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CAPITAL FLOWS, THE CURRENT ACCOUNT, AND THE REAL EXCHANGE RATE: CONSEQUENCES OF LIBERALIZATION AND STABILIZATION

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ABSTRACT

This paper develops a dynamic framework in which macroeconomic liberalization and stabilization measures of the type recently seen in Latin America can be studied. The model is sufficiently general to cover both polar cases of a closed capital account and free private capital mobility, so the effects of liberalizing external asset trade can be studied. Capital-account liberalization leads to an initial period of real appreciation, but a long-run real depreciation; and the economy passes through alternating phases of boom and slump in the process. Devaluation is found to be nonneutral even in the long run and possibly contractionary in the short run. In contrast, a change in the rate of exchange depreciation is neutral, even with sticky prices, when capital is fully mobile. When capital is immobile, a disinflationary reduction in the rate of exchange-rate crawl has effects that are the opposite of those arising from capital-account opening. The model suggests that capital-account liberalization, rather than disinflation, played a part in causing the massive real exchange-rate appreciation that accompanied recent Latin American programs of economic reform.

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Introduction

This paper develops a dynamic model incorporating some key macroeconomic features of more advanced industrializing economies. While the model is quite general, it is motivated by recent events in the Southern Cone of Latin America, where wide-ranging economic reform programs initiated in the 1970s produced dramatic--and ultimately unsustainable--movements in external accounts and real exchange rates. As observed by Diaz Alejandro (1981), the measures undertaken in Argentina, Chile, and Uruguay coincided with steep increases in the prices of nontraded goods relative to tradables, with weak current-account balances, and with massive foreign reserve accumulation. A goal of the present work is to analyze channels through which policy initiatives of the type seen in the Southern Cone influence the economy's long-run position and its transitional behavior.[1]

On the price side, the economy studied is characterized by a crawling-peg exchange-rate regime and sluggish nominal wages that adjust to labor-market disequilibrium and inflation expectations. Nontradable goods use imports as intermediate production inputs, so there is an immediate pass-through of exchange-rate changes to domestic goods' prices. On the asset side there may be restrictions on private capital-account transactions, but the model encompasses both polar cases of free capital mobility and complete capital immobility within a single

framework.[2] This facilitates study of the macroeconomic effects of capital-account liberalization. Under capital mobility the model traces out the dynamic path of the real exchange rate (the price of tradables in terms of nontradables) and the economy's net external assets. Similar paths are traced out when capital is immobile, but the economy's external assets are then owned entirely by the public sector.[3]

The plan of the paper is as follows. Section I sets out the basic structure of the model. The real exchange rate occupies a central position, for its level affects both production and consumption decisions while its time path influences the real domestic interest rate.

Section 2 works out the model's dynamics under perfect foresight.[4] Asymptotically the economy approaches a long-run equilibrium characterized by simultaneous internal and external balance. However, the nature of the path leading there depends on whether a rise in the relative price of tradables improves or worsens the current account. The economy's dynamics will not generally display the monotonic relation between external assets and the real exchange rate characterizing the transition paths of most flexible-price portfolio-balance models. In particular, the approach to long-run equilibrium may be oscillatory.

Liberalization of the capital account is taken up in section 3. The key result of this section concerns the short-term effect of liberalization on the real exchange rate. When the pre-reform domestic interest rate exceeds the depreciation-adjusted world rate, the removal of impediments to capital movement causes an initial period of real appreciation. A current-account deficit emerges on impact, but boom turns into slump as the economy converges to a steady state in which the level of external claims is lower than before liberalization. In the long run there is a real depreciation, an example of a more general

principle that is also established in section 3: any disturbance that leads to a long-run decline in external assets must also depreciate the long-run real exchange rate (assuming that the domestic capital stock is held constant). A similar result is noted in alternative contexts by Bruno (1976) and Obstfeld (1984a).

Section 4 studies the effects of devaluation and disinflation, where the latter is defined as a permanent, credible lowering of the rate of currency depreciation. Devaluation is nonneutral in the long run, leading to an eventual rise in external claims and a long-run real appreciation. In the short run devaluation may occasion a current-account deficit or a domestic contraction, however. When capital is immobile disinflation has effects that are the opposite of capital-account liberalization: an initial real depreciation and slump followed by a long-run real appreciation and increase in net foreign assets. But in the model set out below, a change in the crawl rate is neutral when capital is fully mobile, even though the price of home goods is temporarily fixed. The section concludes by considering possible sources of nonneutrality suggested in the literature.

Section 5 once again summarizes the main results. An appendix contains some technical details concerning the model's dynamics.

1. A General Model

This section describes a small open economy characterized by a crawling- peg exchange-rate regime and short-run inflexibility of nominal wages. Two goods are produced: a composite tradable priced exogenously in the world market, and a nontradable good whose price

reflects the cost of domestic labor and imported intermediates. The response of the real wage to labor-market pressure provides a first component of the economy's intrinsic dynamics. A second source of intrinsic dynamics is provided by private saving, which drives the stock of net foreign assets to its long-run level. Detailed discussion of the economy's dynamic behavior is deferred until section 2. Here I merely set out the economy's structure.

Under a crawling peg the exchange rate follows a path determined by the central bank. To maintain the announced exchange rate when there is free capital mobility, the bank must accommodate any shift in domestic money demand through foreign-exchange intervention. When capital controls are in place, however, residents may not purchase foreign-currency assets and exporters must sell to the monetary authority any foreign exchange earned. To peg the exchange rate under private capital immobility, therefore, it suffices for the central bank to intervene only when there is a trade imbalance.

No stand on the degree of capital mobility need be taken in the present section. The model's generality in this respect will prove useful when the liberalization of the capital account is studied in section 2 below.

1.1 Goods Prices and Production

On the production side the country is a variant of the dependent economy studied by Salter (1959) and many subsequent writers. Let E denote the exchange rate (the domestic-money price of foreign money) and P^{T*} the foreign-currency price of the composite tradable good. Under the small-country assumption P^{T*} is parametric; arbitrage guarantees that in

the absence of trade impediments and transport costs the corresponding domestic-money price of tradables is given by

$$(1) \quad P^T = EP^{T*}.$$

A useful generalization of the present framework would differentiate between imports and exports and allow for commercial restrictions that separate domestic from world prices. That generalization is forgone here in order to focus on the effects of financial policies. The normalization $P^{T*} = 1$ is adopted, so that $P^T = E$ according to (1).

Tradable commodities are produced using capital and labor. Capital operates only in the tradable sector, but labor is free to move between both sectors of the economy. If W denotes the resulting economy-wide nominal wage, then the supply function for tradables is

$$(2) \quad y^T = y^T(P^T/W), \; y^{T\prime} > 0.$$

The derived demand for labor, also increasing in its argument, is denoted

$$(3) \quad n^T = n^T(P^T/W).$$

Output in the nontradables sector is produced using labor (n^H) and imported intermediate materials (m^H) according to a fixed-coefficients technology. The production function for these home goods is

$$(4) \quad y^H = \min(n^H, am^H),$$

where intermediate imports are indistinguishable from final tradables. The parameter 1/a is the amount of intermediate that must be combined with a unit of labor to produce a unit of the home good. Constant returns to scale prevail in the nontradables sector according to (4), so

output y^H is demand determined. Factor demands are given by

(5) $n^H = y^H$, $m^H = y^H/a$.

In equilibrium the price of home goods is given by the zero-profit condition

(6) $P^H = W + (P^T/a) = W + (E/a)$.

1.2 Asset Markets

Residents hold in their portfolios domestic high-powered money M, domestic bonds paying an interest rate R, and (when private capital mobility is permitted) foreign bonds B* having a face value fixed in foreign-currency terms and paying the world interest rate R*. The domestic banking system is not explicitly modelled. In addition to base money and bonds, there is an exogenous nonmarketable component of domestic wealth which can include, for example, titles to capital operating in the tradables sector. This exogenous component of wealth has a fixed value k in terms of tradables (that is, in terms of foreign currency); the determination of k is outside the model's scope. Under a regime of capital controls B* is taken to be identically zero.

Foreigners do not participate in the domestic bond market. Under free capital mobility $R = R^* + DE/E$, where D is the time-derivative operator and perfect foresight is assumed. In words, domestic and foreign bonds are assumed to be perfect substitutes, so that interest parity holds when capital is mobile. When financial controls are in place the domestic credit market is essentially a curb market and R generally differs from the depreciation-adjusted world rate (see Bruno

1979; McKinnon and Mathieson 1981; and van Wijnbergen 1983b).

