NBER WORKING PAPER SERIES

THE CAPITAL INFLOWS PROBLEM REVISITED: A STYLIZED MODEL OF SOUTHERN CONE DISINFLATION

Maurice Obstfeld

Working Paper No. 1456

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 1984

The research reported here is part of the NBER's research program in International Studies. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #1456
September 1984

The Capital Inflows Problem Revisited: A Stylized Model of Southern-Cone Disinflation

ABSTRACT

In the late 1970s countries in Latin America's Southern Cone attempted to lower domestic inflation rates through the progressive reduction of a preannounced rate of exchange-rate devaluation. The stabilization programs gave rise to massive capital inflows, real exchange-rate appreciation, and current-account deficits. This paper develops a stylized intertemporal framework in which the effects of a preannounced exchange-rate oriented disinflation scheme can be studied. It is shown that even when agents have perfect foresight and markets clear continuously, the "capital inflows" problem and the associated real appreciation may result.

While unanticipated, permanent inflation changes are neutral in the paper, anticipated inflation is neutral only in exceptional circumstances. A preannounced disinflation operates by altering the path of an expenditure-based real domestic interest rate that depends on expected changes in the prices of liquidity services and nontradable consumption goods. Alternatively, by raising future real balances, anticipated disinflation may cause an incipient change in the time path of consumption's marginal utility, leading agents to revise consumption plans. It is noteworthy that disinflation's long-run effect on the real exchange rate more than reverses its short-run effect. If disinflation occasions a real appreciation on impact, say, the relative price of tradables must rise in the long run so that the economy can service the additional external debt incurred in the transition period.

Maurice Obstfeld
Department of Economics
Columbia University
New York, NY 10027

(212) 280-5489

Introduction

In the late 1970s countries in Latin America's Southern Cone attempted to lower their domestic inflation rates through the progressive reduction of a preannounced rate of exchange-rate devaluation. The exchange-rate oriented disinflation schemes accompanied wide-ranging liberalization programs aimed at reducing fiscal deficits, deregulating domestic financial markets, and removing most impediments to external trade in goods and assets. While the timing and magnitudes of the various policy initiatives differed among Argentina, Chile, and Uruguay, three features of the stabilization programs have attracted considerable attention. First, capital-account liberalization encouraged extensive foreign borrowing and rapid growth of central-bank foreign reserves. Second, disinflation coincided with substantial rises in domestic price levels relative to import prices, i.e., with real exchange-rate appreciation. Third, current account balances worsened, so that the net external debts of these economies increased more quickly.[1]

Figures for Argentina, drawn from Calvo (1983), illustrate this "capital inflows problem." Although a plan of preannouncing the exchange rate's path was introduced only in December 1978, the disinflation process in Argentina began in early 1976. Between the end of 1976 and the end of 1980, central-bank reserves rose from 1.8 to 7.7 billion U.S. dollars, having reached 10.5 billion dollars at the end of 1979 prior to the domestic banking crisis that marked the beginning of the end of stabilization. On average, the rate of inflation in the consumer price index exceeded the currency's depreciation rate against the dollar by 74.5 percent per annum between late 1977 and late 1980. Given the much lower rate of dollar price inflation over that period, a massive and sustained real appreciation resulted. The current-account response was less immediate, with the surpluses of 1976-1978 giving way to a deficit of 4.8 billion dollars by 1980.

This paper attempts to explain aspects of the Southern Cone experience by developing a simple intertemporal optimizing framework and using it to study a small open economy's response to a preannounced, gradual disinflation. The paper has as its focus the capital inflows problem, and shows how the phenomenon may result from an optimal private-sector response to a phased reduction in inflation. Anticipated disinflation operates by altering the path of an expenditure-based real domestic interest rate that depends on expected changes in the prices of liquidity services and nontradable consumption goods. Alternatively, anticipated disinflation, by raising future desired real balances, may cause an incipient change in the time path of consumption's marginal utility, thus leading individuals to alter their previous expenditure plans.

The framework developed below is highly stylized, and does not pretend to offer a realistic description of Southern Cone economies or a complete account of events there. Other authors have emphasized alternative channels through which disinflation might have had real effects of the type observed. Rodriguez (1982) argues that domestic inflation expectations are sluggish in the short run, so that a reduction in the rate of depreciation immediately reduces the real interest rate through its effect on the nominal rate. This change in turn stimulates spending, causing real appreciation. Dornbusch (1982) ties real appreciation to a domestic inflation rate that adjusts only gradually to goods-market disequilibrium. Calvo (1983) discusses several hypotheses, including portfolio shifts into domestic nonmoney assets and public disbelief in official renunciations of surprise maxi-devaluations. Each of these mechanisms enjoys some degree of empirical plausibility, but no simple model can capture the complexity of a structural economic revolution involving tax and tariff reforms and banking decontrol as well as major shifts in monetary, fiscal, and exchange-rate policy.

The goal of the present work is to elucidate a channel through which capital inflows and real appreciation may occur even if agents have rational expectations, policy is credible, and continuous market clearing prevails. The paper's models therefore demonstrate that the capital inflows phenomenon is not in itself evidence of price stickiness or suboptimal expectations formation. Further, the techniques introduced here permit analysis of a gradual decline in the rate of currency devaluation rather than the unrealistic permanent and unanticipated reduction studied in the previous literature. In fact, only the former policy has real effects in the models set out below.[2]

Partially offsetting the advantage of the paper's technique is a weakness: the assumption that the monetary authority's policy takes the form of a one-time, immutable announcement of all future depreciation rates. While formal exchange-rate tables were published in Chile from January 1978 and in Argentina and Uruguay from December 1978, they covered only a limited future period and therefore appeared periodically. In addition, the capital inflows problem predates the tables' introduction. The perfect-foresight assumption is adopted here because it produces a tractable benchmark model that lays bare some economic forces difficult to analyze in a more complex, stochastic setting.[3]

While the paper has its roots in the recent (and rather short-lived) Southern Cone experience with disinflation and liberalization, it relates also to a classic theoretical question in monetary theory, the superneutrality of money. The model explored here assumes individual intertemporal preferences of the type postulated by Sidrauski (1967); and it therefore has the property, mentioned above, that unanticipated but fully understood permanent changes in inflation do not alter the time path of the economy's stock of productive nonmonetary assets. The paper shows, however, that inflation changes that would be neutral if unanticipated can affect the economy's path if they are expected in advance. The result underscores the point that the inflation rate is a real variable, changes in which will have no real effects only in exceptional circumstances.[4]

The outline of the paper is as follows. Sections I and II set out a model of a single consumption good economy open to international trade and capital movements. Under the crawling-peg exchange-rate regime assumed, it is the public's demand for money that determines the degree to which the country's external asset acquisitions are monetized through central-bank foreign exchange intervention. This model of course does not permit an analysis of the real exchange rate, but it does provide a relatively simple setting in which the economic effects of preannounced disinflation become apparent.

The impact and transitional effects of that disturbance are investigated in section III. Private-sector preferences play a key role in determining the qualitative nature of the economy's short-run and long-run responses. When the marginal utility of consumption rises with real money holdings, the announcement of disinflation causes an impact capital outflow, a fall in consumption, and a corresponding current-account surplus. For the class of utility functions studied here (the constant relative risk aversion class), this corresponds to the case in which the substitution effect of the concomitant rise in the expenditure-based interest rate dominates the income effect. When the marginal utility of consumption is a declining function of real balances--i.e., when the income effect of interest-rate changes dominates--the impact of an announced disinflation program involves a sharp capital inflow, a rise in consumption, and a current deficit. In contrast to the previous case, the transition path is necessarily characterized by a private capital account surplus, and thus is suggestive of the Southern Cone stabilization experience. Only when the utility function is separable in consumption and real balances is money fully superneutral.

Section IV introduces nontradable consumption goods so that the real exchange rate's behavior can be studied. The appropriate definition of "real" balances becomes an important question in a two consumption good setting, and a novel answer, related to work of Michener (1984), is proposed in this section. Section V takes up the analysis of disinflation. The same conditions on preferences as in section III determine whether the impact effect entails a fall in consumption and real balances or a rise. If consumption increases on impact, there is a real appreciation followed by a transitional period in which external assets decline, the relative price of nontradables falls, and (for reasonable parameter values) central-bank reserves increase. It is noteworthy that a disinflation program moves the real exchange rate in opposite directions in the short run and in the long run. If the immediate effect of disinflation is a current deficit and a real appreciation, say, the real exchange rate must depreciate in the long run so that the economy can service the new external debt it has incurred. Bruno (1976) has also observed that a program of sustained external borrowing calls for an eventual real depreciation.

Section VI contains some concluding remarks.

I. A One Consumption Good Model

The analysis is concerned with a small open economy facing a perfect world capital market. To illustrate the basic idea of the paper in a relatively simple setting, I assume initially that all individuals demand a single, tradable consumption good, the domestic supply of which is exogenous and fixed at y. This perishable consumption good can be thought of as a composite whose components have fixed relative prices. Section IV will relax the foregoing assumptions, introducing a nontradable good and domestic supply responses so that variations in the real exchange rate can be studied. Until then, the adjective "real" is to be understood as meaning "measured in terms of the single consumption good."

