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Real Exchange Rate Dynamics in a Developing Country

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Abstract

Though the nominal exchange rate is typically a policy instrument in developing countries, the real exchange rate is an endogenous variable that responds to both exogenous and policy-induced shocks. This paper examines the dynamic effects on the real exchange rate of a variety of shocks, such as devaluation, changes in the terms of trade, fiscal policies, trade policies, and changes in foreign real interest rates. Since the path of the real exchange rate differs for different types of shocks, nominal exchange rate policies designed to achieve a target real exchange rate must take these differences into account.

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I. Introduction

There is general agreement among economists that the real exchange rate is a key relative price in the economic system. 1/ Changes in the real exchange rate have a wide-ranging influence on the economy, affecting foreign trade flows, the balance of payments, the structure and level of production and consumption, employment, and the allocation of resources. While the nominal exchange rate in developing countries is typically a policy instrument, the real exchange rate is an endogenous variable that responds to both exogenous and policy-induced shocks. It is obviously important, therefore, to understand how such shocks affect the real exchange rate in order to be able to design adjustment programs aimed at improving international competitiveness and shifting resources towards the production of tradable goods. 2/

In the past decade or so developing countries experienced a series of external shocks which had a direct impact on their real exchange rates. 3/ Worsening terms of trade, falling growth rates in industrial countries, and sharp changes in the availability of foreign financing that were accompanied by dramatic increases in real interest rates on external borrowing made economic management in general, and exchange rate management in particular, very difficult for policymakers in developing countries. Furthermore, in many cases the adverse effects of these external shocks were compounded by inappropriate domestic policies. The adoption of expansionary demand-management policies combined with rigid exchange rate policies resulted in the emergence of inflationary pressures, steady losses in international competitiveness, and inefficiencies in the allocation of resources arising from distortions in relative prices.

The need for macroeconomic adjustment was not perceived to be pressing as long as foreign financing was readily available. However, as is now well known, in 1982 the private international credit markets reached the conclusion that recent financing trends were no longer sustainable. The flow of new credits to many capital-importing developing countries suddenly evaporated, making external adjustment the prime objective of economic policy. Such adjustment typically involved fiscal and monetary restraint to control both public and private spending,

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1/ For an extensive discussion of the theoretical and empirical aspects of real exchange rates in developing countries see the papers contained in Edwards and Ahamad (1986), and in particular the study by Harberger (1986).

2/ Policies to alter the real exchange rate are often the centerpiece of adjustment programs. See International Monetary Fund (1985).

3/ For a description of the role of external factors that affected developing countries, see Khan and Knight (1983) and Balassa (1986).

trade policies to create the incentives for increased supply of tradables, and the implementation of more flexible exchange rate policies to achieve and maintain international competitiveness.

Taking the view that getting the real exchange rate "right" is a central element in the adjustment efforts of developing countries, this paper addresses the following question: what are the dynamic effects of external shocks and domestic policy actions on the real exchange rate of a developing country? Previous analyses of the effects of external shocks on the real exchange rate, for example by Dornbusch (1985) and Khan (1986), have used essentially a comparative static approach. For policymakers, however, it is often equally important to understand the transition path the real exchange rate follows after a shock as it is to know what its value would be in the long run. The dynamics of real exchange rate behavior needs to be examined, therefore, if useful advice on exchange policies is to be given.

In Section II of this paper we outline a simple theoretical model for the study of real exchange rate behavior in a small developing economy. The advantage of this model is that it allows us to examine the dynamic effects of a variety of shocks on the real exchange rate within a single consistent framework. In Section III we examine the effects on the real exchange rate of a nominal devaluation, changes in the terms of trade, fiscal policies, trade policies, and increases in foreign real interest rates. The concluding section summarizes the main issues covered in the paper, and highlights the policy implications of the study.

II. The Model

The model we specify to analyze the dynamic adjustment of the real exchange rate in a developing economy is an expanded version of the model proposed by Montiel (1986), modified to incorporate a three-good structure--importables, exportables, and nontradables--and to allow for instantaneous nominal wage and price flexibility. The model has its roots in the familiar two-good dependent economy model popularized by Dornbusch (1974), Rodriguez (1978), and Liviatan (1979), among others.

The focus of our analysis is on the dynamic behavior of the real exchange rate induced by asset accumulation, as in Khan and Lizondo (1987). 1/ Thus real private financial wealth is the key predetermined variable. Given the current value of real private financial wealth, the real exchange rate and the real wage adjust continuously to ensure equilibrium in the labor market and the market for nontraded goods. The

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1/ For an analysis of real exchange-rate dynamics induced by changes in the sectoral allocation of capital, see Edwards (1986). Alternative approaches to the question of dynamics are taken by Mussa (1986) and Obstfeld (1986).

model assumes perfect foresight on the part of all agents, and consequently the values of the real exchange rate and the real wage that will clear these markets at any instant depend on the future evolution of the economy.

This section is divided into four subsections. The supply side of the model is described in the first subsection, followed by the demand side. The third subsection analyzes the implications of equilibrium in the market for nontraded goods, and the final subsection presents the solution.

1. Supply

Consider an economy producing three goods: exportables (X), importables (Z), and nontraded goods (N) using a single variable factor of production (labor). Production functions for all goods take the form:

$$(1) \quad y_i = y_i(L_i); \; y_i' > 0, \; y_i'' < 0,$$

where y_i denotes output of good i, L_i is the amount of labor employed in the i^{th} sector, and i = X, Z, N. A prime signifies a derivative, $y_i' = \frac{dy_i}{dL_i}$.

Labor is assumed to be homogenous and instantaneously mobile among sectors. It therefore earns the same nominal wage in each sector. This wage is assumed to be perfectly flexible, so labor-market equilibrium holds continuously:

$$(2) \quad L_X(w/\rho) + L_Z(w) + L_N(we) = \bar{L}$$

Here w is the wage measured in terms of importables (i.e., W/P_Z, if W is the nominal wage and P_Z the domestic-currency price of importables), ρ is the terms of trade, given by $\rho = P_X/P_Z$, where P_X is the domestic-currency price of exportables. The variable e is the real exchange rate, defined as the ratio of the domestic-currency price of importables (P_Z) to that of nontraded goods (P_N)--$e = P_Z/P_N$. 1/ An increase

1/ Note that, as long as ρ is unchanged, this is equivalent to defining e as the ratio of the price of tradables to that of nontradables. When ρ changes, the latter definition becomes ambiguous, and we will examine effects of such changes on both P_Z/P_N and P_X/P_N (see Section III).

(decrease) in e represents a real depreciation (appreciation). The demand for labor in each sector is derived from the profit-maximizing condition $y_i'(L_i) = w_i$, where w_i is the product wage in sector i, so the labor-demand functions satisfy $L_i' = 1/y_i'' < 0$. The aggregate supply of labor is assumed to be inelastic, and is given by $\bar{L}$. Equation (2) permits us to solve for the value of w that clears the labor market as a function of the terms of trade and the real exchange rate:

$$(3) \quad w = w(\rho,e)$$

$$w_1 = (L_x' \, w/\rho^2) \,/\, (L_x'/\rho + L_z' + L_N'e) > 0$$

$$w_2 = - L_N'w/(L_x'/\rho + L_z' + L_N'e) < 0,$$

where w_1 and w_2 are the partial derivatives of the function $w(\rho,e)$. An improvement in the terms of trade brought about by an increase in the price of exportables, for example, increases the demand for labor in the exportables sector, which causes the nominal wage to be bid up in all sectors, thereby releasing labor from the importable and nontradable sectors to be absorbed in the expanding export sector. In contrast, given ρ, a real exchange rate depreciation (increase in e) must be brought about through a relative decrease in P_N. This causes the demand for labor to decrease in the nontraded goods sector. The nominal wage is thus bid down, causing the traded goods sectors to absorb the labor released by the nontraded goods sector. It is easy to verify from the expressions for w_1 and w_2 that the elasticities of w with respect to ρ and e are both less than unity in absolute value, so an increase in ρ reduces the product wage (w/ρ) in the exportables sector and an increase in e increases the product wage in the nontraded goods sector:

$$\frac{d(w/\rho)}{d\rho} = (w_1 - w/\rho)/\rho = [L_x'/(L_x' + L_z'\rho + L_N'\rho e) - 1]\, w/\rho^2 < 0$$

$$\frac{d(we)}{de} = w_2 e + w = [1 - L_N'e \,/\, (L_x'/\rho + L_z' + L_N'e)]\, w > 0.$$

