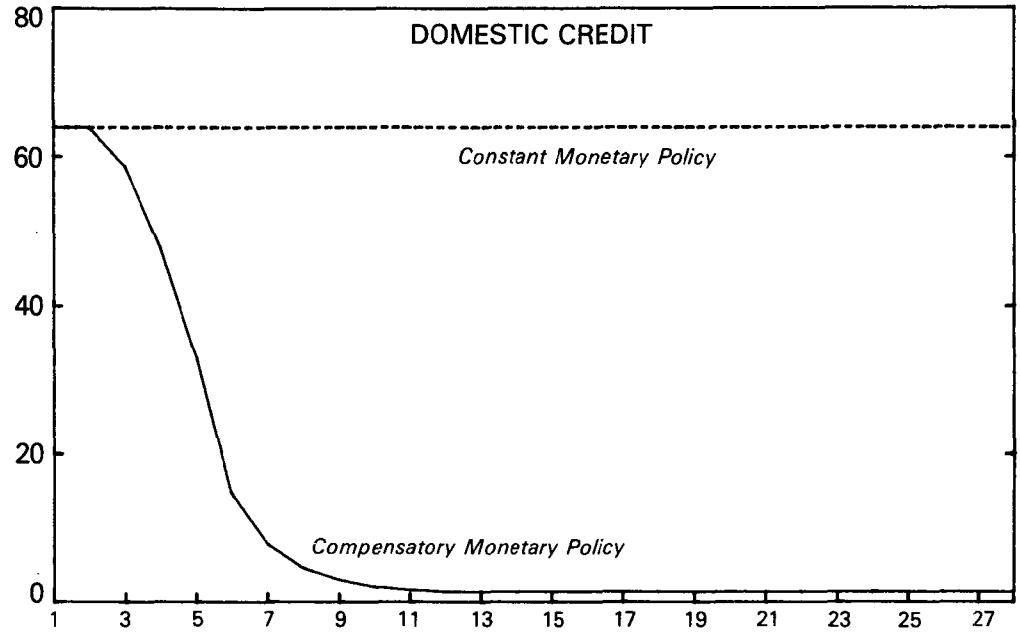
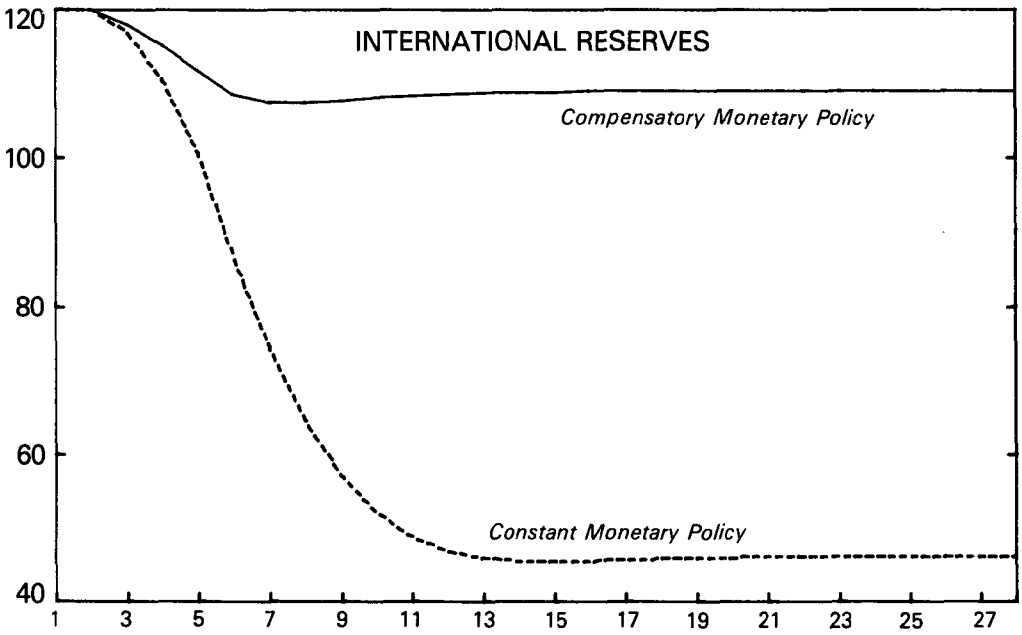