Two assets are available: domestic money (held by domestic residents only) and an internationally tradable bond whose face value is fixed in terms of the consumption good. All money is taken to be high-powered, so the domestic banking system is ignored. The real return on bonds is determined in the world capital market and is constant at the level ρ. The foreign-currency price of the single consumption good is also fixed (at unity, say); thus, the domestic inflation rate, π, may be identified with the rate of depreciation of the currency. The exchange rate--the domestic-currency price of foreign currency --is pegged by the country's central bank, which holds interest-bearing "foreign" reserves (here, interest-bearing consumption-indexed bonds) for this purpose. Although instantaneously pegged, the exchange rate need not be constant, but instead may follow any path chosen by the monetary authority. In effect, the latter chooses the path of domestic inflation. It is important to remember that under conditions of capital mobility, the central bank can peg the exchange rate only if it automatically accommodates any change in private money demand through purchases or sales of foreign reserves.

A representative agent maximizes an intertemporal utility functional of the form

$$V = \int_0^\infty u(c_t, m_t) e^{-\delta t} dt. \tag{1}$$

In (1), the instantaneous utility function $u(.,.)$ depends on consumption (c) and real balances (m), defined as nominal money holdings (M) deflated by the domestic price level (P). As usual, the utility function is increasing in both c and m, strictly concave, twice continuously differentiable, and it satisfies the Inada conditions. The parameter δ in (1) is the agent's constant subjective time-preference rate.

Let b_0 denote initial net private bond holdings and $\{\tau_t\}_{t=0}^\infty$ the expected path of real transfers from the government. The individual's intertemporal budget constraint takes the form

$$\int_0^{\infty}[c_t + (\pi_t + \rho)m_t]\exp(-\rho t)dt \leq (y/\rho) + m_0 + b_0 + \int_0^{\infty}\tau_t\exp(-\rho t)dt. \qquad (2)$$

Constraint (2) states that the present value of lifetime expenditure cannot exceed the present value of lifetime income. The expenditure concept it embodies encompasses both spending on consumption and spending on liquidity services, the real price of the latter good being the nominal interest rate $\pi_t + \rho$. Agents are assumed to possess perfect foresight regarding the future paths of inflation and transfer payments, so no notational distinction is made between expected and realized values.

Necessary conditions for a solution to the consumer's problem are derived by differentiating the Lagrangian expression

$$L = \int_0^{\infty}u(c_t,m_t)e^{-\delta t}dt$$
$$+ \mu_0\{(y/\rho) + m_0 + b_0 + \int_0^{\infty}\tau_t\exp(-\rho t)dt - \int_0^{\infty}[c_t + (\pi_t + \rho)m_t]\exp(-\rho t)dt\},$$

where μ_0 is a multiplier. μ_0 can be interpreted as the initial shadow value of wealth. If it is assumed for convenience that the time-preference rate δ and the world interest rate ρ coincide, the resulting conditions are

$$u_c(c_t,m_t) = \mu_0, \qquad (3)$$

$$u_m(c_t,m_t) = \mu_0(\pi_t + \rho), \qquad (4)$$

for all t.[5] Conditions (3) and (4) by themselves do not suffice to determine the individual's optimal expenditure program, however. The unique, "correct" value of μ_0 is the one allowing the intertemporal budget constraint (2) to hold as an equality when the paths of consumption and real balances are given by (3) and (4).

Explicit computation of the optimal individual plan requires that the foregoing assumptions be specialized. The utility function u(.,.) is now restricted to the constant relative risk aversion family,

$$u(c,m) = (c^{\alpha}m^{1-\alpha})^{1-R}/(1-R), \tag{5}$$

where $R > 0$ and $\alpha \in (0,1)$. Equations (3)-(5) imply that along a perfect-foresight path, desired consumption and real balances are related to μ_0 according to

$$c_t = (\alpha/\mu_0)^{1/R}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}, \tag{6}$$

$$m_t = (\alpha/\mu_0)^{1/R}[\alpha(\pi_t+\rho)/(1-\alpha)]^{[\alpha(1-R) - 1]/R}. \tag{7}$$

It is evident that spending on both goods is a declining function of the utility shadow price μ_0. Combination of (6) and (7) with constraint (2) shows that the shadow price characterizing an optimal individual plan is

$$\mu_0 = \frac{\alpha^{1-R}\{\int_0^{\infty}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{[(y/\rho) + m_0 + b_0 + \int_0^{\infty}\tau_t\exp(-\rho t)dt]^R}. \tag{8}$$

If no unanticipated shocks occur, Bellman's principle implies that the optimal shadow value μ computed by the individual at any time s later than 0 must equal the value μ_0 given by (8). Thus, for any $s \geq 0$ it must also be true that along a perfect-foresight path

$$\mu_0 = \frac{\alpha^{1-R}\{\int_s^{\infty}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp[-\rho(t-s)]dt\}^R}{\{(y/\rho) + m_s + b_s + \int_s^{\infty}\tau_t\exp[-\rho(t-s)]dt\}^R}. \tag{9}$$

Before describing the equilibrium of this economy, it remains to describe the behavior of the public sector. For this purpose it is convenient to consolidate the budgets of the central bank and the fiscal authority. At any time t, the central bank holds foreign reserves r_t and earns interest ρr_t. The government finances an exogenous public consumption level g_t and net lump-sum transfers τ_t through the central bank's foreign interest earnings and the expansion of central-bank credit. The fiscal authority does not itself issue interest-bearing debt. The transfer level τ_t is assumed to adjust endogenously so that the time derivative of domestic credit (measured in real terms) is $\pi_t m_t$: domestic credit expansion just compensates residents for the real depreciation of their money holdings. The level of real transfers is therefore given by

$$\tau_t = \pi_t m_t + \rho r_t - g_t. \tag{10}$$

The fiscal policy rule summarized in (10) is not intended as a realistic description of policies actually pursued in the Southern Cone. Rather, it is an idealized benchmark case, reflecting a policy that seeks consistency between the devaluation rate and the monetized fiscal deficit so that excessive foreign reserve fluctuations are avoided. While this consistency may not have been attained ex post, there is evidence that it was a desideratum of the stabilization plans as originally formulated.[6] It is useful to remember the following implication of domestic credit rule (10): $Dm = Dr$ (where D denotes a time derivative). To see this, note that the time derivative of the nominal money supply is the sum of the time derivatives of its foreign and domestic source components: $DM = PDr + \pi M$. It follows that $Dm = DM/P - \pi m = Dr$.[7]

II. Perfect-Foresight Equilibrium

The previous section section calculated the time-invariant shadow value of wealth associated with an optimal individual plan. The individual plan is formulated on the basis of expected future paths of inflation and real transfers. In turn, the present value of government transfers plus consumption is, through the public sector's intertemporal budget constraint, limited by the path of private money demand and the resulting seigniorage revenue. In this section I discuss the economy's perfect-foresight equilibrium path, along which the expected and realized paths of transfers coincide and the government's intertemporal constraint is satisfied.

A key result is that anticipated changes in inflation generally do influence the path of the current account, even though permanent, unanticipated changes in a constant inflation rate do not. The result implies that money is superneutral only in rather special circumstances.

Let m^d denote private money demand. The government's intertemporal budget constraint takes the form

$$\int_0^\infty (g_t + \tau_t)\exp(-\rho t)dt \leq r_0 + \int_0^\infty (Dm_t^d + \pi_t m_t^d)\exp(-\rho t)dt \quad (11)$$

in the present context. In words, the present value of government spending is limited by initial government assets plus the present value of seigniorage.

Consider now the typical individual's intertemporal constraint (2), and assume that individuals base their decisions on the transfer path appearing in (11) (along with the announced path of inflation) and that the resulting path of private money demand allows (11) to hold. In other words, assume a perfect-foresight equilibrium. Adding (2) and (11) yields the national constraint

$$\int_0^\infty (c_t + g_t)\exp(-\rho t)dt \leq (y/\rho) + r_0 + b_0. \quad (12)$$

Money is a nontradable asset, so (12) states that the present value of national absorption is limited by the present value of the nation's tradable resources.

As noted in the previous section, the individual constraint (2) must hold with equality if individual plans are optimal. After integrating by parts, it is evident that under the credit rule (10), (11) and (12) both hold with equality in equilibrium provided $\lim_{t\to\infty}\exp(-\rho t)m_t = 0$. (Because real balances must be nonnegative, the foregoing limit must also be nonnegative.) This condition is henceforth assumed, so that

$$\int_0^\infty (c_t + g_t)\exp(-\rho t)dt = (y/\rho) + r_0 + b_0 \tag{13}$$

in equilibrium.