Substituting the sectoral labor-demand functions into the respective production functions and using equation (3) permits us to write the sectoral supply functions for exportables, importables and nontradables as:

(4a) $y_x^s = y_x[L_x(w(\rho,e)/\rho)]$

$dy_x^s/d\rho = y_x' L_x' (w_1 - w/\rho)/\rho > 0$

$dy_x^s/de = y_x' L_x' w_2 > 0$

(4b) $y_z^s = y_z[L_z(w(\rho,e))]$

$dy_z^s/d\rho = y_z' L_z' w_1 < 0$

$dy_z^s/de = y_z' L_z' w_2 > 0$

(4c) $y_N^s = y_N[L_N(w(\rho,e)e)]$

$dy_N^s/d\rho = y_N' L_N' w_1 e < 0$

$dy_N^s/de = y_N' L_N' (w_2 e + w) < 0$

The supply of output in each sector is thus a function only of the terms of trade and the real exchange rate. A terms of trade improvement shifts labor from the importable and nontraded goods sectors to the exportable sector, causing output to expand in the latter and contract in the former. By contrast a real exchange-rate depreciation moves labor from the nontraded goods sector into the production of both tradable goods. Output of exportables and importables expands, while that of nontradables contracts.

2. Demand

For the case of a small country the law of one price implies that the foreign component of demand for the tradable goods is perfectly elastic, so that domestic currency prices of these goods are given by:

(5a) $P_x = sP_x^*$

(5b) $P_z = sP_z^*$,

where P_x^* and P_z^* are the foreign-currency prices of exportables and importables respectively, and s is the nominal exchange rate (the domestic-currency price of a unit of foreign currency). By definition there is, of course, no foreign demand for the nontraded good.

Turning to the domestic component of demand, we assume that the exportable good is not consumed at home. We have in mind, therefore, a small country which is specialized in the export of some primary commodity. 1/ Importables and nontraded goods are consumed by the private sector and the government.

a. The private sector

With regard to the private sector, we assume that the representative household possesses a Cobb-Douglas utility function, with share θ for consumption of nontraded goods (c_N) and 1-θ for consumption of importables (c_z) ($0 \leq \theta \leq 1$). 2/ This means that the private sector has constant expenditure shares θ and (1-θ) on nontraded and importable goods, respectively. The price of the consumption basket, denoted P, can therefore be written as:

$$(6) \quad P = P_N^{\theta} P_z^{1-\theta}$$

$$= P_z e^{-\theta}.$$

From equation (6), we can write the relative prices P_z/P and P_N/P in the form:

$$(7a) \quad P_z/P = e^{\theta}$$

$$(7b) \quad P_N/P = e^{\theta-1}.$$

Letting c denote total real consumption measured in units of the consumption basket, constant expenditure shares imply that $P_N c_N = \theta Pc$ and $P_z c_z = (1-\theta)Pc$. Therefore, private sector demand for importables and nontraded goods can be expressed, using (7a) and (7b), as:

1/ This is strictly a simplifying assumption. It has no effects on the basic results of the paper. What it implies in the analysis here is that exports and exportables are one and the same.

2/ We utilize this formulation for reasons of simplicity.

(8a) $c_z = (1-\theta)\, e^{-\theta} c$

(8b) $c_N = \theta e^{1-\theta} c$

Real household consumption c is taken to depend on real factor income (y) net of real taxes paid to the government (t_p), on the real interest rate (r), and on the private sector's real financial wealth, all measured in terms of the consumption basket. For later convenience, we write the last of these variables as $e^{\theta} a_p$, where a_p is real private financial wealth measured in terms of importables. Therefore, real consumption is given by:

(9) $c = c(y - t_p, r, e^{\theta} a_p);\ 0 < c_1 < 1,\ c_2 < 0,\ c_3 > 0$

where c_1, c_2, and c_3 are the partial derivatives of the function c( ). Increases in real factor income net of taxes and in real private financial wealth increase real consumption, while an increase in the real interest rate will reduce it.

Real factor income is simply nominal output divided by the price of the consumption basket, i.e.:

$$y = (P_x y_x + P_z y_z + P_N y_N) / P$$

and using (6) and (7) can be written as:

$$y = e^{\theta} (P_x y_x + P_z y_z + P_N y_N) / P_z$$

$$= e^{\theta} (\rho y_x + y_z + y_N/e),$$

Since sectoral output levels, according to the supply equations (4a) through (4c), depend only on the terms of trade and the real exchange rate, y likewise depends only on ρ and e. We can therefore write:

(10) $y = y(\rho, e)$

Choosing units so that initially $\rho = e = 1$ and using equation (3) we have:

$$y_1 = dy/d\rho = y_x' \, [L_x' + L_z' + L_N'] \, w_1 - y_x' L_x' w + y_x$$

$$= y_x$$

$$y_2 = dy/de = \theta y - y_N + y_N' \, [L_x' + L_z' + L_N'] \, w_2 - y_N' L_N' w$$

$$= \theta y - y_N,$$

Thus, an improvement in the terms of trade increases real income by an amount that depends on the initial level of exports. To interpret the effect of a real exchange-rate depreciation on real income, note that we will assume below that the composition of government spending initially mirrors that of the private sector and that the market for nontraded goods is in continuous equilibrium. This means that θy can differ from y_N only to the extent that real domestic absorption differs from real output, i.e., to the extent that the trade balance is initially in surplus or deficit. If the trade balance is in equilibrium ($\theta y = y_N$), a real-exchange rate depreciation will have no effect on real income. If the trade balance is in surplus ($\theta y > y_N$), the value of domestic production exceeds that of absorption. Since production and absorption of nontraded goods must be equal, this means that output of traded goods must exceed absorption of traded goods, implying that the share of traded goods in production must exceed their share in absorption--i.e., in the consumption basket. Thus an increase in the relative price of traded goods (a real depreciation) must increase the real value of domestic output measured in terms of the consumption basket ($dy/de > 0$). These arguments are reversed if the trade balance is initially in deficit. Since long-run equilibrium will be shown to require a zero current account balance, assuming the home country to be a net international debtor requires a trade surplus in the initial long-run equilibrium. In what follows, therefore, we assume $y_2 > 0$.

Real household financial wealth consists only of real financial assets--which are comprised of real money balances M/P and the real value of foreign securities (sF_p/P)--minus real liabilities, consisting of the stock of credit extended to the private sector by the banking system (D_p/P):

(11) $e^{\theta} a_p = (M + sF_p - D_p)/P$

Money pays no interest, while foreign securities earn the nominal interest rate i^*. The nominal rate charged on bank loans is denoted i. We assume that portfolios are in continuous equilibrium, that domestic and foreign interest-bearing assets are perfect substitutes, and that expectations are characterized by perfect foresight. Under these conditions, uncovered interest parity holds continuously:

$$(12)\quad i = i^{*} + E(\hat{s})$$

$$= i^{*},$$

where $E(\hat{s})$ is the expected rate of depreciation of the domestic currency, 1/ which is zero under fixed exchange rates and perfect foresight. These conditions also imply that the money market is always in equilibrium. Letting the real demand for money (L) depend, in conventional fashion, on real income and the nominal interest rate, we have, using (12) to replace i by i^{*}

$$(13)\quad M/P = L(i^{*}, y);\ L_1 < 0,\ L_2 > 0.$$

where L_1 and L_2 are the partial derivatives of real money balances with respect to i^{*} and y. Finally, since the real interest rate is the nominal interest rate minus the expected rate of inflation, $r = i - E(P)$, we can use the log-differentiated versions of equations (5b) and (6) to write:

$$(14)\quad r = [i^{*} - E(\hat{P}_z^{*})] + \theta E(\hat{e})$$

$$= r^{*} + \theta\hat{e}$$

where $r^{*} = i^{*} - E\ (\hat{P}_z^{*})$ is the external real interest rate.