Foreigners do not hold domestic money. As it is assumed that there is no outside domestic government debt, aggregate nominal assets A are given by

(7) $A = M + EB^* + Ek.$

The money-market equilibrium condition is

(8) $M = L(R)A, \quad L' < 0.$

Under capital immobility M is a predetermined variable that changes only as a result of current-account imbalances and domestic credit creation by the central bank. (The current account of course equals the balance of payments when there is no private international borrowing or lending.) As (8) shows, continuous asset-market equilibrium is in this case maintained through adjustments in the domestic nominal interest rate R.

Under capital mobility, however, the domestic interest rate is the sum of the exogenous world interest rate R* and the policy-determined devaluation rate DE/E. The money stock is now the jumping variable that adjusts instantaneously to preserve asset-market equilibrium: for a given rate of currency depreciation, the central bank can peg the exchange rate's level only if it automatically supplies to the public the money stock dictated by the right-hand side of (8).

1.3 Consumers

Let z denote the level of private domestic expenditure measured in nontraded or home goods. Define the real exchange rate q by

(9) $q = E/P^H$.

By (6), the real exchange rate must be smaller than the technological coefficient a in equilibrium if W and P^H are always positive:

$$q < a.$$

A fraction $\sigma(q)$ of expenditure z falls on tradables, where σ is a decreasing function of q. Final consumption of tradables may therefore be written

(10) $c^T(q,z) = \sigma(q)z/q, \qquad \sigma' < 0,$

and the demand for nontradables takes the form

(11) $c^H(q,z) = [1-\sigma(q)]z.$

Let γ be the average share of tradables in the overall consumer price index. (γ can be thought of as a long-run average value of $\sigma(q)$.) The expected local inflation rate under perfect foresight is then $\gamma(DE/E) + (1-\gamma)(DP^H/P^H)$. (The derivatives are right-hand derivatives, as always.) Private absorption z is a function of real domestic wealth and the real interest rate:

(12) $z = z[A/E^{\gamma}(P^H)^{1-\gamma}, R-\gamma(DE/E)-(1-\gamma)(DP^H/P^H)].$

As usual, an increase in real assets stimulates absorption, while an increase in the real interest rate depresses it. In symbols, $z_1 > 0$ and $z_2 < 0$. (f_i denotes the partial derivative $\partial f(x_1,\ldots,x_s)/\partial x_i$.)

1.4 The Labor Market and Price Adjustment

The nominal wage is taken to be a predetermined or non-jumping

variable that can adjust only gradually. The determinants of nominal wage inflation are excess labor demand and expected consumer-price inflation, as in Obstfeld (1982).

Let n_0 denote the "natural" level of aggregate employment, assumed to be constant. With perfect foresight the wage evolves according to:

$$(13)\quad DW/W = \phi(n^T+n^H-n_0) + \gamma(DE/E) + (1-\gamma)(DP^H/P^H).$$

From (6), the wage and home-goods price are related by $W = P^H - (E/a)$. Equation (13) may therefore be manipulated to yield

$$(14)\quad DP^H/P^H = \pi(q)(n^T+n^H-n_0) + DE/E,$$

where

$$(15)\quad \pi(q) = \phi/[a/(a-q) - (1-\gamma)] > 0.$$

Equations (14) and (15) show how currency depreciation and excess labor demand govern price inflation in the nontradables sector.

1.5 The Monetary and Fiscal Authorities

It is convenient to consolidate the budget constraints of the monetary and fiscal authorities. All domestic liabilities of the central bank take the form of high-powered money. On the asset side the bank holds domestic credit C and foreign bonds whose foreign-currency value is denoted F*. The central-bank balance sheet identity is

$$(16)\quad M_t = C_t + E_tF_t^* - \int_{-\infty}^{t} DE_sF_s^*ds.$$

The last term on the right-hand side of (16) is the sum of past capital gains on official reserves, which inflate the domestic-money value of

bank assets without increasing domestic liabilities. As will be seen below in section 4, equation (16), which corrects for smooth movements in E, is easily modified to take account of capital gains due to discrete maxi-devaluations.

The fiscal authority levies personal taxes to help finance its consumption of tradables (g^T) and nontradables (g^H). An additional source of revenue is the interest earned on the central bank's reserves, equal to ER*F* in terms of domestic money. Any fiscal deficit is financed through domestic credit creation (the government issues no interest-bearing debt). Let T denote nominal personal taxes and G nominal government consumption (equal to $Eg^T + P^H g^H$). Then the monetized deficit is given by

$$(17)\quad DC = G - ER^*F^* - T.$$

The rate of domestic-credit creation implied by (17) may exceed or fall short of the rate at which domestic money demand increases (the time derivative of the right-hand side of (8)). Let M^d denote nominal money demand. Then according to (16), continuous money-market equilibrium requires that

$$(18)\quad EDF^* = DM^d - DC.$$

Domestic-credit growth in excess of money-demand growth leads to a balance-of-payments deficit, so that part of the fiscal deficit is effectively financed through central-bank borrowing abroad. After substituting (18) into (17), integrating forward, and applying the appropriate transversality condition, one obtains the public sector's intertemporal budget constraint

$$(19)\quad \int_t^\infty [g_s^T + (q_s^H/q_s)]e^{-R^*(s-t)}\,ds$$

$$\leq F_t^* + \int_t^{\infty}[(T_s/E_s)+(DM_s^d/E_s)]e^{-R*(s-t)}ds.$$

Constraint (19) limits the present foreign-exchange value of government consumption to that of government revenue from personal taxes and seigniorage, plus initial foreign reserves. Seigniorage revenue is in turn limited by the public's willingness to add to its nominal balances.

It is assumed that the central bank follows the domestic-credit rule

(20) $DC = (DE/E)M$

in order to avoid protracted payments imbalances. To ensure that credit creation covers the government's cash-flow needs when (20) is followed, taxes T adjust endogenously according to

(21) $T = G - ER*F* - (DE/E)M.$

It can be shown that under the foregoing assumptions, constraint (19) will necessarily hold as an equality provided the economy is dynamically stable (see Obstfeld 1984a).

2. Dynamics

It is now time to pursue the dynamic implications of the structure described in section 1. To do so, I reduce the model to a system of two differential equations in the real exchange rate q and the net external asset stock of the economy as a whole, $K* = F* + B*$. Because the nation's foreign assets are given by the past history of the current account, K* is a predetermined variable. Because the nominal wage is predetermined and the exchange rate is pegged, the zero-profit condition

(6) implies that q is predetermined as well.

Equation (14) gives the time derivative of q,

$$(22)\quad Dq/q = -\pi(q)(n^T+n^H-n_0),$$

Equations (3), (6), and (9) imply that

$$(23)\quad n^T = n^T(q),\ n^{T\prime} > 0.$$

The equilibrium condition for the home goods market is

$$(24)\quad y^H = c^H(q,z) + g^H.$$

By (5), labor demand in the nontradables sector, n^H, is equal to $c^H + g^H$.

To complete the derivation of the dynamic law for q, it remains to show that absorption z can be expressed in terms of q and K*. The definition of the real exchange rate q allows one to express the real interest rate as

$$R - (DE/E) + (1-\gamma)(Dq/q).$$

A rise in the expected rate of real depreciation, all else equal, is a rise in the real interest rate. Use (7) to write (12) as

$$(25)\quad z = z(q^{1-\gamma}[(M/E)+B^*+k], R-(DE/E)+(1-\gamma)(Dq/q)).$$

Next, note that $D(M/E) = DM/E - (DE/E)(M/E) = DF^*$ (by (16) and (20)), so $(M/E) = F^* + X$, where X is a constant which can be calculated from (16).[5] Finally, solve (8) for the equilibrium domestic interest rate,

$$(26)\quad R = R(K^*+X),\ R' \leq 0.$$

Under perfect capital mobility $R(K^*+X) = R^* + (DE/E)$ and so $R' = 0$. But

when private capital is immobile $K^* = F^*$ and $R' < 0$. In the latter case a rise in K^* is just a rise in international reserves that increases domestic liquidity, depressing the local rate of interest.

The foregoing observations lead to the equation

$$(27)\quad z = z[q^{1-\gamma}(K^*+X+k), R(K^*+X) - (DE/E) + (1-\gamma)(Dq/q)].$$

With the aid of equations (11), (23), and (27), (22) may now be written

$$(28)\quad Dq/q = -\pi(q)\{n^T(q) + [1-\sigma(q)]z[q^{1-\gamma}(K^*+X+k), R(K^*+X) - (DE/E) + (1-\gamma)(Dq/q)] + g^H - n_0\}.$$

From (28) one obtains the reduced-form law of motion

$$(29)\quad Dq/q = \Gamma(q, K^*).$$

It is assumed that

$$(30)\quad \Gamma_1 < 0,\ \Gamma_2 < 0.$$

Thus, a rise in q raises the demand for labor in both the tradable and home-goods sectors, occasioning a rising real wage and, through (6), a falling (that is, appreciating) real exchange rate. Similarly, a rise in K^*, by stimulating the demand for nontradables, leads to excess labor demand in the home-goods sector and again, an appreciating real exchange rate.[6] A mathematical appendix spells out the conditions under which the inequalities in (30) hold. One condition worth mentioning here is that overall wealth K^*+X+k be positive. This is assumed from now on, although it is not necessary for (30).