Given the form of the utility function assumed in (5), the individual always devotes a fraction α of his expenditure to consumption. Because the present value of expenditure equals the present value of income (the right-hand side of (2)),

$$\int_0^\infty c_t\exp(-\rho t)dt = \alpha[(y/\rho) + m_0 + b_0 + \int_0^\infty \tau_t\exp(-\rho t)dt]. \tag{14}$$

This information yields the equilibrium initial shadow value of wealth, μ_0^*, i.e., the unique value consistent with individual optimality, perfect foresight, and the government's intertemporal budget constraint. By (8), (13), and (14), that value is

$$\mu_0^* = \frac{\alpha\{\int_0^\infty[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{[(y/\rho) + f_0 - \int_0^\infty g_t\exp(-\rho t)dt]^R}. \tag{15}$$

where $f_0 = b_0 + r_0$ is the stock of net claims on foreigners owned by the economy as a whole. Equation (9) implies that for any $s \geq 0$,

$$\mu_0^* = \frac{\alpha\{\int_s^\infty [\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp[-\rho(t-s)]dt\}^R}{\{(y/\rho) + f_s - \int_s^\infty g_t \exp[-\rho(t-s)]dt\}^R} \qquad (16)$$

along a perfect-foresight equilibrium path. (Of course, (15) and (16) could also have been derived directly by solving (14) for μ_0^* using (6).) As is typically the case in asset-pricing models assuming rational expectations, the (shadow) asset price μ_0^* depends on the entire expected future paths of inflation, output, and government spending, as well as on the economy's initial position (as summarized by the predetermined quantity f_0).[8]

The model can be used to derive the equilibrium level of the current-account balance along a fulfilled perfect-foresight path. Private-sector asset accumulation is given by $Dm + Db = y + \rho b + \tau - \pi m - c$; and because government spending in excess of revenue is financed by reserve loss, $Dr = Dm + \pi m + \rho r - g - \tau$. This implies the relation $Df = y + \rho f - c - g$, which expresses the change in the net foreign claims of the economy as a whole--the current-account balance--as the difference between national income and absorption. Since $Dm = Dr$ by (10), the current account also equals net saving by the private sector; but under a pegged exchange rate and capital mobility, the private sector can freely exchange foreign bonds for money (and vice versa) at the central bank, and thus can accumulate wealth in the form of domestic money as well as in the form of foreign claims. As was noted above, the national stock of foreign claims f is given at any point in time by the past history of the current account. It is the public's demand for money that determines the division of f between private bond holdings b and official reserves r.

Recall that the multiplier μ^* remains constant through time in the absence of unanticipated shocks. Differentiation of (16) therefore yields the equilibrium current account as a function of current and anticipated future inflation rates and levels of public consumption:

$$Df_s = \{\rho - \frac{(\pi_s+\rho)^{-(1-\alpha)(1-R)/R}}{\int_s^\infty(\pi_t+\rho)^{-(1-\alpha)(1-R)/R}\exp[-\rho(t-s)]dt}\}\{(y/\rho) + f_s - \int_s^\infty g_t\exp[-\rho(t-s)]dt\}$$
$$+ \{\rho\int_s^\infty g_t\exp[-\rho(t-s)]dt - g_s\}. \qquad (17)$$

Equation (17) elucidates the link between inflation fluctuations and external asset accumulation. On its right-hand side there are two terms, the first reflecting the current-account response to anticipated inflation and the second the response to anticipated changes in government consumption.

The effect of public consumption movements is quite conventional: the private sector offsets the temporary tax changes these imply, thus smoothing its consumption, by running current deficits when government spending exceeds is "permanent" level and running surpluses in the opposite case. If government spending is expected to remain constant for all $t \geq s$, the second term on the right-hand side of (17) is zero. (I have assumed away anticipated changes in the endowment y, which, after a sign change, have the same effect as anticipated changes in g.)

The effect of inflation movements requires more discussion, and therefore is studied in detail in the next section. For now, note that if the inflation rate is expected to remain constant (at π^*, say) for all $t \geq s$, the first right-hand side term in (17) is zero. Further, a permanent, unanticipated change in π^* leaves the current account unchanged, and thus itself induces no change in the nationally-owned stock of foreign claims. Real balances m and hence utility do change, of course, remaining at their new levels forever. But the central-bank reserve sales that accommodate this fall in m have no effect on the economy's consumption possibilities, for they represent a transfer of foreign assets from the central bank to the public rather than a change in the economy's net external claims f. As in the Brock (1974), Calvo (1979), and Fischer (1979b) perfect-foresight versions of Sidrauski's (1967) monetary growth model, one-time changes in a constant inflation rate are superneutral in the sense that they do not alter the economy's stock of productive nonmonetary assets. This is, however, a very special result according to (17). In general, the rate of external asset accumulation is a function of the current inflation rate and of the expected future inflation path.

When R = 1, so that the utility function takes the logarithmic form $u(c,m) = \alpha\ln(c) + (1-\alpha)\ln(m)$, the effect of inflation in (17) disappears. In this case, inflation, regardless of its path, has no consumption effects. There is a dichotomy between the real and monetary sides of the economy when R = 1 because the utility function is then separable in consumption and real balances.

III. Preannounced Disinflation

The balance-of-payments effects of a preannounced disinflation are now considered. The program is first revealed to the public at time zero, and it is assumed for simplicity that, prior to the announcement of the disinflation plan, the inflation rate had been expected to remain constant at level π^* for all time. Once the disinflation program is announced, however, agents anticipate a new inflation path $\{\pi_t\}_{t=0}^{\infty}$ that declines over time from an initial level $\pi_0 = \pi^*$.[9]

Use equation (15) to write the preannouncement (pre-preannouncement?) level of the equilibrium wealth shadow value as

$$\mu_0^{*\prime} = \frac{\alpha\{\int_0^{\infty}[\alpha(\pi^*+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{[(y/\rho) + f_0 - \int_0^{\infty}g_t\exp(-\rho t)dt]^R}. \quad (18)$$

The value of this multiplier just after the announcement depends on the newly-revealed future inflation path, and is repeated here for convenience as equation (19):

$$\mu_0^* = \frac{\alpha\{\int_0^\infty [\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{[(y/\rho) + f_0 - \int_0^\infty g_t \exp(-\rho t)dt]^R}. \quad (19)$$

The initial jump in the multiplier (from $\mu_0^{*\prime}$ to μ_0^*) determines the impact effect of the announcement. Because the multiplier will thereafter remain constant at the level given by (19) (barring further surprises), equation (16) (or, equivalently, (17)) shows how the stock of external claims evolves over time. There are three cases to consider: $R < 1$, $R > 1$, and the logarithmic case. To ease the exposition, I assume that the path of government consumption is flat at an unchanged level both before and after the disinflation program's implementation.[10]

When $R < 1$, a rise in real balances raises the marginal utility of consumption (i.e., u_{cm} is positive). As (18) and (19) show, μ_0^* exceeds $\mu_0^{*\prime}$ in this case: real balances are expected to grow over time as inflation declines, and so the new, constant shadow value of real assets must be higher than it was before the announcement of future disinflation.[11] Because $\pi_0 = \pi^*$, (6) and (7) reveal that the announcement occasions a sharp initial fall in both consumption and desired real balances. The price level, which is pegged, cannot jump upward, so the money market is brought to equilibrium by an immediate fall in nominal balances that has as its counterpart a reserve loss by the central bank. Because consumption falls initially in this case, reducing money demand, preannounced disinflation paradoxically causes a private capital outflow on impact.

The fall in consumption entails an improvement in the current account, and as (16) shows, the economy's external assets rise over time as a result of disinflation. Real balances and hence reserves rise also as inflation falls (by (7)). Because $Df = Db + Dr$ (the balance-of-payments identity), private capital outflow does not fully finance the rest of the world's current deficit vis-a-vis the home country. In fact, the private capital account may at times be in surplus (i.e., $Db < 0$) during the transition to lower inflation.

This occurs when the public runs down its net external assets to finance its increasing demand for money, so that the rate of central-bank reserve accumulation, Dr, exceeds the overall rate of increase in the economy's external claims, Df. As (6) indicates, consumption rises during the adjustment process in the present case.

When $R > 1$ (so that u_{cm} is negative), the equilibrium multiplier falls from $\mu_0^{*\prime}$ to μ_0^* at time zero, as (18) and (19) show. This initial drop is again a consequence of the newly-expected growth in real balances, which now lowers the optimal constant shadow value of assets. Consumption and real balances rise on impact, with the initial portfolio shift from bonds to money accommodated through a central-bank purchase of reserves from the public. There is thus a sharp capital inflow. The rise in consumption implies an impact worsening of the current account deficit. All the immediate effects of disinflation are the opposite of those that occur when consumption and real balances are complementary goods, rather than substitutes.

Equation (16) tells us that when R exceeds unity, μ_0^* can remain constant at its postshock value while inflation is falling only if the consolidated foreign asset stock f declines over time. Consumption falls but real balances rise during the transition to a lower inflation rate, as can be seen from (6) and (7). Given the equality between Dr and Dm, the adjustment path necessarily involves continuing balance-of-payments surpluses. The conjunction of a current deficit and an even larger private capital-account surplus replicates some stylized facts of the Southern Cone experience during the late 1970s. An example: In 1979, the first year of its preannounced exchange-rate table, Argentina's central bank had a reserve gain of 4.4 billion U.S. dollars even though the current account registered a .5 billion dollar deficit.

As was noted above, money is superneutral in the borderline case $R = 1$.

Because the instantaneous utility function is then separable in its two arguments, no time variation in consumption need occur to hold the marginal utility of consumption constant at μ_0^*, the postshock (and preshock) equilibrium shadow value of wealth. Accordingly, real balances (and official foreign reserves) rise during the disinflation; while there are continual private capital inflows during the transition, there is no current imbalance at any time ($Db_s = -Dr_s$, for all $s \geq 0$).