To conclude our description of private sector behavior, we can derive private accumulation of real financial wealth from the private sector's budget constraint. Letting a dot over a variable denote a time derivative, this constraint takes the form:

$$(\dot{P_z a_p}) = Py + i^{*}(sF - D_p) - Pt_p - Pc.$$

Solving for $\dot{a}_p$ by using equation (9) and writing out the expression for L we obtain:

1/ A hat over a variable denotes a proportional rate of change.

$$\dot{a}_p = e^{-\theta}(y - t_p - c) + i^*(a_p - e^{-\theta}L) - \hat{P}^*_z a_p$$

$$= e^{-\theta}(y - t_p - c) + r^* a_p - (r^* + \hat{P}^*_z)e^{-\theta}L$$

$$= e^{-\theta}(y[\rho,e] - t_p - c\,[y(\rho,e) - t_p,\ r^* + \theta\hat{e},\ e^{\theta}a_p])$$

$$+ r^* a_p - (r^* + \hat{P}^*_z)e^{-\theta}L[r^* + \hat{P}^*_z,\ y(\rho,e)]$$

We can summarize the properties of private saving behavior as follows:

$$(15)\quad \dot{a}_p = a(a_p,\ e,\ \rho,\ t_p,\ r^*,\ \hat{e},\ \hat{P}^*_z)$$

$$a_1 = r^* - c_3 < 0$$

$$a_2 = (r^* - c_3)\ \theta a_p + [1 - c_1 - (r^* + \hat{P}^*_z)L_2]y_2 = ?$$

$$a_3 = [1 - c_1 - (r^* + \hat{P}^*_z)L_2]y_1 > 0$$

$$a_4 = -(1 - c_1) < 0$$

$$a_5 = a_p - L - (r^* + \hat{P}^*_z)\ L_1 - c_2 > 0$$

$$a_6 = -\theta c_2 > 0$$

$$a_7 = -[L + (r^* + \hat{P}^*_z)\ L_1] = ?,$$

where all derivatives are evaluated at $e = 1$ and $\dot{a}_p = 0$. The signs of these partial derivatives reflect the following assumptions:

1. An increase in real financial wealth reduces household saving ($c_3 > r^*$). This assumption is not very restrictive, since the propensity to consume out of nonhuman wealth will exceed the real interest rate in a life-cycle context with finite household horizons (see Flavin (1985)).

2. The marginal propensity to save remains positive even after allowing for the loss of interest income caused by the instantaneous

portfolio shift into money induced by an increase in household income $(1-c_1-(r^*+\hat{P}_z^*)L_2 > 0)$.

3. Real household financial wealth exceeds the real value of money holdings $(a_p > L)$.

b. The public sector

The public sector in our model consists of the government and the central bank. The government is assumed to hold no money, so that its net worth is given by:

$$(16) \quad e^{\theta} a_G = (sF_G - D_G) / P,$$

where a_G is the government's net worth measured in terms of importables, F_G is the government's stock of foreign securities and D_G is the stock of credit extended to the government by the central bank. The government consumes current output, collects taxes, receives transfers of profits from the central bank, and accumulates assets. Its actions are subject to the budget constraint:

$$(\dot{P_z a_G}) = P(t_p + t_B) + i^* P_z a_G - P_N g_N - P_z g_z,$$

where t_B is real transfers received from the central bank and g_N and g_z are government consumption of nontraded goods and importables respectively. Defining g as total government spending measured in units of the consumption basket, we assume that initially $g_N = \theta e^{1-\theta} g$ and $g_z = (1-\theta) e^{-\theta} g$. Solving the budget constraint for $\dot{a}_G$ we have:

$$(17) \quad \dot{a}_G = e^{-\theta} (t_p + t_B) + r^* a_G - e^{\theta-1} g_N - g_z.$$

The government's policy variables are t_p, g_N, and g_z. Transfers from the central bank t_B are endogenous (see equation (20) below), and a_G is predetermined. The surplus $\dot{a}_G$ is determined residually. The behavior of the surplus, however, is subject to the intertemporal constraint: 1/

$$(18) \quad \lim_{t\to\infty} a_G(t)\, e^{-r^* t} \geq 0$$

1/ This intertemporal constraint allows us to rule out Ponzi schemes.

By solving the differential equation (17), it can be shown that this condition will be violated unless the long-run values of t_p, g_N, and g_z are such that $\dot{a}_G = 0$. 1/ Since this condition pegs the long-run value of $\dot{a}_G$, one of the policy variables t_p, g_N, or g_z must move to the residual role. We will suppose for now that g_z does so. 2/ In the long run, then, equation (17) becomes:

$$(17a)\quad g_z = e^{-\theta} (t_p + t_B) + r^* a_G - e^{\theta-1} g_N,$$

which implies that changes in t_p or g_N must be offset by changes in g_z that leave the (inflation-adjusted) budget in balance.

Turning to the central bank, its balance sheet is given by:

$$(19)\quad M = sF_B + D_p + D_G.$$

With the stock of foreign-exchange reserves, F_B, being held in the form of foreign securities, bank profits are:

$$(20)\quad t_B = i^* (sF_B + D_p + D_G) / P.$$

The central bank controls the stocks of credit extended to the private sector and to the government. Credit policy is assumed to take the form of growth in these stocks at the constant rate $\hat{D}$. Since the exchange rate is fixed, the money stock and the stock of foreign-exchange reserves are endogenous variables. The stock of foreign-exchange reserves will evolve according to:

$$(21)\quad (\hat{sF_B}) \frac{sF_B}{M} = \hat{M} - \hat{D} \frac{D}{M},$$

$$= \hat{M} - \hat{D} \left(1 - \frac{sF_B}{M}\right).$$

1/ The intertemporal constraint (18) will be violated for the domestic government if $\dot{a}_G < 0$ and for the government of the rest of the world if $\dot{a}_G > 0$.

2/ This will be changed in Section III.

A necessary condition for avoiding a balance-of-payments crisis is that the ratio of foreign-exchange reserves to the domestic money stock (eF_B/M) be bounded from below. 1/ It can be seen from (21) that this requires $\hat{D} \leq \hat{M}$. It can also be shown that unless $\hat{D} \geq \hat{M}$, the private sector will be unable to satisfy its demand for money in the long run. Thus, the central bank has no long-run discretion over $\hat{D}$. Short-run deviations from the long-run value of $\hat{D}$ will be reflected in changes in the long-run equilibrium value of eF_B/M.

3. Equilibrium in the markets for labor and nontraded goods

The price of nontraded goods is assumed flexible in this model, so the market for nontraded goods is always in equilibrium:

$$y_N = c_N + g_N.$$

Substituting for y_N from (4c) and for c_N from (8b) and (9), we have:

$$(22)\quad y_N(L_N[w(\rho,e)e]) = \theta e^{1-\theta}c[y(\rho,e) - t_p,\ r^* + \theta\hat{e},\ e^{\theta}a_p] + g_N.$$

Notice that, since $w(\rho,e)$ is the value of w that clears the labor market, equation (22) imposes simultaneous equilibrium in the markets for labor and nontraded goods. Equation (22) can be written in the form of an equation for the evolution of the real exchange rate:

$$(23)\quad \hat{e} = \phi\ (a_p,\ e,\ \rho,\ g_N,\ t_p,\ r^*)$$

with:

$$\phi_1 = -c_3/\theta c_2 > 0$$

$$\phi_2 = (y_N'L_N'[w_2+w] - \theta c_1 y_2 - \theta^2 c_3 a_p - \theta(1-\theta)c)/\theta^2 c_2 > 0$$

$$\phi_3 = (y_N'L_N'w_1 - \theta c_1 y_1)/\theta^2 c_2 > 0$$

$$\phi_4 = -1/\theta^2 c_2 > 0$$

1/ This condition is not sufficient, since a crisis will ensue if eF_B/M is foreseen to fall below a threshhold value. These conditions are obtained in models of balance of payments crises. See Krugman (1979), Obstfeld (1984), and Blanco and Garber (1986).