CHART E2



COMPENSATORY MONETARY POLICY FOR GRADUAL REDUCTION IN TARIFFS

CHART E3

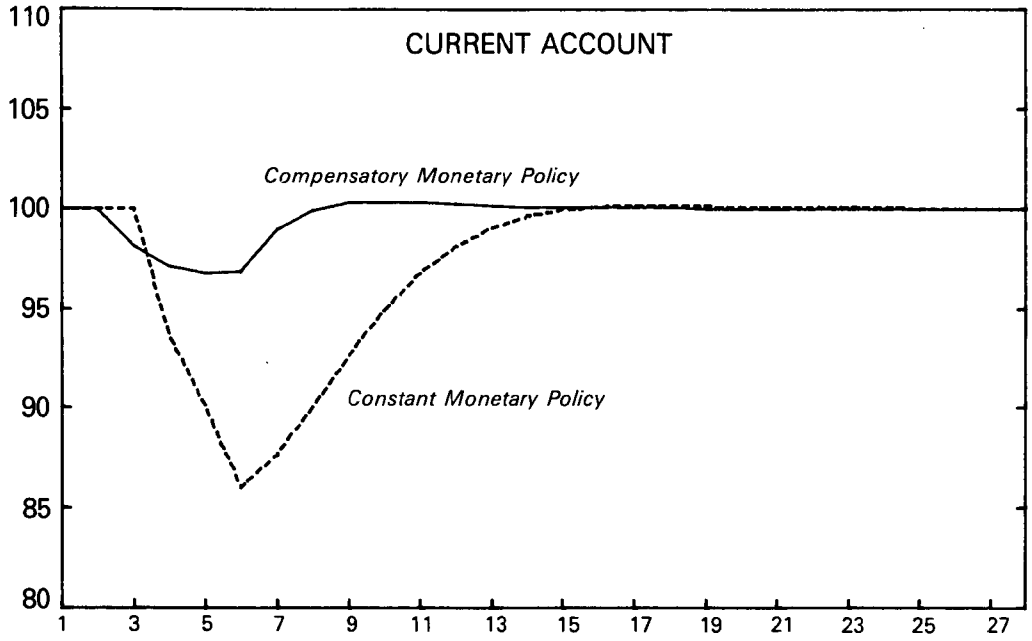
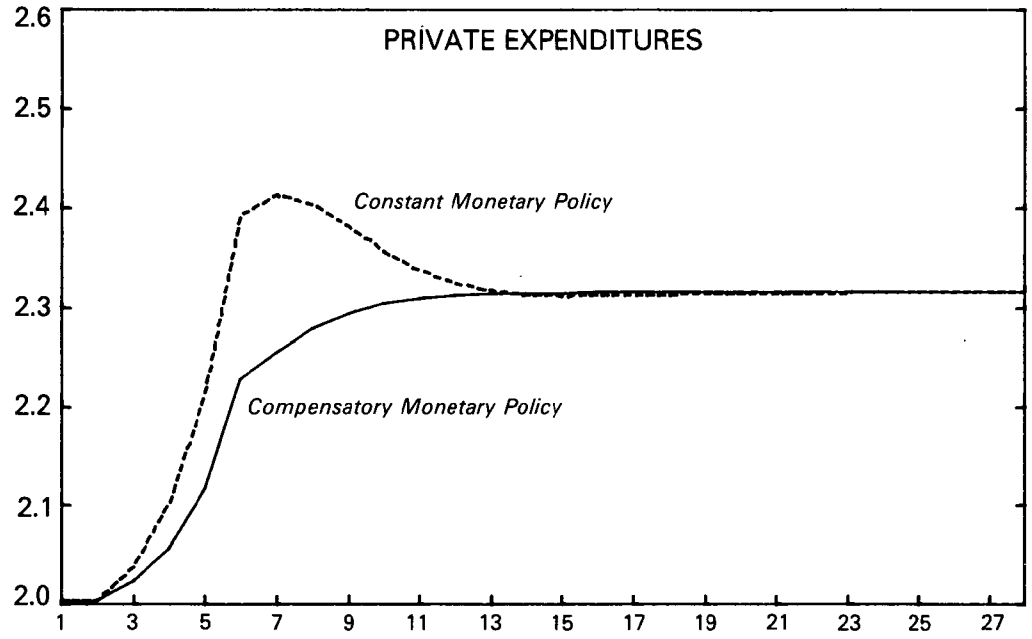


CHART E4



changes in resource allocation and both relative and absolute prices, in current account deficits, loss of international reserves, and in a relatively large fall in aggregate production. The impact of capital account liberalization, on the other hand, results in greater external indebtedness and current account deficits, although international reserves rise initially and then fall. The effects on the structure of production, prices, and the resource gap, are however very small.