The foregoing results may be viewed from a perspective stressing disinflation's effect on a real interest rate defined in terms of the home expenditure bundle. Because domestic expenditure falls on money services as well as on consumption, the relevant consumer price index is a function of the prices of both. Intertemporal variation in the nominal interest rate--the consumption price of money services--entails a parallel variation in the price index, and hence in the expenditure-based interest rate perceived by domestic residents. These interest rate movements can be expected to influence consumption decisions, with the precise result depending on the curvature of the instantaneous utility function.[12]

To make this idea formal, it is convenient to suspend temporarily the previous assumption that the world interest rate ρ is fixed and equal to the time-preference rate δ. Assume instead that the world rate follows the exogenous path $\{\rho_t\}_{t=0}^{\infty}$. Under this new assumption, the discount factor $\exp(-\rho t)$ must be replaced by the factor $\exp(-\int_0^t \rho_v dv)$ in the analysis of sections I and II. As a result, the shadow price μ is no longer constant along perfect-foresight paths, but is instead given by

$$\mu_t = \mu_0 \exp[\int_0^t (\delta - \rho_v) dv].$$

It is straightforward to proceed as before and derive the equilibrium initial shadow price of wealth, μ_0^*. Substitution of μ_0^* into the consumption function (6) yields the initial equilibrium consumption level

$$c(\mu_0^*,\pi_0+\rho_0) = \frac{[\int_0^\infty (y - g_t)\exp(-\int_0^t \rho_v dv)dt + f_0]}{\int_0^\infty \{\exp(\int_0^t \rho_v dv)[(\pi_0+\rho_0)/(\pi_t+\rho_t)]^{1-\alpha}\}^{(1-R)/R}\exp(-\delta t/R)dt}$$

$$= \frac{[\int_0^\infty (y - g_t)\exp(-\int_0^t \rho_v dv)dt + f_0]}{\int_0^\infty (\exp\{\int_0^t [\rho_v - (1-\alpha)D\ln(\pi_v+\rho_v)]dv\})^{(1-R)/R}\exp(-\delta t/R)dt} . \quad (20)$$

Now the expenditure-based interest rate is just the consumption-good rate ρ less the expected change in the consumption-good price of the expenditure bundle, $(1-\alpha)D\ln(\pi+\rho)$. (Recall that the share of money services in spending is $1-\alpha$.) As (20) shows, however, equilibrium consumption depends on the entire expected future path $\{\rho_t - (1-\alpha)D\ln(\pi_t+\rho_t)\}_{t=0}^{\infty}$ of this rate. The effect of the expenditure interest rate on consumption is indeterminate, a reflection of the tension between income and substitution effects. As is well known for the class of utility functions described by (5), substitution effects dominate when R is less than unity. When R exceeds unity, however, marginal utility falls off quickly with additional spending, and so intertemporal substitution is costly. In this case, therefore, income effects dominate, and an upward shift in the path of real interest rates, say, causes the denominator of (20) to fall. For the logarithmic consumer the two effects offset each other exactly: when R = 1, the expenditure-based interest rate does not affect consumption.

Return to the assumption that the path of ρ is flat, and consider again a disinflation program. Because the inflation rate is expected to decline steadily in the wake of the program's announcement, the path of the expenditure interest rate shifts upward. As equation (20) shows, consumption falls on impact if R is less than 1, rises if R exceeds 1, and is unaffected if R = 1. Thus, when the utility function is a member of the constant relative risk aversion family, our previous results may be ascribed to disinflation's effect on the interest rate relevant to private intertemporal allocation decisions.

IV. The Role of Nontradable Goods

The goal of this section is to develop a framework in which disinflation's effect on the relative price of nontradable and tradable goods can be studied. It is therefore assumed that the economy is endowed with a concave production frontier describing the possibilities for transforming tradables into nontradables. The price of nontradables in terms of tradables is p. The inverse of p is often referred to as the real exchange rate, with a real appreciation defined as a rise in p. Output of nontradables is an increasing function $y^N(p)$ of their relative price, while tradable output $y^T(p)$ decreases when p rises. Profit maximization by firms equates p to society's marginal rate of transformation, so that $p = -y^{T\prime}(p)/y^{N\prime}(p)$.

In modelling the economy's demand side, a potential difficulty is the appropriate definition of "real" balances when two consumption goods with a variable relative price are available. Liviatan (1981), in a related model, defines real balances as nominal money deflated by the money price of nontradables. Michener (1984) deflates nominal balances by an arbitrary homogeneous price index in P^T and P^N, the nominal prices of tradables and nontradables. Below, a somewhat different approach is taken. The analysis can be viewed as providing a partial justification for Michener's (1984) assumptions.

Assume that the consumer's instantaneous utility is a function of two variables only, a homogeneous index of consumption of tradables and nontradables, $z(c^T, c^N)$, and some measure of liquidity services. Thus, utility is implicitly separable in consumption and money services (see Deaton and

Muellbauer (1980)). Define $P_z(P^T,P^N)$ to be the nominal unit subutility expenditure function associated with $z(.,.)$, that is, the smallest money expenditure that raises the index $z(.,.)$ by one unit when money prices are P^T and P^N. Then $P_z(P^T,P^N)$ provides the natural measure of the purchasing power of money. Accordingly, "real" balances may be defined as $M/P_z(P^T,P^N)$. Clearly $P_z(.,.)$ is homogeneous of first degree in its arguments, as is the price index assumed by Michener (1984).[13]

Internationally traded bonds remain indexed to tradable goods as in earlier sections, and these are still the only asset other than money. The individual's problem can therefore be stated as follows: choose paths for consumption and nominal balances that maximize

$$V = \int_0^\infty u[z(c_t^T,c_t^N),M_t/P_z(P_t^T,P_t^N)]\exp(-\delta t)dt \tag{21}$$

subject to the intertemporal budget constraint

$$\begin{aligned}&\int_0^\infty[c_t^T + p_t c_t^N + (\pi_t + \rho)(M_t/P_t^T)]\exp(-\rho t)dt \\ &\quad \leq \int_0^\infty[y^T(p_t) + p_t y^N(p_t) + \tau_t]\exp(-\rho t)dt + (M_0/P_0^T) + b_0.\end{aligned} \tag{22}$$

The rate of currency depreciation π need no longer equal the overall inflation rate, the rate at which money loses its real value. Now π is the rate of increase in the nominal price of tradable goods.

To obtain a model solution I will again postulate a particular form for the utility function. It is assumed that the consumption index resides within the class

$$z(c^T,c^N) = (c^T)^\beta(c^N)^{1-\beta}, \tag{23}$$

where $\beta \varepsilon (0,1)$. For this Cobb-Douglas subutility function, $P_z(P^T,P^N)$ is easily shown to be $[P^T/\beta]^\beta[P^N/(1-\beta)]^{1-\beta}$. After normalizing, we may define real balances, again denoted m, by

$$m = M/(P^T)^\beta(P^N)^{1-\beta}. \tag{24}$$

The instantaneous utility function is taken to be of the form

$$u[z(c^T,c^N),m] = [z(c^T,c^N)^\alpha m^{1-\alpha}]^{1-R}/1-R, \tag{25}$$

where $R > 0$ and $\alpha \varepsilon (0,1)$.

Let μ_0 denote as before the Lagrange multiplier associated with the maximiztion of (21) subject to (22). Then (23)-(25) imply the following demand functions for tradables, nontradables, and real balances:

$$c_t^T = \tag{26}$$
$$(\alpha\beta/\mu_0)^{1/R}\beta^{-(1-\alpha\beta)(1-R)/R}[p_t/(1-\beta)]^{-\alpha(1-\beta)(1-R)/R}[\alpha p_t^{1-\beta}(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R},$$

$$c_t^N = \tag{27}$$
$$(\alpha\beta/\mu_0)^{1/R}\beta^{[\alpha\beta(1-R)-1]/R}[p_t/(1-\beta)]^{[(1-\alpha+\alpha\beta)(1-R)-1]/R}[\alpha p_t^{1-\beta}(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R},$$

$$m_t = \tag{28}$$
$$(\alpha\beta/\mu_0)^{1/R}\beta^{[\alpha\beta(1-R)-1]/R}[p_t/(1-\beta)]^{-\alpha(1-\beta)(1-R)/R}[\alpha p_t^{1-\beta}(\pi_t+\rho)/(1-\alpha)]^{[\alpha(1-R)-1]/R}.$$

Combination of (26)-(28) with constraint (22) yields the shadow price of wealth along an optimal individual plan,

$$\mu_0 = \frac{(\alpha\beta)^{1-R}\{\int_0^\infty [p_t/(1-\beta)^{\alpha}]^{-(1-\beta)(1-R)/R}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{\beta^{(1-\alpha\beta)(1-R)}\{\int_0^\infty [y^T(p_t) + p_t y^N(p_t) + \tau_t]\exp(-\rho t)dt + (M_0/P_0^T) + b_0\}^R}. \qquad (29)$$

Assume for simplicity that the government consumes tradable goods only and that it follows the domestic-credit rule

$$\tau_t = \pi_t(M_t/P_t^T) + \rho r_t - g_t, \qquad (30)$$

which implies as before that $D(M/P^T) = Dr$. The government's intertemporal budget constraint is given by (11) (with M^d/P^T replacing m^d), and it holds as an equality under (30) if $\lim_{t\to\infty}\exp(-\rho t)(M_t/P_t^T) = 0$.