Turn next to the dynamic equation for K^*. The growth of nominal private assets equals private saving out of disposable income, so by (7),

$$(31)\quad DA = DM + DE(B^{**}+k) + EDB^{*}$$
$$= Ey^{T} + P^{H}y^{H} + ER^{*}B^{*} + DE(B^{**}+k) - T$$
$$- Ec^{T} - P^{H}c^{H} - Em^{H}.$$

Equation (23) implies that y^{T} can be written as an increasing function of the real exchange rate q. After use of (5), (10), (11), (16), (20), (21), (24), and (29), (31) therefore becomes

$$(32)\quad DK^{*} = y^{T}(q) + R^{*}K^{*} - g^{T}$$
$$- \sigma(q)z[q^{1-\gamma}(K^{**}+X+k),R(K^{**}+X)-(DE/E)+(1-\gamma)\Gamma(q,K^{*})]/q$$
$$- (1/a)\{[1-\sigma(q)]z[q^{1-\gamma}(K^{**}+X+k),R(K^{**}+X)-(DE/E)+(1-\gamma)\Gamma(q,K^{*})] + g^{H}\}$$
$$= \Omega(q,K^{*}).$$

Equation (32) displays the current-account balance as the difference between national production of tradables (including services) and national absorption of tradables. The relative-price effect of a real depreciation tends to improve the current account by increasing output of traded goods and discouraging their consumption. But by shifting demand toward nontradables, a rise in q leads directly to increased imports of intermediate materials. The overall relative-price effect is summarized by the "Marshall-Lerner" condition for the model, which states that with absorption held constant, a real depreciation has a positive effect on the current account, given by

$$(33)\quad y^{T}_{q} - \{[1 - (q/a)]\sigma' - (\sigma/q)\}(z/q) > 0.$$

Inequality (33) must hold in equilibrium because q can never exceed a (see the discussion following equation (9)). But while the expenditure-switching effect of a real depreciation is always positive, it is weakened by the home-goods sector's need for imported intermediates.

The absorption effects of a rise in σ do tend to worsen the cur-

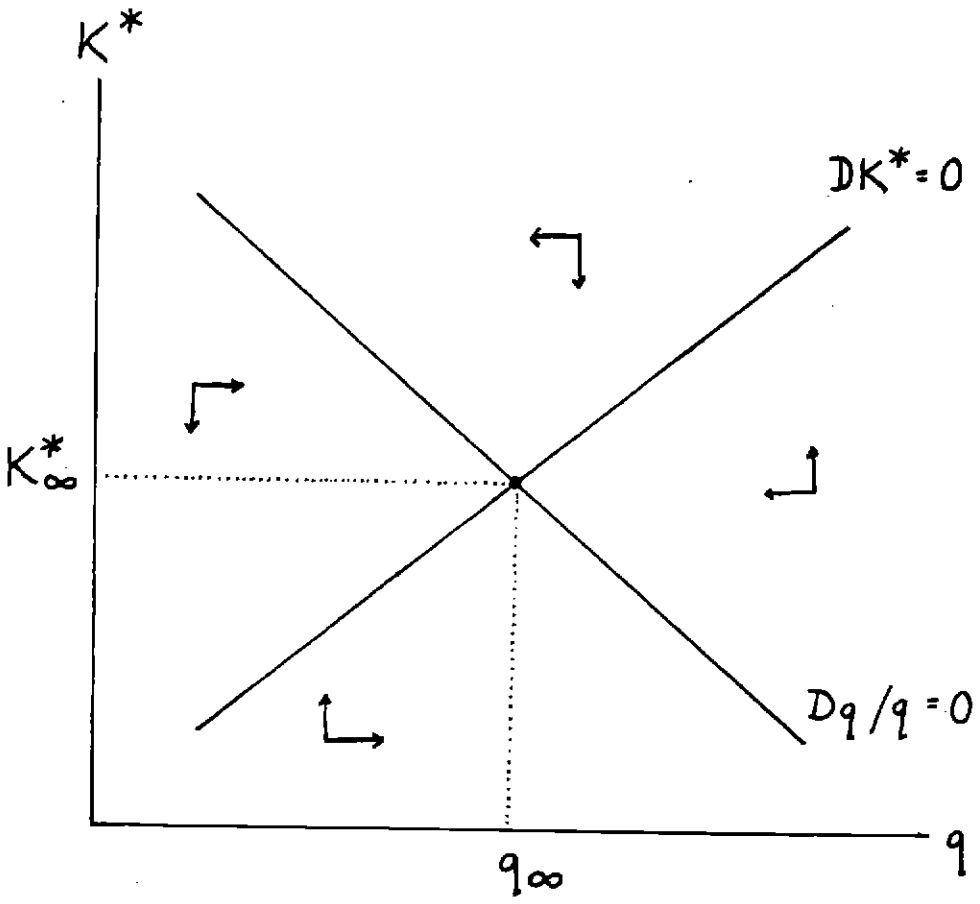

Figure 1

rent account: a real depreciation raises the real value of private wealth and lowers the expected real interest rate, thereby raising expenditure z. It follows that the sign of Ω_1 is indeterminate. The same is true of the sign of Ω_2, but there are sound theoretical reasons for assuming that a rise in net foreign assets K* causes the current account to deteriorate. Accordingly,

$$(34)\quad \Omega_1 \gtrless 0,\ \Omega_2 < 0.$$

The mathematical appendix again discusses the precise conditions underlying the inequalities in (34).

Figures 1 and 2 show the two possible stable configurations of the dynamic system consisting of equations (29) and (32). The long-run or steady-state levels of the real exchange rate and net foreign asset stock are denoted q_∞ and K^*_∞, respectively. (Existence and uniqueness are assumed.) In the first of these diagrams (corresponding to the case $\Omega_1 > 0$) the economy cycles during its approach to long-run equilibrium. In the second (corresponding to the case $\Omega_1 < 0$) the economy's transition path is either monotonic or a half-cycle. An interesting feature of the dynamics is the possibility that a depreciating (appreciating) real exchange rate will accompany a current-account surplus (deficit) along portions of the transition path. This conjuncture is not typical of flexible-price portfolio-balance models (for example, Calvo and Rodriguez 1977).

Because $\Gamma_1 < 0$ and $\Omega_2 < 0$, the stability condition for the system's linear approximation near (q_∞, K^*_∞) is

$$(35)\quad \Gamma_1\Omega_2 - \Gamma_2\Omega_1 > 0,$$

where all functions are henceforth evaluated at long-run equilibrium.

From expressions derived in the appendix, stability condition (35) is equivalent to

$$(36)\quad 0 < -R^*[n^T/-\sigma'z+(1-\sigma)(1-\gamma)q^{-\gamma}z_1(K^*+X+k)] + (q^{1-\gamma}z_1+z_2R')((n^T/-\sigma'z)[(\sigma/q)+(1-\sigma)/a]+(1-\sigma)[y^T/-([(1-(q/a)]\sigma'-(\sigma/q)](z/q)]).$$

The system's stability does not require that Ω_2 be negative as is assumed in (34). When $\Omega_2 > 0$, (35) holds, and the trace condition $q\Gamma_1 + \Omega_2 < 0$ is satisfied, the model has a stable configuration in which the $Dq/q = 0$ and $DK^* = 0$ loci have negative slopes but (contrary to figure 2) the slope of the latter is the greater in absolute value. In the interest of conserving space, this possibility is pursued no further.

While the dynamic behavior of the economy appears qualitatively unaffected by the degree of capital mobility, the model's interpretation and predictions hinge on the regime one assumes.[7] When there are no private capital movements $B^* = 0$ and K^* coincides with the central-bank reserve stock F^*. In this case all net external lending takes the form of reserve movements, so that current-account equation (32) can be interpreted as describing either the balance of payments or the evolution of domestic money holdings measured in tradables. Under capital mobility, however, $K^* = B^* + F^*$, the consolidated external assets of the private and public sectors. Equation (32) again describes the current account, but it no longer applies to the balance of payments. Even though K^* is predetermined, its components B^* and F^* are not when capital is mobile. Private portfolio shifts will force central-bank foreign-exchange intervention that is recorded in the balance of payments. Intervention redistributes the ownership of K^* between the private sector and the central bank, but it cannot cause an instantaneous jump in the economy's overall external claims.