(b) Another interesting result is that the speed with which reforms are instituted also matters. As it would be expected, a shock type approach, whether in the trade sector or on the capital account side, has a more pronounced impact at the beginning, but the adjustment to equilibrium is faster. If the policy is implemented more gradually the time paths of the variables are smoother, but naturally the adjustment process is more delayed. While on the face of it this would seem to suggest that perhaps a more gradualist approach reduces the cost of the opening-up policy, it should be noted that to make an adequate comparison of the effects of alternative strategies requires the introduction of an appropriate social rate of discount. This is something we chose not to do here since it would involve a fair degree of speculation.

(c) If a choice has to be made as to which type of liberalization policy to implement first, it is clear that different policy sequences yield different results from the point of view of the time paths of the principal macroeconomic variables, and it is not immediately obvious which pattern would be preferable. Also, it appears that the effects of the simultaneous liberalization of both the trade and the capital accounts is not simply a linear combination of the policies implemented separately.

It may, therefore, be concluded from the simulations that the economic authorities cannot be indifferent with respect to sequences, magnitudes, and relative speeds of alternative opening-up strategies.

2. The basic time-paths of the variables in the system, which are in a sense the focus of the exercise, depend on a variety of factors, and it may be useful to discuss some of these:

(a) In general terms, the study indicates that even when there is rapid opening-up it takes a number of periods to secure general macroeconomic equilibrium. In particular, even in the case of a sudden liberalization of the capital account, it takes a while for the domestic interest rate to converge to the international rate, appropriately defined. The sensitivity of the speed of convergence of domestic and international rates of interest depends on the interest elasticity of the flow of international capital to the country, the proportion of the monetary disequilibrium that spills into the domestic financial market, and the effect on the country-risk premium of changes in the external debt situation of the country.

(b) A further element which plays an important role in determining the time path of the various macroeconomic variables is the adjustment of prices and quantities in the non-tradable goods market. It is observed that the slower the adjustment of this market and the more important the direct role of effective demand in the supply of such goods, the costlier the process of trade liberalization tends to be in terms of production losses. Likewise, the speed with which domestic and foreign prices tend to equalize when there is removal of trade barriers, depends strongly on the importance of the production of non-tradable goods within total supply, and on the speed of adjustment of prices to disequilibrium in the non-tradables market.

(c) A final element which stands out in defining the time-path of the macroeconomic variables in a process of opening-up is that associated with the speed of response of the production of exportable and importable goods to changes in relative prices. The greater the intersectoral mobility resources and the smaller the differences between the lags in the desired and effective supplies of exportable and importable goods, the smaller will be the transition costs related to unemployment of resources arising from the opening up.

3. Some other specific interesting results which emerge from the exercise are as follows:

(a) When the economy is opened up to the world economy, the global balance-of-payments position may improve even though the current account deteriorates and external indebtedness grows.

(b) Real output temporarily falls when tariffs are reduced. The duration of the resource unemployment is independent of the speed of trade liberalization, but as mentioned, the resource gap is greater at the beginning in the case of "shock" policy, although later its magnitude is less than the one corresponding to gradual case scenario. This result is sensitive to the relative speed of adjustment of quantity and prices in the non-tradable goods market.

(c) As expected, the rate of inflation falls when tariffs are reduced, and the domestic rate of interest moves towards the value of the international rate, appropriately defined, when the economy is opened-up to capital movements. However, these two variables do not converge instantaneously towards their international levels, and the time it takes depends, to some extent, on the speed of the respective processes of opening-up.

(d) Although the production of importable goods falls with tariff reductions as the domestic price falls, the production of exportable goods rises. The proportion of non-tradable goods in the final equilibrium, as compared with the initial equilibrium, depends on the own and cross price elasticities of substitution of production and expenditure. In general, there is a change in the structure of production even though the level may remain constant.

(e) If initially the domestic nominal interest rate is above the relevant (adjusted) foreign rate, it will tend to fall when the economy is initially opened up, but the real rate may rise substantially above its initial value for some time. This case is frequently observed in sudden opening-up strategies in the trade sector and is explained by the (relatively) sharp drop in the domestic (actual and expected) rate of inflation, which results from the reduction in the price of importable goods.