In perfect-foresight equilibrium, individuals optimize given their expectations concerning future values of π, τ, and p; the public sector obeys its intertemporal constraint; the market for nontradable goods clears at each moment; and market-clearing prices equal the expected prices that underlie individual decisions. Associated with a perfect-foresight equilibrium path is a Lagrange multiplier μ_0^* consistent with continuous equilibrium in the home goods market, so that

$$c^N(\mu_0^*,\pi_t,p_t) = y^N(p_t)$$

for all $t \geq 0$. Condition (31) gives the equilibrium price of nontradables implicitly as a function of μ_0^* and π,

$$p_t = p(\mu_0^*,\pi_t). \qquad (31)$$

It is useful in the subsequent discussion to solve explicitly for the natural logarithm of p. Let σ denote the constant relative-price elasticity of supply in the nontradable sector. Then by (27),

$$\ln p_t = \frac{1}{\beta(1-R) - \sigma R - 1}\ln\mu_0^* + \frac{(1-\alpha)(1-R)}{\beta(1-R) - \sigma R - 1}\ln(\pi_t+\rho) + k \tag{32}$$

in equilibrium, where k is a constant. Equation (32) shows that p is a decreasing function of μ_0^*. In contrast, the partial effect of π on p is ambiguous, being positive when $R > 1$ and negative when $R < 1$.[14]

If we assume perfect-foresight equilibrium, combine the private- and public-sector budget constraints, and impose market-clearing condition (31), the following aggregate equality emerges:

$$\int_0^\infty c_t^T \exp(-\rho t)dt = \int_0^\infty [y^T(p_t) - g_t]\exp(-\rho t)dt + f_0. \tag{33}$$

In equilibrium, the present value of private consumption of tradables must equal the present value of the economy's tradable output net of government consumption. This is just the analogue of condition (13). Combining (29), (31), and (33) and recalling that $\alpha\beta$ is the share of tradable consumption in private spending, we find that μ_0^* is defined implicitly by the relationship

$$\mu_0^* = \frac{(\alpha\beta)\{\int_0^\infty p(\mu_0^*,\pi_t)^{-(1-\beta)(1-R)/R}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{\beta^{(1-\alpha\beta)(1-R)}(1-\beta)^{-\alpha(1-\beta)(1-R)}(\int_0^\infty\{y^T[p(\mu_0^*,\pi_t)] - g_t\}\exp(-\rho t)dt + f_0)^R}. \tag{34}$$

Further, for any $s \geq 0$,

$$\mu_0^* = \frac{(\alpha\beta)\{\int_s^\infty p(\mu_0^*,\pi_t)^{-(1-\beta)(1-R)/R}[\alpha(\pi_t+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp[-\rho(t-s)]dt\}^R}{\beta^{(1-\alpha\beta)(1-R)}(1-\beta)^{-\alpha(1-\beta)(1-R)}(\int_s^\infty\{y^T[p(\mu_0^*,\pi_t)] - g_t\}\exp[-\rho(t-s)]dt + f_s)^R}. \tag{35}$$

Note that (34) may be used in concert with (26) to display equilibrium consumption as a function of wealth and the path of an expenditure-based interest rate (equation (20) does this for the one-good model). In the present context, however, the relevant interest rate is $\rho - \alpha(1-\beta)D\ln p - (1-\alpha)[D\ln(\pi+\rho) + (1-\beta)D\ln p]$. This measure adjusts the tradables rate ρ by expenditure-weighted changes in the tradable-good price of nontradables, p, as well as expenditure-weighted changes in the tradable-good price of real money services, $p^{1-\beta}(\pi+\rho)$.

V. Disinflation and the Real Exchange Rate

To study the effect of a change in the inflation path, a diagram showing the determination of μ_0^* by (34) is useful. Let $\Omega(\mu_0^*)$ denote the right-hand side of equation (34). Direct calculation using (32) yields the elasticity of the $\Omega(\mu)$ schedule:

$$\frac{d\ln\Omega}{d\ln\mu} = \frac{(1-\beta)(1-R)}{1-\beta(1-R)+\sigma R} + \frac{\{R/[1-\beta(1-R)+\sigma R]\}\int_0^\infty p(\mu,\pi_t)y^{T\prime}[p(\mu,\pi_t)]\exp(-\rho t)dt}{(\int_0^\infty\{y^T[p(\mu,\pi_t)]-g_t\}\exp(-\rho t)dt+f_0)}. \quad (36)$$

A rise in μ lowers p for all $t \geq 0$. When $R < 1$ the slope of the $\Omega(\mu)$ schedule is therefore ambiguous, but it has an elasticity less than unity, as (36) shows. When $R \geq 1$ the schedule slopes downward. The determination of μ_0^* may therefore be depicted as in figures 1 ($R < 1$) and 2 ($R \geq 1$).

Consider now the experiment of a preannounced, phased reduction in the rate of currency depreciation. The experiment may again be viewed as a change in the expected path of price inflation in the tradables sector from a constant path $\{\pi*\}$ to a declining path $\{\pi_t\}_{t=0}^\infty$ with $\pi_0 = \pi*$. A flat government-consumption trajectory is again assumed for expository convenience.

Prior to the program's announcement at time zero, the equilibrium shadow value of wealth is the solution to

$$\mu_0^{*\prime} = \frac{(\alpha\beta)\{\int_0^\infty p(\mu_0^{*\prime},\pi*)^{-(1-\beta)(1-R)/R}[\alpha(\pi*+\rho)/(1-\alpha)]^{-(1-\alpha)(1-R)/R}\exp(-\rho t)dt\}^R}{\beta^{(1-\alpha\beta)(1-R)}(1-\beta)^{-\alpha(1-\beta)(1-R)}(\int_0^\infty\{y^T[p(\mu_0^{*\prime},\pi*)]-g_t\}\exp(-\rho t)dt+f_0)^R}. \quad (37)$$

Figure 3 shows the determination of $\mu_0^{*\prime}$ in the case $R < 1$. How does the