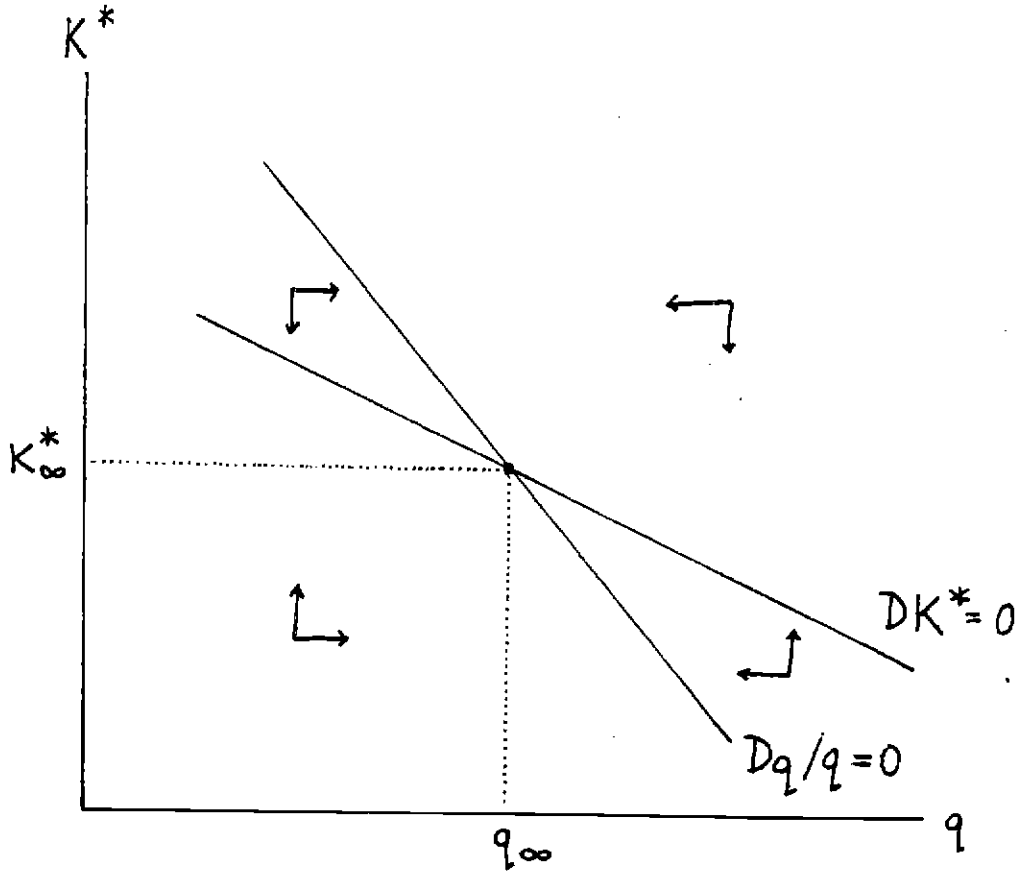

Figure 2

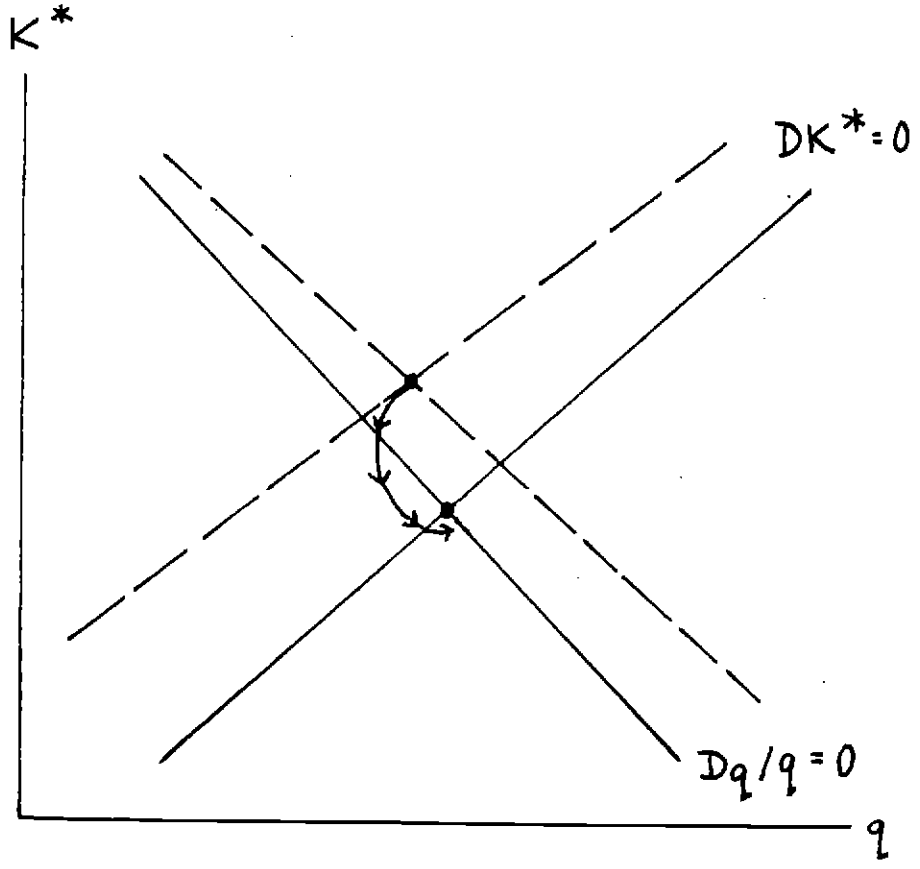

Figure 3

3. Liberalization of the Capital Account

The first policy action considered is the liberalization of the capital account.[8] Initially there is no private external asset trade and the domestic interest rate is a function of the predetermined money supply. Liberalization takes the form of a complete removal of barriers to financial capital movements. The economy is assumed to be at its long-run equilibrium when liberalization takes place.

The effect of liberalization depends on the relation between the interest rate prevailing before liberalization and the depreciation-adjusted world rate. It is most natural to assume that the domestic rate exceeds R* + (DE/E) prior to the reform, so that there is a fall in the cost of credit on impact.[9] The initial and long-run effects of the policy change can be visualized with the aid of figures 3 and 4.

The fall in the domestic interest rate raises absorption for every level of q and K*. Accordingly, the Dq = 0 and DK* = 0 schedules shift downward: for a given real exchange rate, a lower level of wealth is now required for both internal balance (labor-market equilibrium) and external balance (current-account equilibrium).[10] The real exchange rate begins to appreciate in the face of excess domestic demand, and a current-account deficit emerges. As wealth and expenditure subsequently fall the real appreciation ceases and is reversed. The underemployment that emerges at this point is gradually eliminated (perhaps with oscillations) as the economy converges. What is most noteworthy is that in spite of its eventually deflationary effects, liberalization of the capital account may cause the economy to undergo a protracted initial phase of currency overvaluation.

On the asset side the fall in the home interest rate raises money

demand. The private sector reaches portfolio equilibrium by borrowing foreign exchange from abroad and selling it for domestic money. Because the central bank must purchase this foreign exchange to hold the exchange rate fixed, private borrowing leads to an instantaneous rise in the aggregate money supply. The financial capital inflow results in a transfer of external claims from the private sector (which becomes indebted to foreigners) to the central bank (which enjoys an offsetting increase in reserves). K*, however, cannot jump on impact. As external assets begin to fall in the wake of liberalization, the balance-of-payments swings into deficit.

The model suggests that the removal of capital controls may have contributed to the real appreciations, external deficits, and capital inflows that accompanied the economic reform programs in Argentina, Chile, and Uruguay. Capital-account liberalization is likely to provide only part of the explanation, however. In Chile, for example, the beginning of real appreciation certainly pre-dates the removal of external financial restrictions (Edwards 1985a).