(f) Compensatory policies can be designed which tend to reduce some of the undesirable transitory effects of the process of opening-up. The model makes it possible to devise such policies, and to evaluate the trade-offs implicit in their application.

4. It is important to list certain caveats at this stage. The analysis has been conducted in a non-growth framework, and it has been assumed that potential output is exogenous. In the opening-up process, when a current account deficit occurs, for there to be no net capital accumulation (a necessary condition to maintain real potential output as exogenous) it has been assumed that foreign savings are a perfect substitute for domestic savings. Furthermore, the assumption of exogenous real potential output implies that the model does not incorporate the possibility that in the process of opening-up, some part of the existing capital stock can become economically (but not necessarily technically) obsolete, and that there may be an improvement in efficiency due to inputs of new modern capital goods.

Some further caveats, which do not necessarily limit the relevance of our study, should also be pointed out. For example, even though our results have obvious implications regarding the behavior of factor markets and changes in the distribution of income, property or wealth, which may be quite important in some experiences of economic opening-up, no explicit analysis of such phenomena has been conducted. Also, all goods in the model are final goods, and as such, there is no allowance for intermediate inputs; therefore, there is no direct analysis of costs of production, the level and composition of which may change in the process of opening-up. The model further makes no distinction between consumption and investment goods. This omission may be important, particularly as one of the must frequently discussed topics in processes of opening-up is that of their impact on the rate of accumulation. Finally, expectations have been modelled in a fairly simplified fashion and it is possible that the introduction of more sophisticated expectations-generating schemes could alter some of the results. In this context we are also aware that a model such as the one developed here is vulnerable to the so-called "Lucas critique". In other words, it is quite likely that certain structural parameters which have been assumed to be constant, particularly those relating to expectations, could be altered as a consequence of the change in the policy regime. Unfortunately, to our knowledge, there is no obvious way to take account of such a criticism.

5. It should also be noted that the various simulations upon which our conclusions are based were conducted using the strong assumption that other domestic policies, as well as international factors, remained unchanged. It is obvious that the results could be significantly altered if, for example, the government ran large fiscal deficits, engaged in excessive monetary expansion, or maintained an unrealistic exchange rate at the same time that it was engaged in a liberalization process. Furthermore, changes in the international environment, as have been witnessed recently, namely the high foreign real rates of interest, declining growth in industrial world, rising protectionism in the export markets of developing countries, and sharp changes in commodity prices which have generally worsened the terms of trade of these countries, would also be expected to change the outcomes of the liberalization experiments. Although such factors have not been explicitly dealt with here, the model is capable of handling them.

6. Finally, the further development of this model will make it possible to facilitate the analysis of real cases. The next stage would undoubtedly involve, apart from some theoretical refinements, the actual estimation of structural parameters, lags, and coefficients of adjustment, for either individual countries, or using cross-country data. The expectation is that the basic model designed and studied here will serve as a foundation on which more detailed structures can be built, taking due care to incorporate institutional and other characteristics of the particular case at hand. Such models would help to evaluate more precisely the economic policy options related to the liberalization process. In addition, it would be quite informative to compare the short-term results from this model with the more longer-term results that emerge from static general equilibrium models that incorporate some type of welfare function. However, it should be mentioned that even in its current stage, the model has provided some systematic general information on the macroeconomic effects associated with the liberalizing of trade and capital flows.

Simulation Model

A. Equations

1. Production and supply

(1) Factor endowment:

$$y_t^* = \bar{y}_t^*$$

(2) Supply of importable goods:

$$I_t^s = \lambda_1 \left[\frac{\gamma_2\gamma_3 y_t^{*2}\, Pi_t^2}{\gamma_1\gamma_2\gamma_3\, Pi_t^2 + \gamma_1^2\gamma_3\, Px_t^2 + \gamma_1^2\gamma_2\, Pn_t^2} \right]^{1/2} + (1-\lambda_1) I_{t-1}^S$$

(3) Supply of exportable goods:

$$X_t^S = \lambda_2 \left[\frac{(\gamma_1^2\gamma_2) y_t^{*2}\, Px_t^2}{\gamma_1\gamma_2\gamma_3\, Pi_t^2 + \gamma_1^2\gamma_3\, Px_t^2 + \gamma_1^2\gamma_2\, Pn_t^2} \right]^{1/2} + (1-\lambda_2) X_{t-1}^s$$