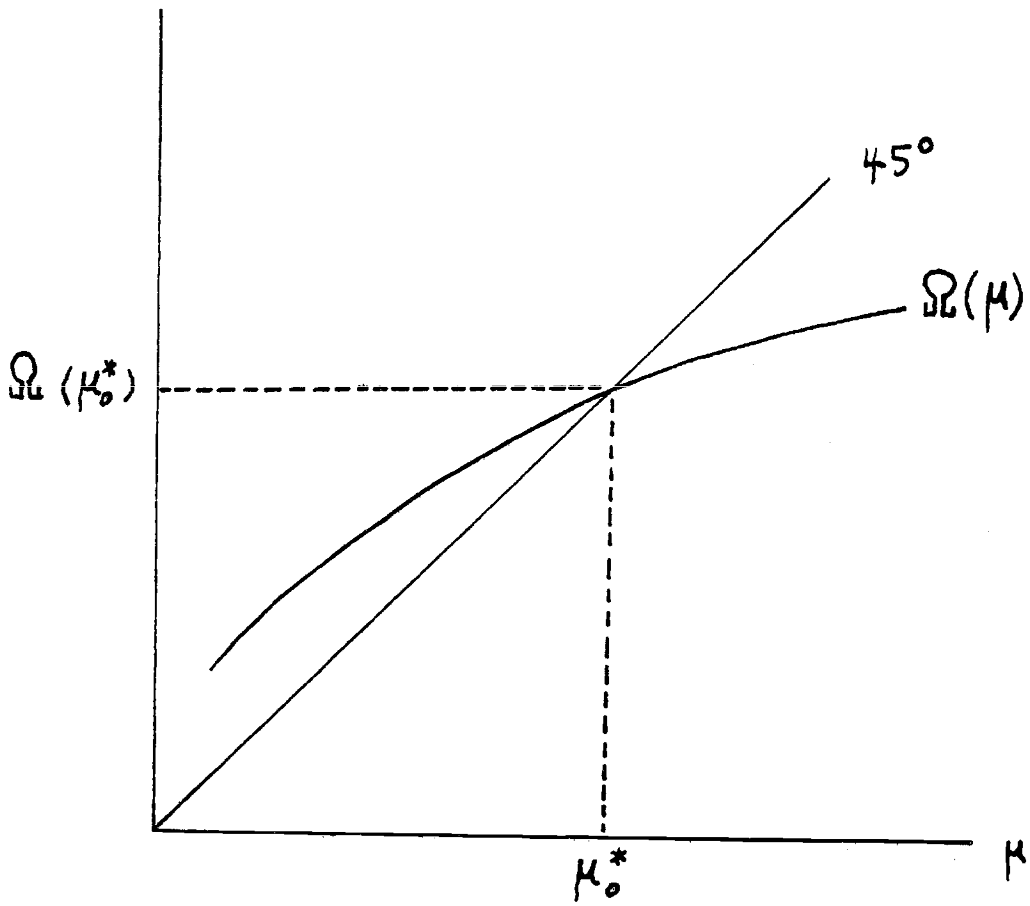

Figure 1

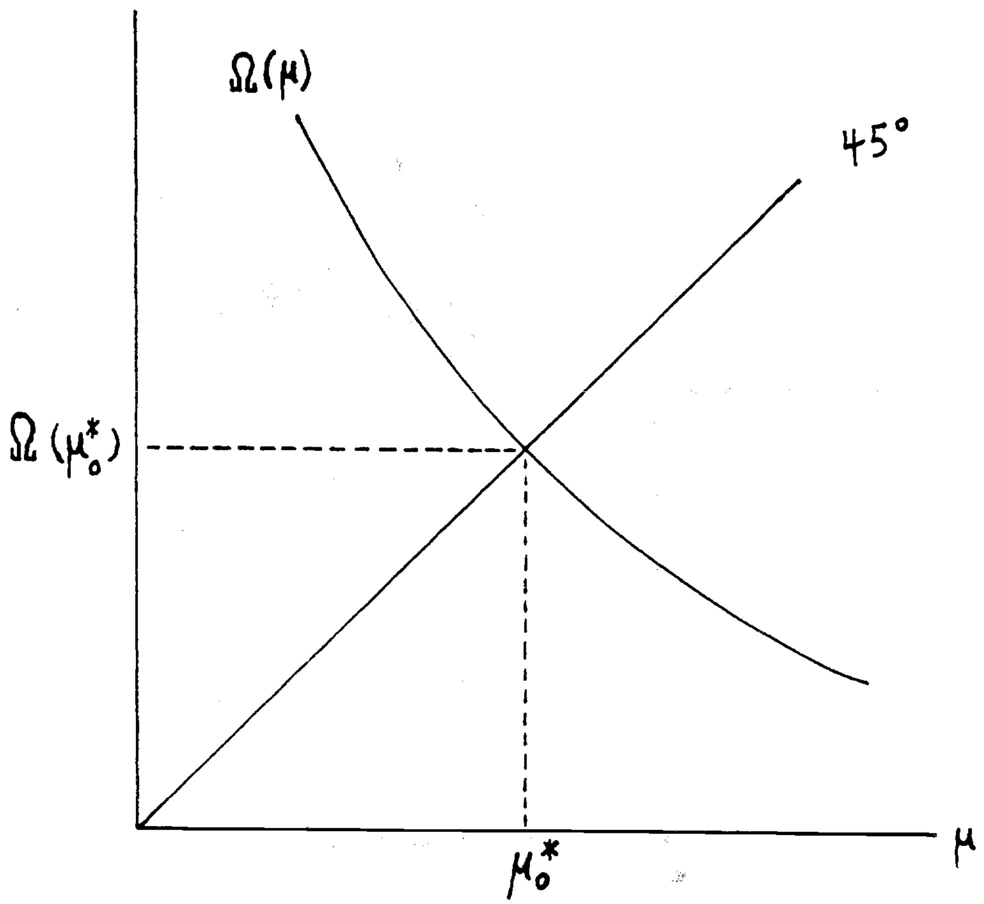

Figure 2

change in the expected inflation path shift $\Omega(\mu)$? When $R < 1$, a fall in π raises equilibrium p (see (32)). However, the elasticity of the integrand in the numerator of $\Omega(\mu)$ with respect to $\pi+\rho$ is

$$\frac{(1-\alpha)(1-R)^2 - (1+\sigma R)(1-\alpha)(1-R)}{R[1 - \beta(1-R) + \sigma R]}, \tag{38}$$

which is negative if $R < 1$. Thus, for a given μ, the numerator of $\Omega(\mu)$ rises as a result of disinflation. Since a rise in p lowers output of tradables, the denominator simultaneously declines, so that the $\Omega(\mu)$ schedule in figure 3 shifts upward. The postannouncement equilibrium shadow value μ_0^* given by (34) is therefore higher than the prior value given by (37).

In the case $R > 1$, p and π move in the same direction, given μ. It follows immediately from (37) that $\Omega(\mu)$ shifts downward upon the announcement of the disinflation scheme. While this case is not pictured, figure 2 indicates that the equilibrium multiplier falls to the level μ_0^* defined by (34). The disinflation program of course has no effect on figure 2 when $R = 1$, for in that case p is independent of π.

Armed with the foregoing information, one can use (34) and (35) as in section III to trace out the path of the external asset position. It is easy to verify that the results are qualitatively identical to those reported in that section . In particular, the case $R > 1$ is again characterized by an initial rise in consumption of both goods and in money holdings. The economy's subsequent path in this case involves a succession of current-account deficits.

What is most noteworthy in the present setting is the behavior of the real exchange rate. When $R < 1$, the initial fall in demand occasioned by the rise in the shadow value of wealth leads to a fall in p, i.e., a real depreciation. (Recall that $\pi_0 = \pi^*$.) Over time, the relative price of nontradables rises as inflation falls, demand recovers, and the current surplus dwindles. When

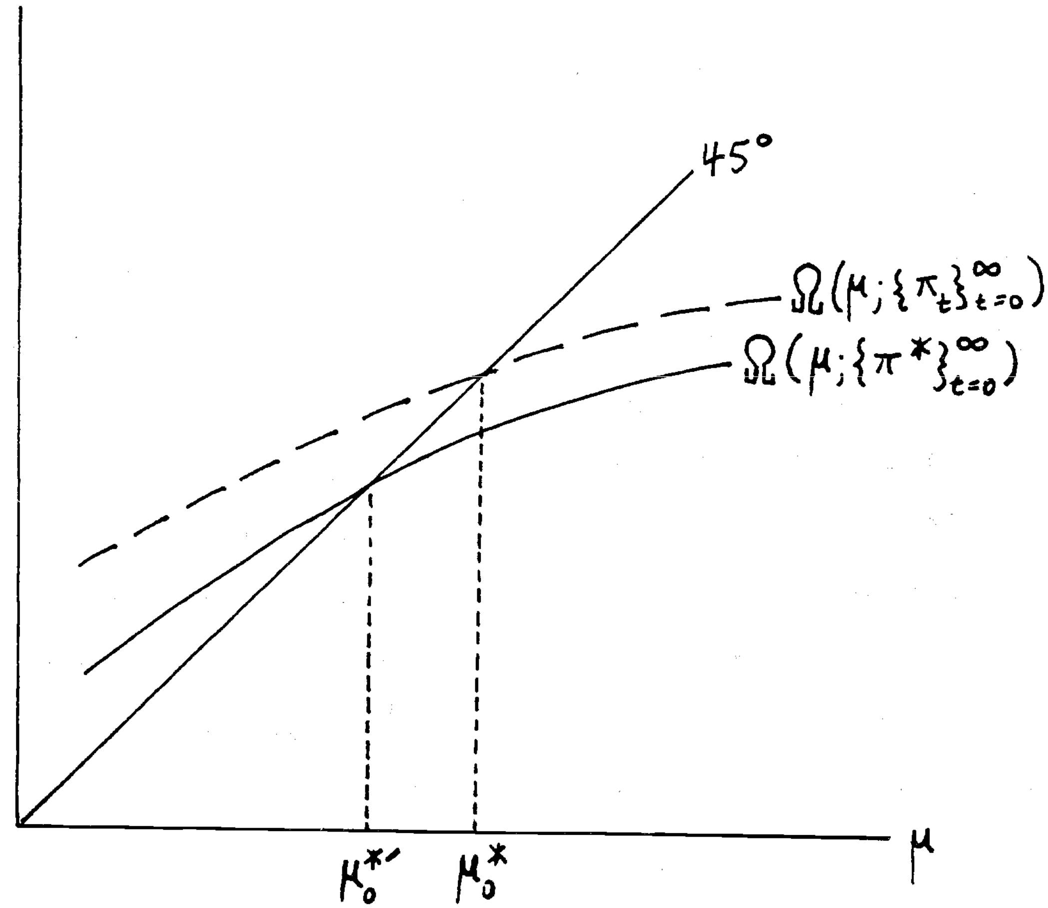

Figure 3

$R > 1$, there is an initial real appreciation, or rise in p, when disinflation is announced. This real appreciation accommodates the impact increase in the demand for nontradables, and it is reversed over time as the current deficit disappears.

Indeed, the only respect in which the present results contradict those of the single-good model involves the behavior of the transitional balance-of-payments when $R > 1$. As was just noted, after the initial real appreciation there is a steady decline in the relative price of nontradables as disinflation progresses. For a given exchange rate, a fall in p lowers the real-balance deflator, and so has an ambiguous net effect on the demand for nominal balances. The latter effect is negative when $R > 1$; during disinflation it counteracts and, if sufficiently strong, may even offset the direct increase in nominal money demand caused by the declining nominal interest rate. Thus, it is no longer the case that $R > 1$ implies an unambiguously positive balance of payments during disinflation. It turns out that for R sufficiently large, reserves may decline over time after the impact capital inflow occasioned by the announcement of disinflation. However, there is always a band above unity for R such that the ensuing sequence of current deficits is accompanied by a sequence of even larger capital-account surpluses, as before.[15] The conjunction of real appreciation, current deficit, and official reserve accumulation replicates the constellation of events accompanying the Southern Cone stabilization plans.

The results sketched above may again be viewed from the perspective of disinflation's effect on the expenditure-based domestic interest rate. Even when p rises over time after an initial decline, the net effect of disinflation is to raise the whole future path of the expenditure-based rate (see (38)). As before, this depresses absorption when $R < 1$ but stimulates it when $R > 1$.

The short-run real exchange rate effect of disinflation has now been clarified, but what of the long-run effect? In other words, how does the real exchange rate's level at the conclusion of the plan compare to its pre-plan level? The interesting answer is that the real exchange rate depreciates in the long run if it appreciates in the short run, and appreciates in the long run in the opposite case.

Figure 4 illustrates this result for the case $R > 1$, in which there is an impact real appreciation followed by a sequence of current-account deficits. The figure shows the economy's production possibilities frontier QQ together with the typical consumer's preferences over tradables and nontradables (i.e., isoquants for the subutility index $z(c^T, c^N)$). Before the announcement of the stabilization plan, the economy is at the initial equilibrium A with the real exchange rate equal to (minus) the common slope of QQ and $z_A z_A$ at A. A's position on QQ reflects the assumption that the initial net foreign asset position of the economy is zero. The announcement of disinflation raises expenditure above income and moves the economy to B, forcing a real appreciation to maintain equilibrium in the nontradables sector. At the conclusion of disinflation the economy is at C on a budget line that has now shifted within QQ. Because the economy borrows continuously along its transition path, national income measured in tradables falls short of national product by an amount equal to the foreign debt service. The long-run real depreciation is needed because absorption equals this lower income level once external balance is attained. Since 1982, when Southern Cone countries came under pressure to reduce external deficits, real exchange rates have indeed depreciated sharply.