Figures 3 and 4 suggest two results that have not yet been demonstrated. First, the figures suggest that the long-run external debt necessarily increases, a result that is obvious only in the case $\Omega_1 > 0$ shown in figure 3. Second, they suggest that liberalization necessarily entails a long-run real depreciation (in contrast to the real appreciation that clearly emerges in the short run). It is an implication of the system's stability (as will be shown later) that the long-run external asset stock declines. On the assumption that it does, I will now argue that the real exchange rate must rise in the long run. The argument made is of independent interest in that it establishes a rather general proposition: provided the domestic capital stock does not change, any

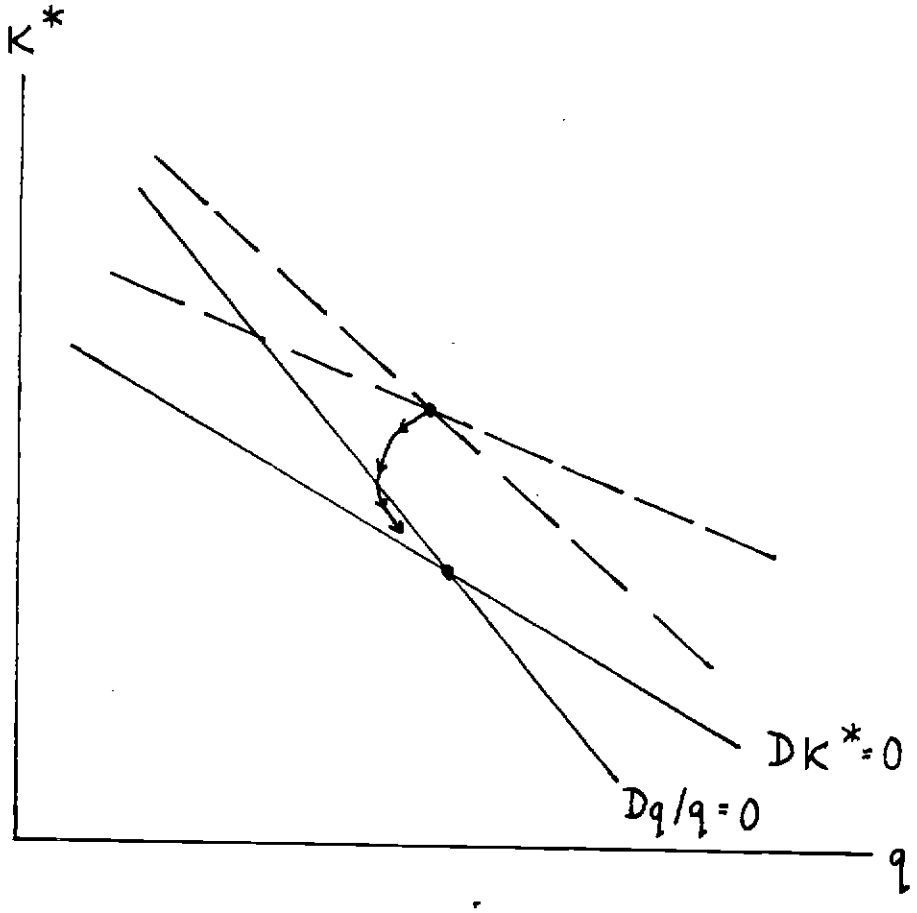

Figure 4

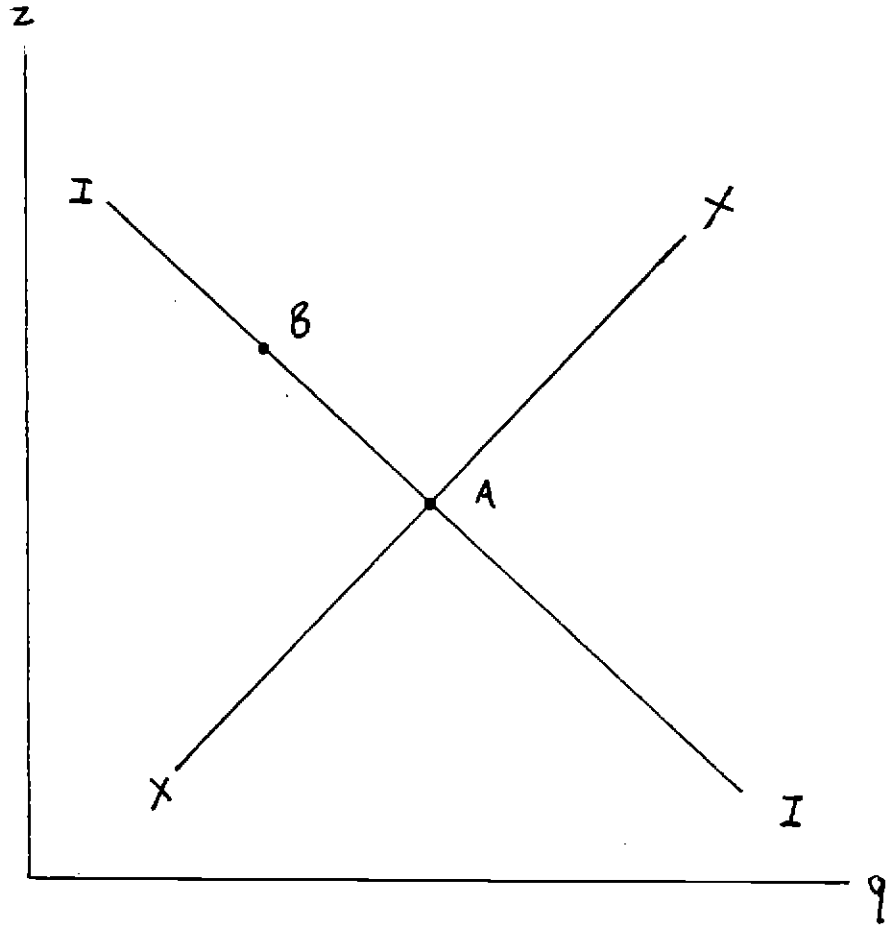

Figure 5

disturbance that causes a decline in steady-state external claims must also cause a rise in the steady state real exchange rate.

For a given long-run foreign asset stock, figure 5 shows the determination of long run absorption z and the long-run relative price q. The II or internal-balance schedule shows combinations of q and z that clear the labor market (that is, satisfy (28) with $Dq = 0$). The schedule's slope is given by

$$(37)\quad (dz/dq)|_{II} = -(n^T/-\sigma'z)/(1-\sigma) < 0.$$

Points above II are associated with excess demand for labor. The XX or external-balance schedule shows q-z combinations consistent with a zero current account for a fixed value of K*. Its slope is

$$(38)\quad (dz/dq)|_{XX} = [y^T/-\{[1-(q/a)]\sigma'-(\sigma/q)\}(z/q)]/[(\sigma/q)+(1-\sigma)/a] > 0.$$

Points above XX are characterized by external deficits, and XX shifts upward along an unchanging II schedule as K* rises. Point A, at the schedules' intersection, is the unique point consistent with both internal and external balance.

On the maintained assumption that K* falls in the long run as a result of liberalization, imagine that long-run absorption returns to its pre-reform level. Then internal balance would require that long-run q also be at its pre-reform level, q_∞. But with K* (and hence, national income) lower, such a position, shown as point B in figure 5, would not be consistent with external balance; in fact, there would be a deficit. To restore full equilibrium with a lower steady state external asset stock, z must fall and q must rise from q_∞. This downward movement along II brings the economy to point A. It follows that if the external debt rises in the long run, the real exchange rate, after falling in the

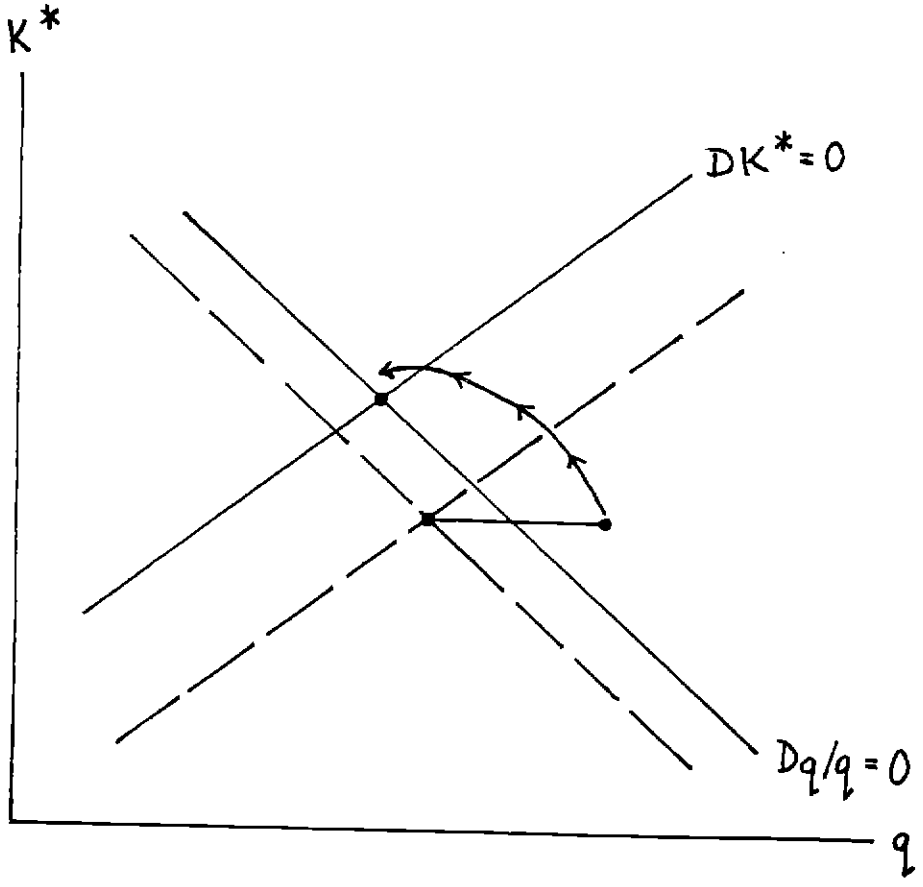

Figure 6

short run, must ultimately rise above its initial level.