$$\phi_5 = c_1/\theta c_2 < 0$$

$$\phi_6 = -1/\theta < 0,$$

where the partial derivatives are evaluated at e = 1, and the sign of ϕ_2 assumes that the substitution effect of a change in the real exchange rate ($\theta(1-\theta)c$) dominates the income effect ($\theta c_1 y_2$). Equation (23) describes the rate of real exchange rate depreciation that will clear the market for nontraded goods for given values of the variables on the right-hand side. An increase in the rate of depreciation of the real exchange rate implies, given $\hat{P}_z^*$, an increase in the domestic rate of deflation and thus an increase in the domestic real interest rate. Such an increase induces a reduction in the excess demand for nontraded goods and becomes necessary whenever excess demand for such goods is created by an increase in household wealth, a real depreciation (i.e., decline in P_N), an increase in real income due to a favorable terms of trade shift, or an increase in government spending on nontraded goods. This explains the first four partial derivatives above. The rate of real depreciation must decrease to lower the domestic real interest rate and stimulate increased demand for nontraded goods, when such demand has been depressed by increased taxation or an increase in international real interest rates. This justifies the signs of the two remaining partial derivatives.

4. Solution of the model

Solving the model described above requires ascertaining values of e and $\hat{e}$. But since the equilibrium value of e depends on the contemporaneous value of a_p--a predetermined variable--it follows that future values of e will depend on future values of a_p. Thus the dynamics of the real exchange rate and the accumulation of private financial wealth must be worked out jointly. 1/ This can be done by using the private sector saving equation (15) and the equilibrium condition for the nontraded goods market (23). These equations are reproduced here for convenience:

$$(15) \quad \dot{a}_p = a(a_p, e, \rho, t_p, r^*, \hat{e}, \hat{P}_z^*)$$

$$(23) \quad \hat{e} = \phi(a_p, e, \rho, g_N, t_p, r^*)$$

1/ See Khan and Lizondo (1987).

Private asset accumulation depends on the rate of depreciation of the real exchange rate, and substituting for $\hat{e}$ in equation (15) from equation (23) we have:

$$(24) \quad \dot{a}_p = \psi\,(a_p, e, \rho, g_N, t_p, r^*, \hat{P}_z^*),$$

with:

$$\psi_1 = r^* > 0$$

$$\psi_2 = r^*\theta a_p + (1-\theta)\,c + [1-(r^*+\hat{P}_z^*)L_2]\,y_2 - y_N'L_N'[w_2+w]/\theta > 0$$

$$\psi_3 = [1 - (r^* + \hat{P}_z^*)\,L_2]\,y_1 - y_N'L_N'w_1/\theta > 0$$

$$\psi_4 = 1/\theta > 0$$

$$\psi_5 = -1 < 0$$

$$\psi_6 = a_p - L - (r^* + \hat{P}_z^*)\,L_1 > 0$$

$$\psi_7 = -[L + (r^* + \hat{P}_z^*)\,L_1] = ?$$

Equations (23) and (24) are a system of differential equations in e and a_p. Linearizing this system around the equilibrium $\dot{e} = \dot{a}_p = 0$, we have:

$$(25) \quad \begin{bmatrix} \dot{a}_p \\ \dot{e} \end{bmatrix} = \begin{bmatrix} \psi_1 & \psi_2 \\ \phi_1 & \phi_2 \end{bmatrix} \begin{bmatrix} da_p \\ de \end{bmatrix} + \begin{bmatrix} \psi_3 & \psi_4 & \psi_5 & \psi_6 & \psi_7 \\ \phi_3 & \phi_4 & \phi_5 & \phi_6 & 0 \end{bmatrix} \begin{bmatrix} d\rho \\ dg_N \\ dt_p \\ dr^* \\ d\hat{P}_z^* \end{bmatrix}$$

The determinant of the 2x2 matrix on the right-hand side of (25) is:

$$(26) \quad \psi_1\phi_2 - \phi_1\psi_2 = -\left(\frac{r^* - c_3}{\theta c_2}\right)[(1-\theta)c + c_1y_2 - y_N'L_N'\,(w_2+w)/\theta] + \frac{c_3}{\theta c_2}[1-c_1-(r^*+\hat{P}_z^*)L_2]y_2 < 0$$

Thus the equilibrium $\dot{e} = \dot{a}_p = 0$ is a saddlepoint. The phase diagram for the system (25) is depicted in Figure 1. From equation (24), the condition $\dot{a}_p = 0$ traces out a locus in (e, a_p) space. Its slope is:

$$\left.\frac{de}{da_p}\right|_{\dot{a}_p = 0} = -\psi_1/\psi_2 < 0$$

Similarly, the locus traced out by $\dot{e} = 0$ has slope:

$$\left.\frac{de}{da_p}\right|_{\dot{e} = 0} = -\phi_1/\phi_2 < 0$$

From equation (25), however:

$$\left.\frac{de}{da_p}\right|_{\dot{e} = 0} - \left.\frac{de}{da_p}\right|_{\dot{a}_p = 0} = (\psi_2\phi_2)^{-1} (\psi_1\phi_2 - \phi_1\psi_2) < 0,$$

so the locus $\dot{e} = 0$ is steeper than $\dot{a}_p = 0$, as shown in Figure 1. The direction of the arrows in Figure 1 follows from the fact that ψ_1 and ϕ_2 are both positive. The saddle path to the equilibrium point A, labeled SS', therefore, must lie in the second and fourth quadrants--i.e., it must have a negative slope.

III. Effects of Shocks on the Real Exchange Rate

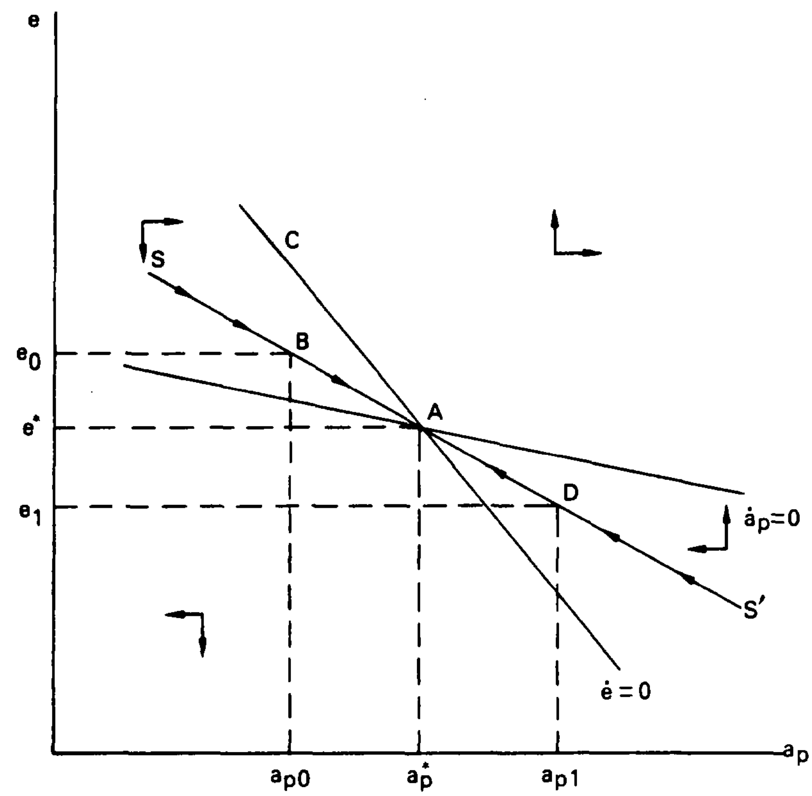
To study the dynamics of adjustment to long-run equilibrium we consider the time path of the response of the real exchange rate to a variety of exogenous and policy-induced shocks. The specific shocks examined are:

1. Nominal devaluation;
2. Terms of trade improvement;
3. Change in the composition of government spending;
4. Tax-financed increase in government spending on importables;
5. Imposition of import and export taxes; and
6. Increases in international real interest rates.