VI. Conclusion

This paper has used an intertemporal maximizing framework to study a small open economy's response to a gradual, preannounced disinflation. The model employed draws on the Southern Cone experience of the late 1970s and early 1980s by postulating free capital mobility and a disinflation program

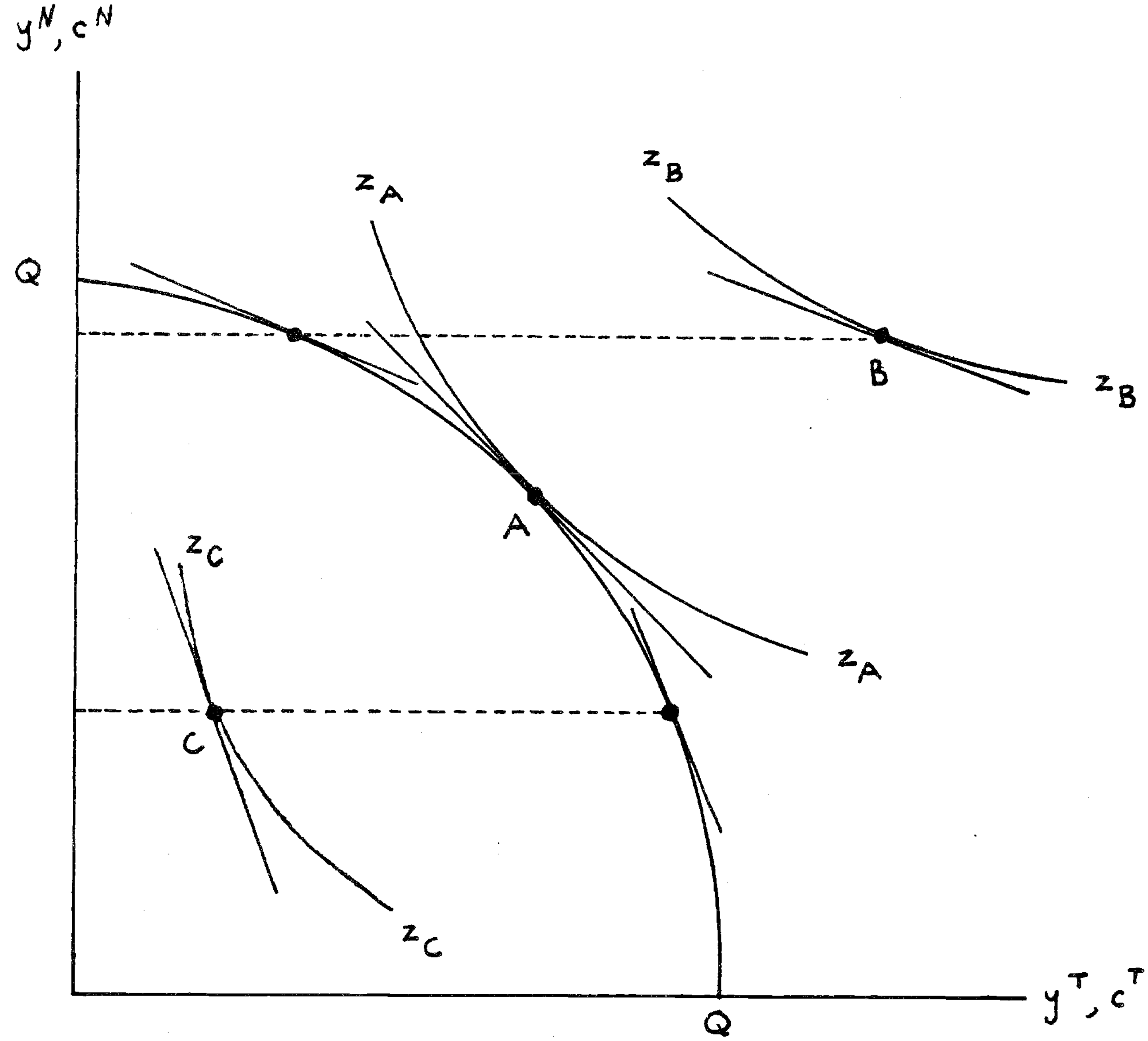

Figure 4

that operates through a phased reduction in the depreciation rate of a momentarily pegged exchange rate. While at best an impressionistic representation of the economies that underwent exchange-rate oriented stabilization programs, the model serves to elucidate the effect of disinflation on an expenditure-based interest rate corresponding to the domestic spending mix. This interest-rate effect, absent when disinflation is abrupt and permanent, allows the model to replicate the current deficits, reserve accumulation, and real exchange-rate appreciation that accompanied Southern Cone stabilization efforts.

It must be reiterated, however, that the model cannot provide a full explanation consistent with all facets of the Southern Cone expeience. For example, it does not explain the sustained and cumulative character of the real appreciations documented by Calvo (1983) and Harberger (1982). Nor can it address the possibility of policy-induced employment fluctuations, discussed by Buffie (1983). What the model does do is expose, in an austerely neoclassical equilibrium setting, a real effect of disinflation that one would expect to be relevant under a variety of assumptions about the economy's structure.

For the class of utility functions studied in the paper, the direction of disinflation's expenditure effect hinges on whether the marginal utility of consumption increases or decreases as real balances rise. It is somewhat disturbing that the model's predictions depend so strongly on this sign. A superior approach would model money's role directly, rather than simply postulating that real balances somehow yield utility. Attempts to derive "utility-of-money" functions from underlying transactions schemes (such as those in Brock (1974), Feenstra (1984), and Gray (1984)) yield little guidance concerning the relation between real money holdings and the marginal utility of consumption. Pending the development of money-demand theories more satisfactory than those available, it seems unreasonable to rule out any of the possibilities considered above.

Footnotes

* This paper is due in part to a stimulating suggestion of Robert Mundell. An earlier version was presented in seminars at the Universities of Minnesota, Rochester, and Western Ontario, and at the National Bureau of Economic Research 1983 Summer Institute in International Studies. Several participants in those seminars made valuable suggestions, particularly Assaf Razin, Lars Svensson, and Charles Wyplosz. The very helpful comments of three anonymous referees are also appreciated. All errors and opinions are mine, however. Financial support from the National Science Foundation is acknowledged with thanks.

1. Diaz Alejandro (1981) reviews the Southern Cone stabilization experience of the late 1970s. For a detailed discussion of Argentina's experience, see Calvo (1983); on Chile, see Edwards (1985) and Harberger (1982). Buffie (1983) includes a discussion of Argentina and Uruguay. Dornbusch (1984) surveys aspects of the Argentine and Chilean experiences, emphasizing the role of expected relative-price changes on consumer-durable and investment spending.

2. Alternative models of Southern Cone stabilization include Blejer and Mathieson (1981), Buffie (1983), Krugman (1980), Obstfeld (1984a), and van Wijnbergen (1983). See Calvo (1981), Djajic (1982), and Obstfeld (1981) for theoretical studies of the effect of once-and-for-all, unanticipated changes in a constant underlying inflation rate. Rodriguez (1981) analyzes the stability of policy rules that make the rate of exchange-rate crawl endogenous.

3. It should also be noted that the paper's assumption of unrestricted capital mobility limits its full applicability to Argentina and Uruguay, both of which had liberalized their domestic financial systems and capital accounts by the time exchange-rate preannouncement began. In contrast, the Chilean authorities initiated capital-account liberalization only in June 1979, the same month in which their preannounced exchange-rate crawl was terminated and the Chilean peso's U.S. dollar price was fixed.

4. Even when all changes in inflation are unanticipated and permanent, superneutrality can break down in models similar to Sidrauski's. Brock (1974, p. 774) presents one example; but there are others. The neutrality of one-time inflation surprises in this paper's model (as in Sidrauski's) stems from the assumed constancy of agents' subjective time-preference rates. Michener (1981) and Obstfeld (1981) descibe maximizing models in which money is not superneutral because time preference rates are endogenous rather than fixed. Hodrick (1982) studies the flexible exchange rate analogue of the single-good model developed below, noting that anticipated changes in monetary growth will in general cause current-account movements. He does not derive an explicit solution for the economy's path, however. For discussions of monetary nonneutrality in alternative models, see Begg (1980), Fischer (1979a), and Weiss (1980).

5. The assumption $\delta = \rho$ is the only possibility consistent with the existence of a stationary long-run equilibrium for the economy. If this assumption did not hold, the equilibrium consumption level and stock of foreign claims would be changing over time even if the inflation rate were expected to remain fixed forever. The nonconvergence phenomenon is avoided if an endogenous time-preference rate is postulated, as in Obstfeld (1981), or if individuals have uncertain lifetimes, as in Blanchard (1984).

6. Arriazu (1983, p. 181) summarizes the "basic idea" of a preannounced exchange-rate schedule as follows: "If a country wants to have a fixed rate system and it confronts a large fiscal deficit, it is clear that the end result would be reserve losses and periodic balance of payments crises --with devaluations. In these circumstances, if you cannot have a fixed rate but you want the advantages of a fixed rate system, in the sense of having more transparent markets, less uncertainty, and items like that, then one possibility is to proceed as follows: start by estimating how large the fiscal deficit is going to be and how much monetary base will be

created as a result of this and other factors. This allows an estimate of how large a flow demand for monetary base is required to be able to maintain balance of payments equilibrium, given the fiscal deficit.... The problem is, therefore, how to estimate the size of a devaluation needed to generate the required flow demand for base money to compensate for the effects of the fiscal deficit." Strictly speaking, the rule (10) differs from that described by Arriazu in that it is the rate of devaluation, rather than the deficit, that is the exogenous variable. In general, the problem of finding an inflation rate yielding a given level of real resources to the government can admit multiple solutions or no solution. It should be noted that in Argentina before 1981, some official reserve growth was apparently due to a rate of domestic credit growth that fell short of the rate of crawl (Calvo, 1983).