It remains to establish that the stock of foreign claims does indeed fall in the long run. Direct calculation shows that long-run foreign assets move in the same direction as the sign of the expression

$$(39)\quad z_2\{(n^T/-\sigma'z)[(\sigma/q)+(1-\sigma)/a]+(1-\sigma)[y^T/-\{[1-(q/a)]\sigma'-(\sigma/q)\}(z/q)]\}/(\Gamma_1\Omega_2-\Gamma_2\Omega_1).$$

Because $z_2 < 0$, stability condition (35) implies that (39) is negative.

4. Devaluation and Disinflation

In this section I discuss the effects of abrupt changes in both the level and the rate of change of the exchange rate. An unanticipated discrete devaluation may or may not occasion an initial contraction, but in the long run it appreciates the real exchange rate and increases the foreign asset stock. Disinflation, defined here as a permanent, unanticipated reduction in the rate of currency depreciation, is neutral under perfect capital mobility and rational expectations, price rigidities notwithstanding. But when capital movements are prohibited, a fall in DE/E causes an initial slump followed by a cumulative balance-of-payments surplus and an eventual real appreciation.

4.1 Devaluation

The effects of a sharp rise in E may be visualized with the aid of figures 6 and 7. The monetary authority is assumed to deviate from rule (20) when it devalues, failing to match the exchange-rate increase with a compensating increase in domestic credit. Devaluation therefore af-

facts the economy in part by decreasing the foreign-exchange value of assets denominated in domestic currency--here the high-powered money stock. This private-sector capital loss, in turn, reduces absorption. In the model this effect takes the form of a change in the relation linking foreign reserves and the exchange-rate deflated money stock M/E.

Prior to devaluation we have $M/E = F^* + X$, where, by (16),

$$(40)\quad X = (1/E_t)(C_t - \int_{-\infty}^{t} DE_s F_s^* ds).$$

Devaluation-induced capital gains on foreign reserves are not automatically reflected in the monetary base, but instead lead to the creation of artificial offsetting accounting liabilities on the central bank's balance sheet. Let the exchange rate rise at time t from E_t^- to E_t^+, let $\varepsilon = (E_t^+ - E_t^-)/E_t^+$ denote the percentage devaluation, and let M_t^- be the level of the nominal money supply just before the devaluation takes place. For all $v \geq t$, the central-bank balance sheet becomes

$$(41)\quad M_v/E_v = F_v^* + (1/E_t^+)[C_t - \int_{-\infty}^{t} DE_s F_s^* ds - (E_t^+ - E_t^-)F_t^*]$$

or

$$(42)\quad M_v/E_v = F_v^* + X - \varepsilon(M_t^-/E_t^-)$$

in the absence of further unanticipated devaluations (cf. (40)). Equation (42) implies that for any level of external assets, devaluation lowers the foreign-exchange value of private wealth by the amount of the concomitant capital loss on domestic money holdings. (See Obstfeld 1984b for further discussion.)

Because devaluation lowers private wealth for any K*, the two loci in figures 6 and 7 shift upward: given q, a higher level of foreign claims will be necessary for internal as well as external balance. As in

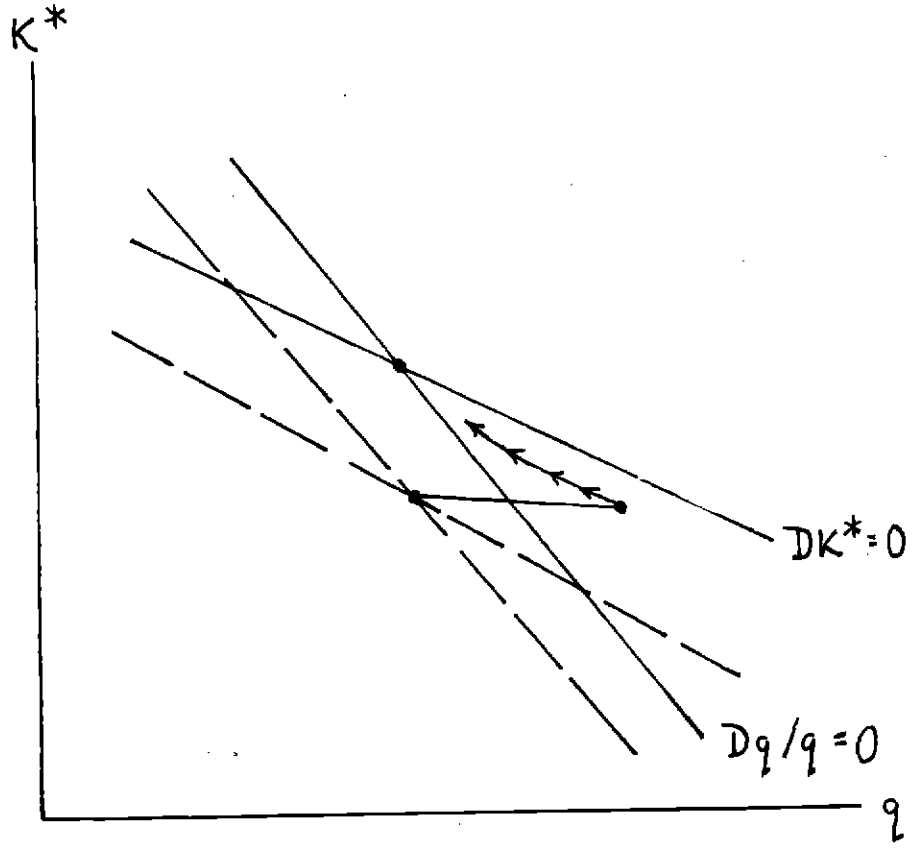

Figure 7

section 3, dynamic stability implies that the long-run level of foreign claims must increase. (This is obvious in the case associated with figure 6.) The arguments made in the previous section therefore imply that the real exchange rate falls in the long run. This real appreciation is coupled with a rise in steady-state absorption relative to the economy's initial equilibrium.

What can be said about the economy's transitional behavior? In addition to shifting the economy's steady state, devaluation also causes an instantaneous initial rise in the real exchange rate. Since the wage is predetermined, (6) yields the impact relative-price effect

$$(43)\quad dq/dE = [1 - (q/a)]/P^H > 0.$$

It is clear from (43) that the elasticity of q with respect to devaluation is smaller the greater the import content of nontradables (that is, the smaller is a): to the extent that devaluation raises costs in the home-goods sector, its effect on relative final-goods prices is reduced.

In figure 6, devaluation shifts the real exchange rate to the right of the new $Dq/q = 0$ locus, so that initially there is an expansion of employment and a current-account surplus. Over time foreign assets rise and the real exchange rate appreciates, with the economy approaching its new rest point in a cyclical fashion. There is no reason in general why the initial postdevaluation position of the economy cannot be to the left of the new $Dq/q = 0$ schedule. This is the case of a contractionary devaluation, the impact effect of which is a slump in employment and a depreciating real exchange rate. Even in this case, increasing wealth eventually reverses these impact effects. The probability that devaluation is contractionary is directly related to the importance of intermediates in the production of nontradables (Krugman

and Taylor 1978; Buffie 1984). It is worth reiterating that if a is low, a large nominal devaluation may achieve only a minor real devaluation because of the substantial and immediate pass-through of import-price changes to domestic costs. In this case, the short-run expansionary effects of the associated rise in q will be small relative to the contractionary wealth effects that shift the two schedules in figure 6 upward.

Under capital immobility there is an initial liquidity squeeze and a rise in the domestic interest rate. But if the capital account has already been liberalized there is a sharp capital inflow that immediately expands central-bank reserves and the monetary base so as to maintain the domestic interest rate at the depreciation-adjusted world level.

Similar dynamics arise in the case shown in figure 7, although the economy's approach to its long-run position is direct when $\Omega_1 < 0$. Because the impact rise in q now worsens the current account it is possible that devaluation occasions a temporary external deficit that shrinks and is reversed as foreign assets fall and the real exchange rate appreciates. Contractionary devaluation is possible here, too, but only an expansionary devaluation can cause an initial deficit.