The model described by equations (23) and (24) is sufficiently general to handle these six shocks. While the list of shocks is considered selective, we nevertheless believe that they are representative

FIGURE 1

EFFECTS OF A DEVALUATION



of the actual shocks that developing countries have experienced in recent years.

1. Nominal devaluation

Consider the effects of a nominal devaluation which is announced and implemented simultaneously. 1/ Since none of the exogenous and policy variables in equations (23) and (24) are affected by this shock, the loci $\dot{e} = 0$ and $\dot{a}_p = 0$ do not move. The devaluation will increase the domestic-currency price of importables, however, and since the nominal domestic-currency value of a portion of private wealth is predetermined, the real value of private wealth measured in terms of importables decreases--i.e., a_p falls, say to a_{p0} in Figure 1. 2/ The reduction in wealth creates an excess supply of nontraded goods, causing the *real exchange rate to depreciate.* However, the real depreciation cannot be sufficient by itself to clear the nontraded goods market--this would be the case at point C--because to the right of $\dot{a}_p = 0$ the private sector is saving, and this increase in private wealth is associated with a continuous appreciation of the real exchange rate. Since this future appreciation is foreseen, the real interest rate drops on impact, and this combines with the real depreciation to absorb the initial excess supply in the nontraded goods market. The economy moves to B on the saddle path SS'.

After the initial impact, the economy moves to the southeast along the segment BA until the initial real equilibrium is restored. It can readily be shown that along this path domestic inflation exceeds the world rate and the current account is in surplus. The first part of this statement follows simply from the fact that the real exchange rate appreciates continuously along BA. To show the second part, define the (inflation-adjusted) current account, measured in terms of importables, as:

$$ca = e^{-\theta} (y-c) - (e^{\theta-1} g_N + g_z) + r^* sF/P_z,$$

i.e., the current account is the excess of real income (including interest receipts from abroad) over real domestic absorption. Summing the budget constraints for the private and public sectors and using equations (17a) and (2) we have:

$$(27) \quad ca = \dot{a}_p.$$

1/ There is now a large literature on the effects of nominal exchange rates on the real exchange rates. See Khan and Lizondo (1987), and the references cited therein.

2/ This will be true as long as $M-D_p > 0$, which we take to be the normal case.

Since $\dot{a}_p > 0$ along BA, devaluation induces a current account surplus until the original level of real assets is restored.

Notice that, although a nominal devaluation has no long-run real effects in our model in the sense that the long-run equilibrium at A is undisturbed by devaluation, this does not imply that the initial real equilibrium will tend to reestablish itself after a nominal devaluation, other things equal. The initial real configuration of the economy will never be restored after a nominal devaluation unless that configuration happens to be one of long-run equilibrium. From an initial position such as D in Figure 1, for example, a nominal devaluation equal to $(1 - a_p^*/a_{p1})$ would move the economy directly and permanently to A. Real-world devaluations should therefore be expected to move the economies concerned permanently away from their initial real configurations. 1/

As a corollary, notice that since a nominal devaluation can often by itself move the economy permanently away from its initial real configuration, it is not generally true that the effectiveness of devaluation depends on the implementation of restrictive aggregate demand policies. Such policies may not be necessary even when--as in our model--nominal wages are completely flexible. We show below that such policies will indeed affect the long-run equilibrium level of the real exchange rate, but they do so independently of the level of the nominal exchange rate. As argued by Khan and Lizondo (1987), adjustments in the latter affect only the path of adjustment to the eventual equilibrium.

2. Terms of trade improvement

Consider now an improvement in the terms of trade, i.e., an increase in ρ. From equations (23) and (24) we have:

$$\left.\frac{de}{d\rho}\right|_{\dot{e} = 0} = -\phi_3/\phi_2 < 0$$

$$\left.\frac{de}{d\rho}\right|_{\dot{a}_p = 0} = -\psi_3/\psi_2 < 0,$$

i.e., both $\dot{e} = 0$ and $\dot{a}_p = 0$ shift down to $\tilde{\dot{e}}$ and $\tilde{\dot{a}}_p$, respectively. It can be shown, however, that if the initial trade surplus is small, the

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1/ Although this point is well known, it is frequently lost sight of, and has recently been reemphasized by Edwards (1985).

downward shift in $\dot{a}_p = 0$ must exceed that in $\dot{e} = 0$. 1/ Thus the situation is as depicted in Figure 2.

When the improvement in the terms of trade is brought about by an increase in export prices, the economy's short-run equilibrium will be at point B. The improvement in the terms of trade creates an excess demand in the market for nontraded goods, so the real exchange rate appreciates. However, the appreciation will not be such as to leave $\dot{e} = 0$, because the new higher real income due to the terms of trade improvement will induce the private sector to save, and this accumulation of wealth is associated with a further real appreciation. In the new long-run equilibrium, private real wealth is higher and the real exchange has appreciated. Once again, during the period of adjustment from B to C, domestic inflation will exceed the world level and the current account will be in surplus.

Since the real exchange rate has appreciated at C, the price of nontraded goods has to have risen in absolute terms (recall that the price of importables is constant in this case). It remains to investigate the magnitude of the increase in nontradable prices relative to the increase in the price of exports. To do so, we use equation (25) to calculate de/dρ across long-run equilibria:

$$\frac{de}{d\rho} = -\frac{\psi_1\phi_3 - \psi_3\phi_1}{\psi_1\phi_2 - \psi_2\phi_1}.$$

Substituting for the partial derivatives from equations (23) and (24) we have:

1/ To see this, note that:

$$\frac{\phi_3}{\phi_2} = \frac{y_N'L_N'w_1 - \theta c_1 y_1}{y_N'L_N'(w_2+w) - \theta c_1 y_2 - \theta^2 c_3 a_p - \theta(1-\theta)c}$$

$$\frac{\psi_3}{\psi_2} = \frac{y_N'L_N'w_1 - \theta[1 - (r^* + \hat{P}_z^*)L_2]y_1}{y_N'L_N'(w_2 + w) - \theta[1-(r^* + \hat{P}_z^*)L_2]y_2 - \theta^2 r^* a_p - \theta(1-\theta)c}$$

Since $1-c_1-(r^* + \hat{P}_z^*)L_2 > 0$, $c_3 > r^*$, and y_2 is approximately zero when the initial trade surplus is small, the result follows.

(28)
$$\frac{de}{d\rho} = - \frac{y_N' L_N' w_1 - \left(\frac{r^* - \frac{[1-(r^* + \hat{P}_z^*)L_2]}{c_1} c_3}{r^* - c_3} \right) \theta c_1 y_1}{y_N' L_N' (w_2 + w) - \theta(1-\theta)c - \theta c_1 y_2}$$

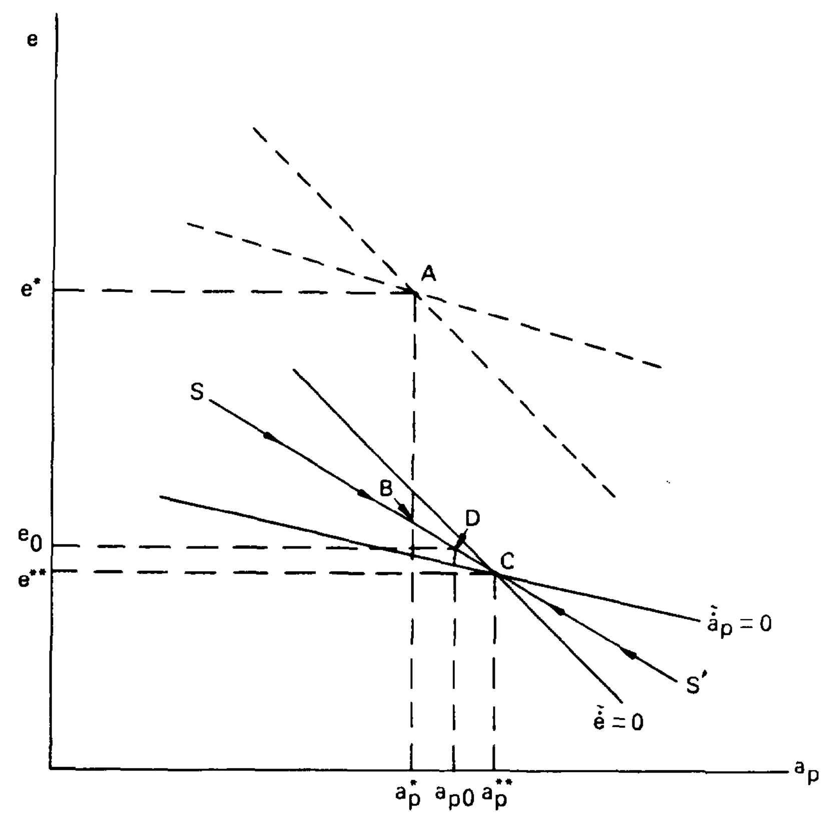
Since $w_2 + w > w_1$ and $\theta(1-\theta)c > -c_1 y_2$, this expression must be smaller than one in absolute value if the second term in the numerator is sufficiently small. The magnitude of this term depends on the size of the income effect of the change in the terms of trade on consumption of nontradables ($\theta c_1 y_1$). If the terms of trade improvement has a sufficiently large income effect, demand for nontradables could rise sufficiently to cause P_N to increase more than in proportion to P_x (and therefore $de/d\rho < -1$). Otherwise the increase in P_N will be smaller than that of P_x and the real exchange rate will appreciate when defined as $e = P_z/P_N$, but depreciate when defined as P_x/P_N. 1/