(4) Desired supply of non-tradable goods:

$$N_t^{s*} = \left[\frac{(\gamma_1^2\gamma_2/\gamma_3) y_t^{*2}\, Pn_t^2}{\gamma_1\gamma_2\gamma_3\, Pi_t^2 + \gamma_1^2\gamma_3\, Px_t^2 + \gamma_1^2\gamma_2\, Pn_t^2} \right]^{1/2}$$

(5) Supply of non-tradable goods:

$$\log N_t^s = \log N_t^{s*} + \lambda_3 [\log N_t^d - \log N_t^{s*}]$$

(6) Real output:

$$y_t = [\gamma_1 I_t^{s\,2} + \gamma_2 X_t^{s\,2} + \gamma_3 X_t^{s\,2}]^{1/2}$$

(7) Nominal income:

$$Y_t = Pi_t I_t^s + Px_t X_t^s + Pn_t N_t^s + \varepsilon_t \cdot \tau_t \cdot I_t$$

(8) Disposable income:

$$YD_t = Y_t - T_t - \varepsilon_t \cdot \tau_t \cdot Pf_t \cdot I_t$$

2. Expenditures

(9) Total private expenditures:

$$\log EPRD_t = \lambda_4[\gamma_4 \log YD_t + \gamma_5(\log M_t - \log M_t^d) - \gamma_6 rd_t] + (1-\lambda_4)\log EPRD_{t-1}$$

(10) Private expenditures on goods:

$$EP_t = EPRD_t - rd_t \cdot Bf_t$$

(11) Total expenditures:

$$E_t = EP_t + G_t$$

(12) Total expenditures on importable goods:

$$\Delta\log(PiI^d)_t = \Delta\log E_t + \Delta\log Pi_t + (1/w_i^d)[-\gamma_7\Delta\log Pi_t + (w_x^d + (\gamma_7 + \gamma_8 - \gamma_9 - 1)/2)\Delta\log Px_t + (w_n^d + (\gamma_7 - \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pn_t]$$

(13) Total expenditures on exportable goods:

$$\Delta\log(PxX^d)_t = \Delta\log E_t + \Delta\log Px_t + (1/w_x^d)[w_n^d + (\gamma_7 + \gamma_8 - \gamma_9 - 1)/2)\Delta\log Pi_t - \gamma_8\Delta\log Px_t + (w_i^d + (-\gamma_7 + \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pn_t]$$

(14) Total expenditures on non-tradable goods:

$$\Delta\log(PnN^d)_t = \Delta\log E_t + \Delta\log PN_t + (1/w_n^d)[(w_x^d + (\gamma_7 - \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pi_t + (w_i^d + (-\gamma_7 + \gamma_8 + \gamma_9 - 1)/2)\Delta\log Pn_t]$$

3. Prices and unemployment

(15) Prices of importable goods:

$$\log Pi_t = \lambda_5[\log Pf_t + \log\varepsilon_t + \log(1+\tau_t)] + (1-\lambda_5)\log Pi_{t-1}$$

(16) Prices of exportable goods:

$$\log Px_t = \log Pf_t + \log\varepsilon_t$$

(17) Prices of non-tradable goods:

$$\Delta\log Pn_t = \lambda_6[\log N_t^d - \log N_t^s] + \lambda_7\Delta\log Pn_t$$

(18) General price index:

$$\Delta \log P_t = w_i^d \, \Delta \log Pi_t + w_x^d \, \Delta \log Px_t + w_n^d \Delta \log Pn_t$$

(19) Expected inflation:

$$\Delta \Pi_t = \lambda_8 [\Delta \log P_t - \Pi_{t-1}]$$

(20) Resource unemployment:

$$U_t = U_0 + \gamma_{10} \, (\log y_t^* - \log y_t)$$

4. Money and credit

(21) Nominal demand for money:

$$\log M^d = \alpha_1 + \gamma_{11} \log Y_t - \gamma_{12} \Pi_t - \gamma_{13} rd_t$$

(22) Nominal money supply:

$$M_t = CRG_t + CRP_t + R_t$$

(23) Domestic interest rate:

$$\Delta rd_t = \gamma_{14} [\log M_t^d - \log M_t]$$

5. Balance of payments

(24) Imports (in foreign currency):

$$I_t = Pf_t [I_t^d - I_t^s]$$

(25) Exports (in foreign currency):

$$X_t = Pf_t [X_t^s - X_t^d]$$

(26) Current account:

$$CA_t = \varepsilon_t [X_t - I_t] - rd_t . Bf_t$$

(27) Capital flows:

$$DK_t = \lambda_9 \varepsilon_t + \beta [\gamma_{15} (rd_t - rf_t - \rho_t - \Delta \log \varepsilon_t)]$$