The long-run nonneutrality of devaluation contrasts sharply with the asymptotic neutrality results stressed in the monetary approach to the balance of payments (Frenkel and Johnson 1976). The result is in part a consequence of the assumption that central-bank reserves earn interest. Under capital immobility individuals rebuild their real balances after the sharp initial rise in prices. Steady-state foreign reserves rise as a result, and because these earn interest, national income and private absorption rise in the long run as well. When capital

is mobile the liquidity effect of devaluation is counteracted by capital inflows, but the wealth effect induces an initial fall in consumption and a long-run effect on national income similar to that arising when there are capital controls.

It is noteworthy that in models incorporating the Ricardian equivalence of government borrowing and taxation, the wealth effect of devaluation disappears in the mobile-capital case. This is because the fall in private wealth associated with the initial capital inflow is exactly offset by a rise in the present discounted value of expected future transfer payments from the government. These additional transfer payments are just the increased interest earnings on the higher stock of central-bank foreign reserves. It is therefore possible for the private sector to rebuild its real balances instantaneously through foreign borrowing without changing its lifetime consumption possibilities. For an analysis of these questions in models based on individual intertemporal maximization, see Obstfeld (1981, 1984b) and Stockman (1983).

4.2 Exchange-Rate Oriented Disinflation

Consider next the consequences of a credible, permanent reduction in the rate of devaluation DE/E. In light of the Southern Cone experiences surveyed by Diaz Alejandro (1981), it is of particular interest to ask under what circumstances an exchange-rate oriented disinflation scheme causes a real appreciation of the currency. The two cases of internationally immobile and mobile capital are considered in turn.

Under capital immobility the domestic nominal interest rate is predetermined. A fall in DE/E increases the real interest rate (all else equal), leading to underemployment and a current surplus at the initial

levels of q and K*. As (28) and (32) show, both the Dq/q = 0 and DK* = 0 schedules therefore shift upward (see figure 8). Model stability requires that when $\Omega_1 < 0$, as is the case in figure 8, K* rises in the long run. This is clearly so when $\Omega_1 > 0$, so that the DK* = 0 locus slopes upward. By the results of section 3, the steady-state real exchange rate appreciates. Indeed, an increase in the devaluation rate has dynamic effects which are qualitatively identical to those of capital-account liberalization.

In figure 8 there is an initial period of real depreciation as an increase in the real interest rate leads to underemployment. An external surplus emerges on impact, and spending rises over time while real money holdings are built up and the domestic nominal and real interest rates fall. Excess demand for labor arises as the economy crosses the new Dq/q = 0 schedule. The real exchange rate appreciates and external assets continue rising during the subsequent approach to the steady state. In the model's alternative configuration (not pictured), the medium-term dynamics are similar but the approach to long-run equilibrium is oscillatory.

When capital is mobile the nominal interest rate is given by R* + (DE/E) and the domestic <u>real</u> rate is just R* + (1-γ)(Dq/q). A fall in DE/E leaves this real interest rate unchanged and, as (28) and (32) show, does not effect either of the schedules defining the system's dynamics. With rational expectations, therefore, a permanent and credible reduction in the rate of devaluation is neutral in spite of the rigidity of domestic prices.

It is instructive to ask why a change in the depreciation rate is neutral with capital mobility. There are two reasons for this. First, the central bank's commitment to peg the exchange rate forces it to

fully accommodate the private portfolio shift caused by the change. A fall in DE/E lowers the nominal interest rate and raises money demand. But the public can increase its nominal money holdings immediately by borrowing foreign exchange abroad and selling it to the central bank. This transaction raises offical reserves but causes no change in the economy's overall income, wealth, or spending. The second factor ensuring neutrality is related to the assumptions regarding expectations and wage behavior. Because the rate of wage inflation can adjust instantaneously, the fall in DE/E is matched by an equal fall in DW/W, so that no change in employment need occur. The overall result is a sharp, permanent fall in the domestic inflation rate with no transitional variation in spending or employment.

Neutrality would not hold if the exchange rate were floating and disinflation took the form of a reduction in trend monetary growth. Asset market equilibrium would then require a currency appreciation that would raise real balances and expenditure. For a discussion of this effect see Calvo and Rodriguez (1977).

Regardless of the degree of capital mobility, the model as formulated gives little support to the notion that a reduction in the rate of upward crawl is itself a cause of real appreciation. Brief consideration of some mechanisms not included in the present model is therefore worthwhile. (The following list is of course not exhaustive.)

Disinflation may lead to real appreciation if expectations of inflation in the nontradables sector are adaptive. This view is set forth by Rodriguez (1982). When uncovered interest parity holds, a widely understood fall in DE/E lowers the domestic nominal interest rate immediately but leaves DP^H/P^H unchanged in the short run. The associated fall in the real interest rate encourages expenditure and so lowers the

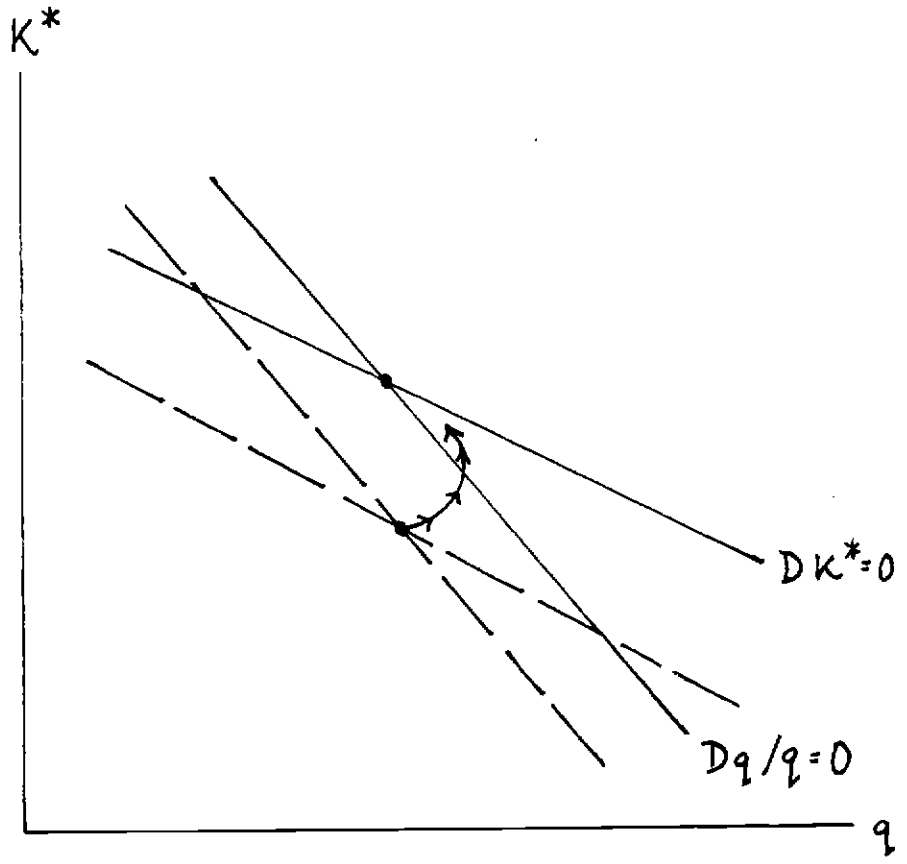

Figure 8

relative price of tradables. This fall in the real interest rate is to be contrasted with the increase that occurs in the present model when expectations are rational but capital is internationally immobile.

Dornbusch (1982) suggests that the rate of domestic price inflation, like the level of domestic prices, is sluggish. If this is so, a fall in the depreciation rate tautologically forces an initial period of real appreciation. The rate of home price inflation must eventually fall to match that in the tradables sector, but the dynamics of this process are likely to be complex.

Buffie (1983) constructs a model in which banks hold nontradable claims to capital which are imperfectly substitutable for foreign bonds and hence endogenously priced. A reduction in DE/E raises banks' demand for this asset, driving up its price (Tobin's q) and hence investment demand. The result is again a short-run real appreciation.

The present model has assumed for simplicitly that disposable income does not influence absorption. In a similar setting, van Wijnbergen (1983a) shows that this neglected channel may lead to real appreciation if disposable income is defined properly so as to reflect the inflation tax on real balances. Because a lowering of the devaluation rate also lowers domestic-price inflation, the inflation tax falls and disposable income rises. The resulting increase in consumption falls partially on nontradables, driving their relative price upward. Calvo (1983) also discusses this mechanism.

Yet another channel of nonneutrality is suggested in the optimizing framework of Obstfeld (1981), which incorporates Ricardian equivalence and Metzlerian target-wealth saving behavior. Disinflation causes a rise in desired nominal balances matched by a capital inflow and an increase in interest-bearing official reserves. Because individuals

capitalize expected government transfers, there is an increase in the public's perceived consumption possibilities and a rise in expenditure. Although the model does not explicitly encompass nontradables, this rise in expenditure is consistent with real appreciation.