The analysis for the case in which the improvement is the result of a reduction in the price of importables is quite similar. Notice first, from equations (23) and (24), that since all exogenous variables take on the same values whether a change in ρ is brought about by an increase in P_x^* or a reduction in P_z^*, the economy's long-run equilibrium is the same in both cases, as one would expect. In particular, whether a reduction in P_z^* is associated with a decrease or an increase in the equilibrium price of nontraded goods will again depend on the magnitude of income effects, as shown by Edwards and van Wijnbergen (1985). The dynamics, however, may be quite different. This is because when the improvement in ρ is brought about by a reduction in P_z^*, the domestic price level falls on impact. As a result, the real value of private financial wealth measured in terms of importables, a_p, rises, to a value such as a_{po} in Figure 2 (assuming, as in Section II, that $(M-D_p) > 0$). It follows that when the improvement in the terms of trade results from a reduction in P_z^*, the economy's short-run equilibrium will move on impact to a point such as D, located to the southeast of B on the stable path SS'. The magnitude of the real appreciation on impact must exceed that which results from a rise in ρ due to an increase in P_x^*.

1/ As Harberger (1986) has stressed, this ambiguity limits the usefulness of the conventional definition of the real exchange rate as the price of tradables measured in terms of nontradables. See also Khan and Zahler (1985).

FIGURE 2

EFFECTS OF AN IMPROVEMENT IN THE TERMS OF TRADE



The qualitative features of the short-run dynamics in this case will depend crucially on whether $a_{p0} > a_p^{**}$. If this inequality holds, D will be located to the southeast of the long-run equilibrium at C. If so, a_p will <u>fall</u> and e will <u>rise</u> during the period of adjustment--i.e., the current account will be in deficit and the domestic rate of inflation will fall short of the world level. Since a_{p0} rises in proportion to the increase in ρ times the share of $M-D_p$ in private financial wealth on impact, the relationship between a_p^{**} and a_{p0} can be examined by calculating the elasticity of a_p^{**} with respect to ρ. Using equation (25), this is:

$$(29)\quad \frac{da_p^*}{d\rho}\frac{1}{a_p^*} = -\left(\frac{\phi_2\psi_3 - \psi_2\phi_3}{\psi_1\phi_2 - \psi_2\phi_1}\right)\frac{1}{a_p^*}$$

$$= \theta\,\frac{y_N'L_N'w_1}{y_N'L_N'(w_2+w) - \theta(1-\theta)c - \theta c_1 y_2} + \Omega\theta c_1 y_1,$$

where:
$$\Omega = \frac{1 - \dfrac{1+(r^*+\hat{P}_z^*)L_2}{c_1}}{(r^*-c_3)\theta a_p} - \theta\,\frac{r^* - \dfrac{1-(r^*+\hat{P}_z)L_2}{c_1}c_3}{(r^*-c_3)[y_N'L_N'(w_2+w) - \theta(1-\theta)c - \theta c_1 y_2]} > 0.$$

The first term in equation (29) is positive and less than unity. Since the second term is also positive, the size of the elasticity will depend on the income effect of the terms of trade change on nontradables consumption ($\theta c_1 y_1$). If this income effect is sufficiently large, this elasticity will exceed unity, in which case a_{p0} will fall short of its long-run equilibrium value a_p^{**} (D lies above C on SS', as in Figure 2). The current account goes into surplus in the short run and domestic inflation exceeds the world level. If the income effect is small, on the other hand, it is possible that $a_{p0} > a_p^{**}$.

3. <u>Change in the composition of government spending</u>

Consider an increase in government spending on nontraded goods, offset by a reduction in spending on importables. 1/ For a given a_p,

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1/ Experiments relating the real exchange rate to changes in the structure of government spending are described in Montiel (1986) and Khan and Lizondo (1987).

the increased spending on nontradables requires a real appreciation to restore equilibrium in the nontraded goods market. Thus the $\dot{e} = 0$ locus shifts down, as in Figure 2. Similarly, at the original a_p, the increase in g_N induces an increase in the domestic interest rate to maintain equilibrium in the nontraded goods market, and since this increases private saving, a real appreciation is required to induce the private sector to desist from the accumulation of financial assets. Thus $\dot{a}_p = 0$ shifts down as well to $\dot{a}$. These shifts are given by:

$$\left.\frac{de_r}{dg_N}\right|_{\dot{e}=0} = -\frac{1}{c_3\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)}$$

$$\left.\frac{de}{dg_N}\right|_{\dot{a}_p=0} = -\frac{1}{r^*\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)}$$

Since $c_3 > r^*$, the downward shift in $\dot{a}_p = 0$ is dominant and qualitatively at least the dynamics resemble those of Figure 2. The real exchange rate appreciates to a point such as B on impact, by more than enough to restore equilibrium in the market for nontraded goods. The domestic real interest rate falls as domestic inflation accelerates while the nominal interest rate remains at international levels. During the adjustment period, domestic inflation exceeds the world rate, the current account is in <u>surplus</u> (recall that government spending on importables has fallen <u>pari passu</u>), and financial assets are accumulated by the private sector.

4. <u>Tax-financed increase in government spending on importables</u>

An increase in taxes used to finance increased government spending on importables would, at the original a_p^*, reduce private saving and depress private demand for nontraded goods. A real exchange-rate depreciation is required both to restore the original level of private savings and to clear the market for nontraded goods. These conclusions follow from:

$$\left.\frac{de}{dt_p}\right|_{\dot{a}_p=0} = \frac{\theta}{r^*\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)} > 0$$

$$\left.\frac{de}{dt_p}\right|_{\dot{e}=0} = \frac{\theta}{c_3\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)} > 0$$

Since $c_1 < 1$ and $c_3 > r^*$, it follows that the real depreciation required to clear the nontraded goods market falls short of what is needed to restore the original level of private savings--i.e., the $\dot{a}_p = 0$ curve shifts upward further than the $\dot{e} = 0$ curve in Figure 3. The economy jumps to the new saddle path at B and moves gradually to a new long-run equilibrium at C with a lower value of private wealth and a depreciated real exchange rate. The transition period combines relatively low domestic inflation with current account deficits. The relatively low level of domestic inflation is the means whereby the further required real exchange rate depreciation is accomplished.

5. Commercial policies

We now turn to considering the effects on the real exchange rate of the implementation of commercial policies, which is a subject that has received considerable attention recently in this literature. 1/ We define commercial policies here as the imposition of taxes on exports or imports. 2/ Note that, since such taxes will increase government revenues, an explicit assumption is necessary concerning the disposition of such additional revenues. Equation (17a) would imply that such revenues are used to finance additional government spending on importables. It is more illuminating, however, to abandon this assumption for the present and suppose instead that the additional funds collected by the government are used to finance a lump-sum transfer to the private sector, so that total net tax receipts are unaffected.