(28) Balance of payments:

$$BP_t = CA_t + DK_t$$

(29) Stock of international reserves:

$$R_t = R_{t-1} + BP_t$$

(30) Foreign debt:

$$Bf_t = Bf_{t-1} + DK_t$$

(31) Risk premium:

$$\rho_t = \rho_0 + \gamma_{16}(Bf/Y)_t$$

6. Government sector

(32) Government expenditures:

$$G_t = T_t + \varepsilon_t \cdot \tau_t \cdot Pf_t \cdot I_t + GD_t$$

(33) Taxes:

$$T_t = t_0 + \gamma_{17}\, Y_t$$

(34) Credit to the government:

$$\Delta CRG_t = GD_t$$

7. Definitional equations

(35) Proportion of expenditures on importable goods:

$$w^d_{it} = (PiI^d)_t/E_t$$

(36) Proportion of expenditures on exportable goods:

$$w^d_{xt} = (PxX^d)_t/E_t$$

(37) Proportion of expenditures on non-tradable goods:

$$w^d_{nt} = (PnN^d)_t/E_t$$

B. Exogenous Variables

$\bar{y}^*$ = potential real output.

ε = exchange rate (index of units of domestic currency per unit of foreign currency), set equal to unity.

τ = uniform nominal tariff on imports.

Pf = index of foreign prices, equals 100.

rf = foreign rate of interest, set equal to 0.1.

β = index of restrictions on capital movements.

CRP = credit to the private sector.

GD = government fiscal deficit.

APPENDIX II

Values of Parameters Used in Simulations

Despite the seemingly large size of the model, it contains only 30 parameters--17 structural, 9 adjustment, and 4 constants. In choosing the values for these various coefficients we were guided by two basic principles. First, the parameters should be consistent, in that the various theoretical restrictions implicit in the model, particularly relating to the supply and demand elasticities, be satisfied. Second, the combination of parameters should be such as to ensure that the model be dynamically stable and settle down to a steady-state, which may or may not be necessarily equal to the original equilibrium. The specific values of the parameters used in the simulations reported in the text are given in Table A.2.

1. Structural parameters

There is very little information available on the price elasticities of demand and supply of importables, exportables, and non-tradable goods, other than those contained in the study by Clements (1980) for the United States. Other general equilibrium models either use arbitrary values themselves, or do not deal with sectors at the level of aggregation used in the study here. For the supply side, therefore, we arbitrarily chose a value for the price elasticity of importable goods (2.0) that was twice as large as the corresponding price elasticity of the supply of exportable goods. Developing countries in general, because of the type of goods they export (primary and semi-manufactured), are characterized as having a relatively low supply response of export goods, while the response of importables supply is considered larger. Having determined these two elasticities, the price elasticity of the supply of non-tradable goods was readily obtained from the restriction that the weighted sum of the three elasticities must equal zero. The relevant weights themselves were calculated from national accounts data for six Latin American countries--Argentina, Brazil, Chile, Colombia, Mexico and Uruguay--using the methodology outlined by Goldstein and Officer (1979) and Clements (1977). The production and expenditure weights obtained are shown in Table A.1 below:

Table A.1. Weights of Importable, Exportable, and Non-Tradable Goods in Total Income and Expenditure*

Goods	Proportion of:	
	Income	Expenditure
Importables	0.35	0.47
Exportables	0.17	0.08
Non-Tradables	0.48	0.45

* Calculated as average of the six countries data for the period 1970-79.

The price elasticity of demand for importables, γ_7, and exportables, γ_8, were calculated as an average of the price elasticities of demand for imports and exports, respectively, as reported by Khan (1974). Again the use of the expenditures weights (Table A.1) yielded the estimate of the price elasticity of demand for non-tradable goods.

The parameters in the private expenditures equation are based on the empirical results of Aghevli and Khan (1980) and Knight and Mathieson (1982), and the money demand coefficients correspond to those obtained by Khan (1980), Mathieson (1981), (1982), and others, for developing countries. The risk premium parameter, γ_{16}, is selected so that when the ratio of the stock of external debt to nominal income is 0.25, and the constant risk premium is 0.05, the total risk premium should be 0.1. The tax parameter, γ_{17}, is also set such as to maintain equality between tax revenues and nominal income, assuming the constant to be zero. The remaining parameters were imposed to guarantee a consistent initial equilibrium.