The foregoing models all consider a permanent unanticipated fall in DE/E rather than the preannounced, phased decline in the devaluation rate that was a hallmark of the Southern Cone plans. In Obstfeld (1984a) I employ an intertemporal maximizing model to study such schemes. Anticipated disinflation affects the economy by raising the path of an expenditure-based real interest rate reflecting expected changes in the prices of nontradables and liquidity services. If intertemporal substitution is sufficiently low, the immediate result is a rise in spending, an external deficit, and a real appreciation. The temporary real appreciation gives way to a long-run decline in the relative price of nontradables.

A final observation relates to the question of credibility. As Calvo (1983) and others have emphasized, much depends on the public's belief in official promises to avoid maxi-devaluations. If the public views a discontinuous exchange-rate jump as a possiblity, this will be built into inflation expectations and subsequent wage settlements. A persistent belief in a maxi-devaluation that does not materialize will therefore lead to an extended period over which domestic prices rise more quickly than the exchange rate. Even if the initial fear of devaluation was in some sense unjustified, the resulting real appreciation is likely to force the government's hand.[11]

5. Conclusion

This paper has constructed a dynamic framework in which liberalization and stabilization measures of the type recently seen in Latin America's Southern Cone can be studied. The model attempts to capture some salient features of advanced industrializing economies by postulating a crawling-peg exchange-rate system, slow labor-market adjustment, and an important role for imported production inputs. Because the model encompasses economies with closed and open capital accounts as special cases, the impact of capital-account restrictions on policy effects is highlighted. A further advantage of this general framework is its ability capture the macroeconomic consequences of opening the capital account.

Liberalization of the capital account leads to an initial period of real exchange-rate appreciation, but a long-run real depreciation and increase in foreign debt. The economy passes through alternating phases of boom and slump in the transition process. Devaluation is nonneutral even in the long run, and may be contractionary in the short run. Even though this measure entails an impact real depreciation, it drives the economy to a new stationary position in which the relative price of nontradables is higher than initially. Finally, attempts to disinflate through manipulation of the rate of currency devaluation may have minimal effects under capital mobility. When capital is immobile, however, disinflation has effects qualitatively similar to those of closing the capital account.

An important omitted variable of the model is imperfect credibility: public disbelief in the permanence of reform initiatives and in official promises not to inflict capital losses through devalua-

tion or other measures. There can be little doubt that incredulity played a central role in both the unfolding and the unraveling of the Southern Cone stabilization programs. Understanding of this phenomenon is currently incomplete, but it is at the top of the agenda for future research.

Appendix

The purpose of this appendix is to supply a detailed discussion of the assumptions underlying the model's dynamics. Let (q_∞, K^*_∞) denote the steady state of the system described by (29) and (32). The linear approximation to the system near its steady state is

$$Dq = q_\infty \Gamma_1 (q - q_\infty) + q_\infty \Gamma_2 (K^* - K^*_\infty),$$

$$DK^* = \Omega_1 (q - q_\infty) + \Omega_2 (K^* - K^*_\infty),$$

where all functions are evaluated at (q_∞, K^*_∞). Since the two dynamic variables are predetermined, the linearized system is stable if its two characteristic roots are negative. Necessary and sufficient conditions for this are the trace condition $q_\infty \Gamma_1 + \Omega_2 < 0$ and the determinant condition (35).

Direct calculation using (28) and (32) shows that in a neighborhood of the steady state,

$$\Gamma_1 = -\pi[n^T/-\sigma' z + (1-\sigma)(1-\gamma) z_1 a^{-\gamma}(K^* + X + k)]/[1 + \pi(1-\sigma)(1-\gamma) z_2],$$

$$\Gamma_2 = -\pi(1-\sigma)(z_1 q^{1-\gamma} + z_2 R')/[1+\pi(1-\sigma)(1-\gamma)z_2],$$

$$\Omega_1 = y^T{}' - \{[1-(q/a)]\pi' - (\sigma/q)\}(z/q)$$
$$- (1-\gamma)[(\sigma/q)+(1-\sigma)/a](z_1 q^{-\gamma}(K^*+X+k)+z_2\Gamma_1),$$

$$\Omega_2 = R^* - [(\sigma/q)+(1-\sigma)/a]\{z_1 q^{1-\gamma} + z_2[R'+(1-\gamma)\Gamma_2]\}.$$

The inequalities in (30) and (34) are predicated on the assumption that the economy is near its long-run equilibrium. Those in (30) rely also on the assumption that $1 + \pi(1-\sigma)(1-\gamma)z_2 > 0$. For a discussion of this condition, and a theoretical rationale, see Obstfeld and Rogoff (1984). Once it is assumed that $1+\pi(1-\sigma)(1-\gamma)z_2 > 0$, the additional assumption $K^*+X+k > 0$ (which is clearly stronger than necessary) delivers (30). The inequality $\Omega_2 < 0$ in (34) is just the standard requirement that an increase in wealth raise absorption by more than income at a constant real exchange rate. As was mentioned in the text, the assumption $\Omega_2 < 0$ is needed for brevity rather than stability.

Inequality (36) follows immediately from the partial derivatives listed above and the assumption that $1+\pi(1-\sigma)(1-\gamma)z_2 > 0$.

Footnotes

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1. For discussion of individual countries see Foxley (1982), Harberger

(1982), Buffie (1983), Calvo (1983), Dornbusch (1985), and Edwards (1985a). See also the papers and discussion collected in Ardito Barletta, Blejer, and Landau (1983). A full account of the collapse of the Southern Cone reform programs is beyond this paper's scope. Diaz Alejandro (1984), Dornbusch (1985), and Edwards (1985a) address that topic. Edwards (1985b) surveys some of the relevant analytical questions.

2. A single exchange-rate regime, the pegged rate, is assumed throughout. Bruno (1983) discusses interactions between the degree of capital mobility and the exchange-rate regime.

3. Related models have been developed by Blejer and Mathieson (1981), Calvo (1982), and van Wijnbergen (1983a). Blejer and Mathieson (1981) stress the role of the domestic banking system. The setup in Calvo (1982) is similar to that of the present paper. But while a simple Phillips curve governs the wage dynamics described below, Calvo assumes that the home price level is an index of firms' predetermined output prices, set at staggered intervals. Another related model is due to Buffie (1983), and incorporates a banking system and a richer menu of assets. The intrinsic dynamics arising from asset accumulation are not pursued in that model, however. Khan and Knight (1981) estimate and simulate a fairly detailed developing-country macromodel.

4. By assuming perfect foresight I am pushing aside undoubtedly important questions about the credibility of government policies and the speed with which expectations adjust to new policy regimes. See section 4.2 below for further discussion.

5. See equation (40) below. The coefficient λ can be altered by certain government policies, for example a discrete devaluation ΔE of the currency not matched by a "helicopter" domestic-credit increase ΔC satisfying equation (20), or by an increase in domestic credit not matched by the appropriate devaluation. Along this model's perfect foresight paths, however, official transfer payments always compensate the private sector for the depreciation of its money holdings against foreign currency. (Of course, any individual takes these transfers to be parametric, and so does not view them as a function of her own portfolio decisions.) The effect of an "uncompensated" devaluation on the relation between M/E and F* is discussed in section 4.

6. It should be kept in mind that under rule (20), the experiment of raising q corresponds to a rise in E (a devaluation) coupled with a compensating increase in domestic credit. (See footnote 5.) More simply, q can be viewed as rising through a fall in the predetermined nominal wage.

7. Note that both loci are flatter when there is no capital mobility.

8. Khan and Zahler (1983) use a detailed simulation model to evaluate the effects of opening the capital account. The dynamic adjustment produced by their model is quite similar to that found below. Dorihiac (1984) studies the effect of financial opening on the real exchange rate in an intertemporal maximizing model. Calvo (1982) also studies capital-account liberalization, identifying its effects with those of an increase in domestic wealth. He obtains dynamics similar to those obtained here, but the long-run results are different because the service account

is ignored. See Calvo (1983) for a less formal discussion of liberalization.

9. Strictly speaking, the use of the diagrams for this experiment is valid only for small changes. This implies that the difference between the pre- and post-reform nominal interest rates can not be too great.

10. The broken lines in figures 3 and 4 are of course the pre-reform internal- and external-balance loci. The assumption $\Omega_2 < 0$ is what permits the assertion that a fall in K*, all else equal, improves the current account.

11. Under capital mobility, the nominal interest rate will fully and immediately reflect the possibility of devaluation. This may explain why in Argentina, for example, the difference between the local and world nominal rates generally exceeded the preannounced rate of devaluation in the period after January 1979. As Calvo (1983) observes, however, expected devaluation should not affect the real interest rate, for it raises the nominal rate and expected inflation by the same amount.

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