The imposition of a tax on exports is then equivalent to an adverse movement in the terms of trade which has the same effect on domestic producer prices, except that the loss of real income associated with the reduction in producer prices (given by τy_x, where τ is the rate of the ad valorem export tax) is exactly offset by the subsidy paid to the private sector out of the proceeds of the tax. It follows that the effects of the imposition of an export tax are similar to those of an adverse movement in the terms of trade brought about by a fall in export prices. The analysis of Figure 2 would in this case be conducted in reverse--i.e., the loci $\dot{e} = 0$ and $\dot{a}_p = 0$ would both be displaced vertically upwards, and the real exchange rate would depreciate on impact as at point B in Figure 4. A further depreciation would accompany a current account deficit during the adjustment to long-run equilibrium.

Though qualitatively the situation is analogous to that of an adverse terms of trade shock, the quantitative effects on the real exchange rate of an adverse terms of trade shock and an export tax which

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1/ See, for example, Obstfeld (1986), Mussa (1986), and Edwards and van Wijnbergen (1985).

2/ The analysis holds equally for the case of tariff reductions and removal of export taxes.

have the same effect on domestic producer prices are different due to the absence of an income effect in the latter case. By setting $y_1 = 0$ in the expressions for ϕ_3 and ψ_3 in equations (23) and (24), it can be shown that for a given effect on domestic producer prices the shifts in the $\dot{e} = 0$ and $\dot{a}_p = 0$ loci will be smaller for the case when the reduction in domestic producer prices of exportables is brought about through the imposition of an export tax. It follows that both the initial and the final real depreciations, as well as the cumulative current account deficits during the period of adjustment, will be smaller in this case.

The analysis of the imposition of a tax on imports proceeds along similar lines. In qualitative terms the long-run analysis is similar to that of an adverse movement in import prices of an equal amount brought about by higher world prices of importables. However, the quantitative effects will again be muted in the long run in this case due to the absence of income effects. There will be a real depreciation and a reduction in the real value of private financial wealth on impact, but the former will fall short of what would have been observed had the change in domestic prices of importables been brought about by higher world prices. The effects of import liberalization are also fairly clear--a reduction in tariffs will lead to a real appreciation. 1/

Moreover, in the case of tax-financed commercial policies, although the real long-run equilibrium generated by an export tax is the same as that produced by an import tariff at the same ad valorem rate, the short-run dynamics are again different. By setting $y_1 = 0$ in equations (28) and (29), we can show that a reduction in the internal terms of trade will cause the real exchange rate to depreciate less than in proportion to the change in ρ and that the elasticity of a_p with respect to ρ is less than 1. The latter implies that, if net foreign assets are a sufficiently small fraction of private wealth, the new short-run equilibrium when an import tariff is imposed must be at a point such as D in Figure 4, since real private financial wealth falls in proportion to the change in the internal terms of trade times the share of net domestic assets in private financial wealth on impact. If follows that the imposition of an export tax gives rise to a current account deficit and domestic inflation below world levels in the short run, while an import tariff generates a current account surplus and inflation rates above world levels during the period of adjustment.

6. Increases in international real interest rates

Because of the uncovered interest parity condition, an increase in the external real (and nominal) interest rate is immediately transmitted to domestic interest rates. Private saving increases, but this is partly due to a reduction of private spending on nontraded goods. Thus

1/ This is a fairly standard result. See Khan and Zahler (1985).

FIGURE 3

EFFECTS OF A TAX-FINANCED INCREASE IN GOVERNMENT SPENDING ON IMPORTABLES

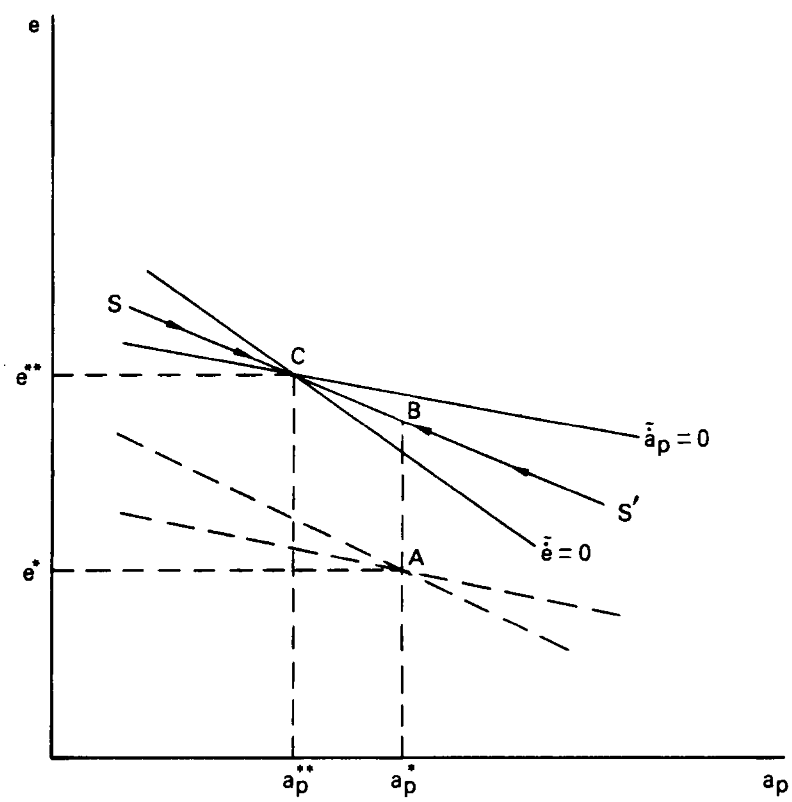
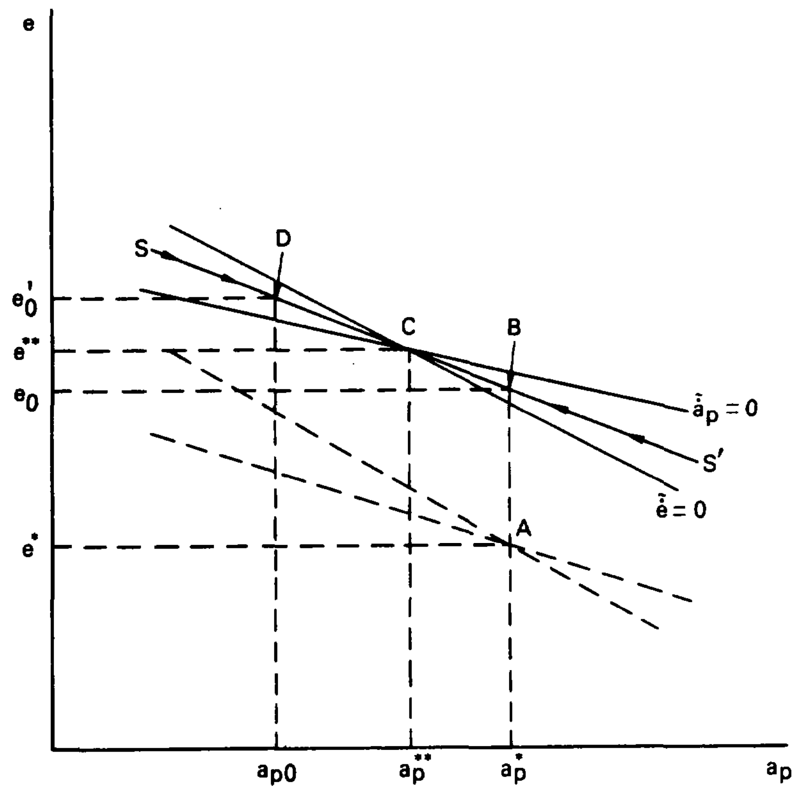


FIGURE 4

EFFECTS OF EXPORT AND IMPORT TAXES



an incipient excess supply exists in the nontraded goods market, which must be eliminated by a real exchange rate depreciation. On the other hand, a real appreciation is called for to restore domestic saving to its original level. It follows that the $\dot{e} = 0$ locus shifts upward, while the $\dot{a}_p = 0$ locus shifts downward. Formally:

$$\left.\frac{de}{dr^*}\right|_{\dot{e} = 0} = - \frac{\theta c_2}{c_3\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)} > 0$$

$$\left.\frac{de}{dr^*}\right|_{\dot{a}_p = 0} = - \frac{\theta[a_p - L - (r^* + \hat{P}_z^*) L_1]}{r^*\theta^2 a_p + \theta(1-\theta)c + \theta c_1 y_2 - y_N' L_N' (w_2 + w)} < 0$$

The dynamic adjustment process is depicted in Figure 5. The new long-run equilibrium exhibits a lower value of e and higher private wealth than the original one. 1/ During the period of adjustment, the current account must be in surplus and the inflation rate must exceed the world level, as the domestic real interest rate only gradually rises to the new level of the external rate.