7. The precise rate of domestic credit expansion is irrelevant as far as the economy's real equilibrium is concerned; only the balance of payments is affected. It must be assumed, however, that the rate of credit growth does not exceed π by so large a margin that the public-sector intertemporal budget constraint, discussed in the next section, is violated. See Obstfeld (1984b) for a detailed discussion of this constraint in an open-economy context. In the present setting, the upper bound on the rate of domestic-credit growth is the nominal interest rate $\pi+\rho$.

8. Since it is never optimal for private consumption to be zero, the denominator of (15) is always positive (cf. (12)).

9. It is convenient to assume that the inflation path is differentiable. Note that the analysis applies equally to a situation in which the disinflation program and the possibility of foreign asset trade are introduced simultaneously (provided the economy is initially in a steady state). If capital movements were not allowed prior to the stabilization program, the initial private stock of net foreign claims, b_0, is zero.

10. If the stabilization program is accompanied by a declining path of government consumption, the current-account surplus will be smaller than it would have been if g had remained flat. This effect represents consumption smoothing by the private sector, financed entirely through private borrowing abroad.

11. There is an implicit assumption that the integral in the numerator of (19) converges.

12. Bruno (1976), Dornbusch (1983), and Obstfeld (1983) develop nonmonetary optimizing models in which the real interest rate relevant to consumers depends on both the world rate and expected changes in the relative price of nontradables or imports.

13. A similar device is used by Svensson and Razin (1983) to define within-period price indices in a nonmonetary optimizing model. The price index $P_z(.,.)$ corresponds to the ideal price index discussed by Samuelson and Swamy (1974). After the present paper had been completed, Rob Feenstra drew my attention to the very general treatment of money in the utility function by Samuelson and Sato (1984), in which the case discussed here is mentioned.

14. If the government consumed nontradable goods as well as tradables, its demand for the former would enter the reduced-form relative-price equation (32) with a positive partial derivative.

15. In order that there be a current deficit accompanied by a greater capital-account surplus, it must be true that $1 < R \leq [(1-\alpha)(1+\sigma)+(1-\beta)]/[1-\alpha(1+\sigma)-\beta]$ if $1-\alpha(1+\sigma)-\beta > 0$. If $1-\alpha(1+\sigma)-\beta \leq 0$, a current deficit is accompanied by a balance-of-payments surplus for any $R > 1$. The foregoing results are derived by combining equations (24), (28), and (32) to derive the reduced-form equation for $\ln(M/P^T)$, changes in which mirror changes in central-bank reserves. The parameter values for which the capital inflows phenomenon occurs seem quite reasonable.

References

ARRIAZU, R.H. (1983), "Panel Discussion on the Southern Cone," International Monetary Fund Staff Papers, 30, 177-184.

BEGG, D.K.H. (1980), "Rational Expectations and the Non-neutrality of Systematic Monetary Policy," Review of Economic Studies, 47, 293-303.

BLANCHARD, O.J. (1984), "Debts, Deficits, and Finite Horizons" (Working Paper, National Bureau of Economic Research, Cambridge, Massachusetts).

BLEJER, M.I. and D.J. MATHIESON (1981), "The Preannouncement of Exchange Rate Changes as a Stabilization Instrument," International Monetary Fund Staff Papers, 28, 760-792.

BROCK, W.A. (1974), "Money and Growth: The Case of Long Run Perfect Foresight," International Economic Review, 15, 750-777.

BRUNO, M. (1976), "The Two-Sector Open Economy and the Real Exchange Rate," American Economic Review, 66, 566-577.

BUFFIE, E.F. (1983), "Price-Output Dynamics, Capital Inflows, and Real Appreciation" (Working Paper, University of Pennsylvania).

CALVO, G.A. (1979), "On Models of Money and Perfect Foresight," International Economic Review, 20, 83-103.

CALVO, G.A. (1981), "Devaluation: Levels versus Rates," Journal of International Economics, 11, 165-172.

CALVO, G.A. (1983), "Trying to Stabilize: Some Theoretical Reflections Based on the Case of Argentina," in P. Aspe Armella, R. Dornbusch, and M. Obstfeld (eds.), Financial Policies and the World Capital Market: The Problem of Latin American Countries (Chicago: The University of Chicago Press).

DEATON, A. and J. MUELLBAUER (1980), Economics and Consumer Behavior (Cambridge, England: Cambridge University Press).

DIAZ ALEJANDRO, C.F. (1981), "Southern Cone Stabilization Plans," in W.R. Cline and S. Weintraub (eds.), Economic Stabilization in Developing Countries (Washington, D.C.: The Brookings Institution).

DJAJIC, S. (1982), "Balance-of-Payments Dynamics and Exchange-Rate Management," Journal of International Money and Finance, 1, 179-191.

DORNBUSCH, R. (1982), "Stabilization Policies in Developing Countries: What Have We Learned?" World Development, 10, 701-708.

DORNBUSCH, R. (1983), "Real Interest Rates, Home Goods, and Optimal External Borrowing," Journal of Political Economy, 91, 141-153.

DORNBUSCH, R. (1984), "External Debt, Budget Deficits, and Disequilibrium Exchange Rates" (Working Paper, National Bureau of Economic Research, Cambridge, Massachusetts).

EDWARDS, S. (1985), "Stabilization with Liberalization: An Evaluation of Ten Years of Chile's Experience with Free-Market Policies," Economic Development and Cultural Change, forthcoming.

FEENSTRA, R.C. (1984), "Functional Equivalence between Liquidity Costs and the Utility of Money" (Working Paper, Columbia University).

FISCHER, S. (1979a), "Anticipations and the Nonneutrality of Money," Journal of Political Economy, 87, 225-252.

FISCHER, S. (1979b), "Capital Accumulation on the Transition Path in a Monetary Optimizing Model," Econometrica, 47, 1433-1439.

GRAY, J.A. (1984) "Dynamic Instability in Rational Expectations Models: An Attempt to Clarify," International Economic Review, 25, 93-122.

HARBERGER, A.C. (1982), "The Chilean Economy in the 1970's: Crisis, Stabilization, Liberalization, Reform," in K. Brunner and A. Meltzer (eds.), Economic Policy in a World of Change, Carnegie-Rochester Conference Series on Public Policy vol. 17 (Amsterdam: North-Holland).

HODRICK, R.J. (1982), "On the Effects of Macroeconomic Policy in a Maximizing Model of a Small Open Economy," Journal of Macroeconomics, 4, 195-213.

KRUGMAN, P.R. (1980), "The Capital Inflows Problem in Less-Developed Countries" (Working Paper, Massachusetts Institute of Technology).

LIVIATAN, N. (1981), "Monetary Expansion and Real Exchange Rate Dynamics," Journal of Political Economy, 89, 1218-1227.

MICHENER, R.W. (1981), "Money, Growth, and the Theory of Interest" (Doctoral Dissertation, University of Chicago).

MICHENER, R.W. (1984), "The Monetary Approach to the Balance of Payments for a Small Country on Fixed Exchange Rates: A Perfect Foresight Optimizing Model," Review of Economic Studies, forthcoming.

OBSTFELD, M. (1981), "Capital Mobility and Devaluation in an Optimizing Model with Rational Expectations," American Economic Review, 71, 217-221.

OBSTFELD, M. (1983), "Intertemporal Price Speculation and the Optimal Current-Account Deficit," Journal of International Money and Finance, 2, 135-145.

OBSTFELD, M. (1984a), "Capital Flows, the Current Account, and the Real Exchange Rate" (Working Paper, Columbia University).

OBSTFELD, M. (1984b), "Speculative Attack and the External Constraint in a Maximizing Model of the Balance of Payments" (Working Paper, National Bureau of Economic Research, Cambridge, Massachusetts).

RODRIGUEZ, C.A. (1981), "Managed Float: An Evaluation of Alternative Rules in the Presence of Speculative Capital Flows," American Economic Review, 71, 256-260.

RODRIGUEZ, C.A. (1982), "The Argentine Stabilization Plan of December 20th," World Development, 10, 801-811.

SAMUELSON, P.A. and S. SWAMY (1974), "Invariant Economic Index Numbers and Canonical Duality: Survey and Synthesis," American Economic Review, 64, 566-593.

SAMUELSON, P.A. and R. SATO (1984), "Unattainability of Integrability and Definiteness Conditions in the General Case of Demand for Money and Goods," American Economic Review, 74, 588-604.

SIDRAUSKI, M. (1967), "Rational Choice and Patterns of Growth in a Monetary Economy," American Economic Review, 57, 534-544.

SVENSSON, L.E.O. and A. RAZIN (1983), "The Terms of Trade and the Current Account: The Harberger-Laursen-Metzler Effect," Journal of Political Economy, 91, 97-125.

VAN WIJNBERGEN, S. (1983), "The Crawling Peg, Capital Flows and the Real Exchange Rate in LDCs" (Working Paper, World Bank).

WEISS, L. (1980), "The Effects of Money Supply on Economic Welfare in the Steady State," Econometrica, 48, 565-576.