2. Adjustment parameters

The adjustment parameters were selected for the most part to ensure non-instantaneous adjustment to equilibrium, in keeping with our intention to trace out the transition path of certain important variables. The main distinctions were made in the supply sector and the determination of the price of non-tradable goods. Basically, it was assumed that the supply of importables would respond generally faster than the supply of exportable goods, implying thus that $\lambda_1 > \lambda_2$. On the non-tradable goods side λ_3 was set equal to zero in the simulations reported in the text, meaning that adjustment of the quantity of non-tradables responded to changes in demand through variations in prices rather than directly. The parameter λ_3 was, however, allowed to vary so as to permit a degree of direct demand effects on the behavior of non-tradable goods. The price of non-tradable goods was assumed to adjust slowly to excess demand because of "stickiness," and in the long-run was expected to grow at a rate somewhat less than the rate of increase of the price of importables. 1/ For the present analysis it was assumed, though it is not necessary to do so, that the price of importables adjusted immediately to a change in a change in tariffs, i.e., that $\lambda_5 = 1$. The coefficient of expectations, λ_8, is an approximate average of the values obtained by Khan (1980) in the context of a study of the demand for money function for a group of developing countries. No autonomous capital flows were permitted so that λ_9 was initially set to zero.

1/ As the period of analysis does not strictly correspond to a full long-run situation we did not feel it necessary to set $\lambda_7 = 1$.

To allow for some permanent or "normal" level of under-employment, U_0 was fixed at 5 per cent. The constant in the money demand equation was chosen simply to ensure equilibrium in the money market, given the initial values of the variables involved and the relevant parameters. The constant risk premium is assumed to be 5 per cent, and the average tax rate zero.

While there is no doubt that the choice of parameters for the simulation experiments is, in the final analysis, essentially arbitrary, the exercise was repeated by varying certain key parameters. The sensitivity analysis, while yielding different transition patterns for some of the variables, did not qualitatively change the results, or the main conclusions of the study. 1/

1/ The results of these additional exercises are available from the authors.

Table A.2. Values of Parameters

Equation No.	Variable	Parameter Values: Structural	Adjustment	Constant
(2c)	N^{s*} = desired supply of nontradable goods	$\gamma_3 = 0.3591$	-	-
(4a)	I^s = supply of importable goods	$\gamma_1 = 2.0$	$\lambda_1 = 0.8$	-
(4b)	X^s = supply of exportable goods	$\gamma_2 = 1.0$	$\lambda_2 = 0.4$	-
(5)	N^s = supply of non-tradable goods	-	$\lambda_3 = 0$	-
(11)	EPRD = private expenditures	$\gamma_4 = 1.0$ $\gamma_5 = 0.3$ $\gamma_6 = 0.5$	$\lambda_4 = 1.0$ - -	- - -
(14a)	I^d = demand for importable goods	$\gamma_7 = 0.4721$	-	-
(14b)	X^d = demand for exportable goods	$\gamma_8 = 0.0833$	-	-
(14c)	N^d = demand for non-tradable goods	$\gamma_9 = 0.4446$	-	-
(17)	P_i = price of importable goods	-	$\lambda_5 = 1.0$	
(19)	P_n = price of non-tradable goods	-	$\lambda_6 = 0.6$ $\lambda_7 = 0.7$	- -
(21)	Π = expected inflation	-	$\lambda_8 = 0.5$	-
(22)	U = resource unemployment	$\gamma_{10} = 1.0$	-	$U_0 = 0.05$
(23)	M^d = nominal demand for money	$\gamma_{11} = 1.0$ $\gamma_{12} = 1.0$ $\gamma_{13} = 1.0$	- - -	$\alpha_1 = 0.2924$ - -
(25)	rd = domestic rate of interest	$\gamma_{14} = 0.5$	-	-
(29a)	DK = capital flows	$\gamma_{15} = 100.0$	$\lambda_9 = 0.0$	-
(32)	ρ = risk premium	$\gamma_{16} = 0.2$	-	$\rho_0 = 0.05$
(35)	T = taxes	$\gamma_{17} = 0.1222.$	-	$t_0 = 0.0$

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