The impact effect of the interest rate change is ambiguous, however. The new saddle path may lie either above (as in Figure 5) or below the original long-run equilibrium at A. This depends on the relative magnitudes of the shifts in $\dot{a}_p = 0$ and $\dot{e} = 0$, as is apparent in Figure 5. The larger the effect of the increase in real interest rates on the excess supply of nontradables relative to its effect on private saving, the larger will be the vertical displacement of the $\dot{e} = 0$ locus relative to that of the $\dot{a}_p = 0$ locus. In this case, the need for a real depreciation on impact to restore equilibrium to the nontraded goods market is likely to dominate that for a real appreciation to restore the original level of private saving, and the saddle path is likely to pass above the original equilibrium at A. Note that this situation is more likely when private spending is very sensitive to the real interest rate (c_2 is large in absolute value) and when real private financial wealth is initially low.

Before leaving the discussion of the effects of real interest rate shocks, it may be worth observing that the results described here are not as counterintuitive as they may seem. It may be thought that, in countries that are net international debtors, an increase in real international interest rates would require a real depreciation to generate the trade surplus required to service the debt. Nothing has

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1/ Dornbusch (1985) and Khan (1986) also reach the same conclusion, namely that an increase in foreign real interest rates will lead to a depreciation in the real exchange rate.

been said here about the country's net international position. Suppose now that the country is a substantial debtor, in that the government's net financial assets are sufficiently negative so as to offset a positive level of private financial wealth. Since the argument above did not need to refer to the government's real financial wealth, nothing would change. The reason is that the government is assumed to adjust to its larger interest obligations by curtailing government spending on importables (recall equation (17a)), so adjustment in its accounts can be achieved without moving resources. Suppose, on the other hand, that the government's larger interest payments were financed with some combination of higher taxes on the private sector or less government spending on nontraded goods. In this case the analyses of subsections 3 and 4 would apply and the real exchange rate could quite easily depreciate both on impact and in the long run. Thus, the counterintuitive result is generated by the assumption regarding the mode of financing the government's external interest obligations.

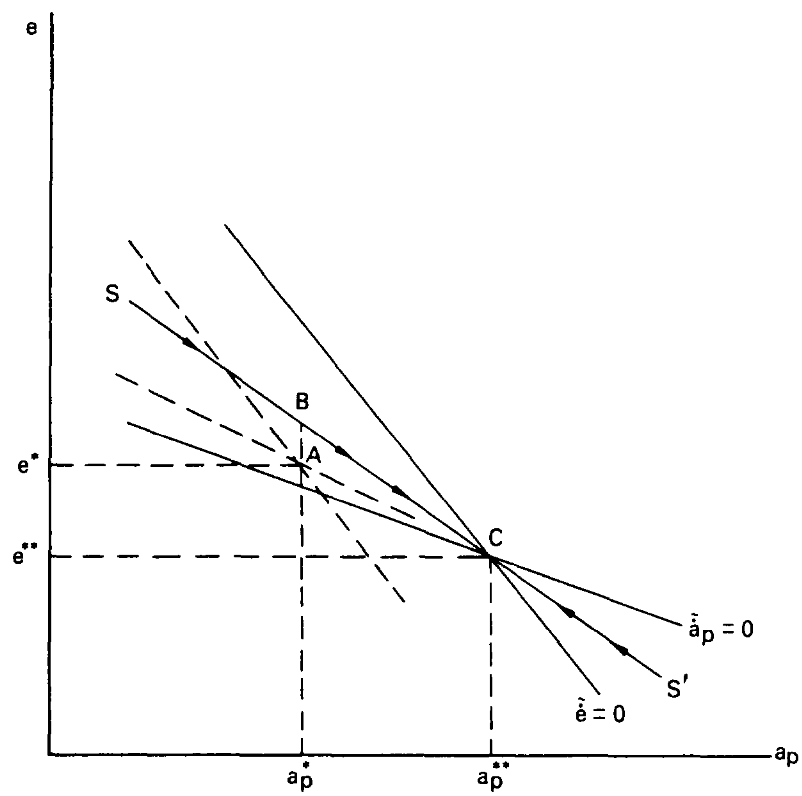
IV. Conclusions

The question of how the real exchange rate in developing countries responds to external and domestic shocks has been receiving increasing attention in recent years. The studies that have examined this question, however, have generally been restricted to considering only equilibrium movements in the real exchange rate, and have not analyzed the underlying dynamics. If one is to properly understand the behavior of the real exchange rate over time, it is obviously important to have an idea of both the short-run and long-run effects of shocks, and thus the dynamics becomes central to the analysis.

This paper has focused on the dynamic responses of the real exchange rate in a developing economy to a variety of exogenous and policy-induced shocks. Taking the case of external shocks first, we showed that an unanticipated worsening of the terms of trade would, other things being equal, lead to a short-run depreciation of the real exchange rate. This result is, of course, quite familiar. We also showed, however, that the short-run real depreciation will not be sufficient to restore current account equilibrium. The exchange rate will continue to depreciate and the current account will continue to be in deficit during the transition to long-run equilibrium. The response to an unanticipated increase in the external real interest rate, on the other hand, depends on the fiscal reaction of the government. If the government offsets the budgetary impact of the interest rate change by altering its spending on traded goods, then the long-run exchange rate will tend to appreciate, contrary to what is conventionally assumed. Nevertheless, a real depreciation is quite plausible on impact if increased interest payments are financed by the imposition of higher taxes and/or reduced spending on nontraded goods.

FIGURE 5

EFFECTS OF AN INCREASE IN THE FOREIGN REAL INTEREST RATE



The effects on the real exchange rate of alternative types of fiscal measures are not well-appreciated in the existing literature. Even with an unchanged fiscal deficit, variations in the level and composition of government spending were shown to have both short-run and long-run impacts on the real exchange rate. A tax-financed increase in government expenditures on importables, for example, would depreciate the real exchange rate, while an increase in public spending on nontradables financed similarly would result in a real appreciation in both the short run and the long run. Furthermore, a change in the composition of government expenditures with unchanged taxes would also affect the real exchange rate in both the short run and the long run. If the government increased spending on nontradables at the expense of importables, the real exchange rate would tend to appreciate. By contrast, a change in the composition of government spending towards importables would lead to a real depreciation.

In the area of trade policies, a liberalization of imports and exports through reductions in tariffs and export taxes would result in an appreciation of the real exchange rate. However, the former would be associated with a current account deficit and the latter with a surplus during the transition to the new long-run equilibrium. Finally, a devaluation would depreciate the real exchange rate relative to its initial value in the long run, if the initial current account deficit exceeds its long-run level, even with flexible wages and prices and perfect foresight. While this result is certainly well known, it is often ignored and can only be demonstrated clearly in an explicitly dynamic framework.

In conclusion, the analysis here has shown that the real exchange rate will respond differently to different types of shocks, and in certain instances the short-run response will not necessarily be the same as the long-run response. These results have important implications for policies that are aimed at altering the real exchange rate. Such policies have to be designed to take the dynamics of real exchange rate adjustment into account, although as this paper has shown, this is by no means an easy task. Nevertheless, simple theoretical models of the type developed here can offer broad guidelines to policymakers in their efforts to achieve an appropriate level for the real exchange rate over time.

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