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Chapter Author: John E. Floyd

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PORTFOLIO EQUILIBRIUM AND THE THEORY OF CAPITAL MOVEMENTS

JOHN E. FLOYD · University of Toronto

1 INTRODUCTION

THE purpose of this paper is to construct a portfolio-balance theory of international capital movements and to incorporate it in a general-equilibrium model depicting a small, fully employed economy embedded in a large trading world. Although the analysis is primarily a refinement and extension of the author's previous work on international portfolio equilibrium [1,2], the results were anticipated at a number of points by Johnson [3], McKinnon and Oates [4], and undoubtedly others.[1]

To understand fully the nature and determinants of international capital movements it is necessary to approach the problem from the point of view of portfolio equilibrium. The flow of ownership claims to capital between countries cannot be satisfactorily explained without a simultaneous explanation of the international allocation of the existing stocks. The model that is developed in this paper incorporates both stock and flow equilibria. It is shown that disturbances of equilibrium involve both once-for-all stock adjustments comprising an international transfer of ownership of part of the existing stock of capital, and changes in the allocation of the ownership of the continuous flow of additions to the stock of capital through time. The former involve

NOTE: The work for this paper was done while the author was Associate Professor of Economics at the University of Washington.

[1] Although he does not use the concept of portfolio equilibrium in deriving the capital flows in his model, R. A. Mundell's work [5, 6, 7] cannot be ignored in contemporary discussions of the monetary theory of international trade. I am indebted to him in many ways.

temporary short-term changes in the balance of payments, while the latter involve permanent long-term changes.[2]

After developing the theory of portfolio equilibrium and capital movements in the next section, we extend the analysis in Section 3 to a full general equilibrium model of the domestic economy. As in the author's previous work, the full model contains three equations corresponding to the three sectors of the economy: (1) the asset sector; (2) the real-goods sector; and (3) the foreign-exchange sector. In Section 4 the model is applied to the question of the ability of the government of a small country to control the level of domestic prices through the use of monetary, fiscal, and commercial policy. The results under both fixed and flexible exchange rates are examined. Particular attention is paid to the ability of such a government to insulate the country from foreign inflation. Although the general conclusions that hold in the absence of international capital mobility are also found to hold here, the introduction of interdependence of the asset sectors of the domestic and world economies results in a process of adjustment that is fundamentally different from the adjustment process as currently understood.

2 CAPITAL MOVEMENTS IN A THEORY OF PORTFOLIO EQUILIBRIUM

IN defining the assets in the portfolio, we distinguish three broad categories of wealth: money balances, skills or human capital, and machines or physical capital.

The stock of monetary wealth is denoted by the stock of real money balances, while there are at least three ways in which one could define the stock of physical capital. First, we could define it as the total value of the stock of machines (or ownership claims to machines). Second, it could be defined as an index of the quantity of machines. Third, we could define it as the number of units of real income in per-

[2] Since our concern is solely with international trade in ownership claims to capital, we will assume that there are no movements of capital goods across international boundaries.

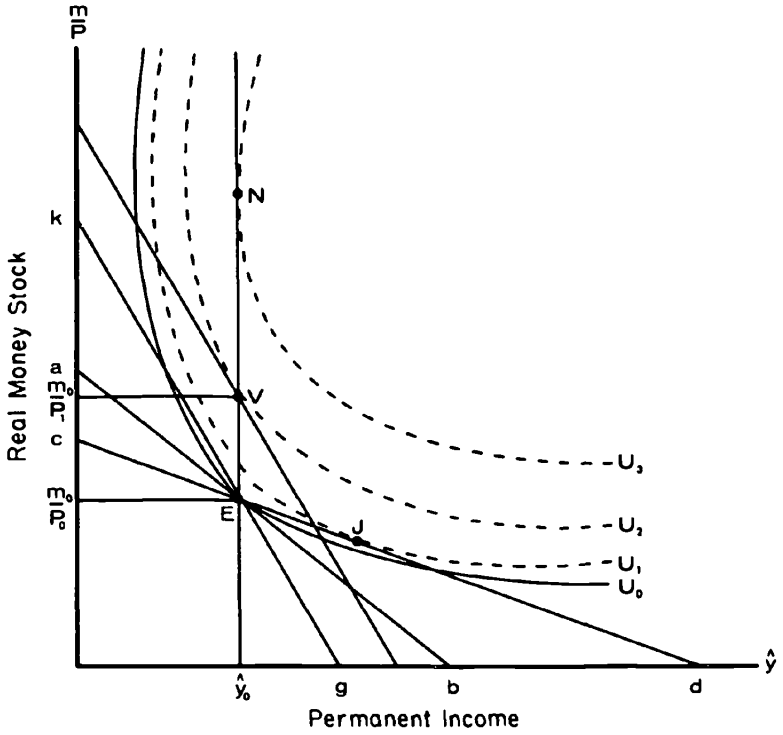
petuity equivalent to the income stream yielded by the stock of machines. Our choice is the last of these definitions, largely because it is the easiest one to work with. Under the first definition, the stock of capital would vary in inverse proportion with the interest rate, a problem that does not arise when we define the stock of capital as the perpetual income-stream yielded by the stock of machines.[3] The second definition is an inappropriate measure of wealth in the sense that an improvement of the productivity of machines would make the community wealthier without increasing measured wealth.

Given our measure of physical wealth, it is appropriate to measure human wealth by the number of units of real income in perpetuity equivalent to the income stream from labor at its current level of skill. Furthermore, to allow for the possibility of uncertainty, we measure capital by the "expected" or "permanent" income stream it yields. This measure incorporates the expectations of individuals as to the future yield of the skill or machines involved.

Let us first consider the theory of asset preference with reference to a closed economy, then extend the results to a two-country situation. Also, for the moment, let us assume that the markets for both human and physical capital are perfect so that the two forms of capital can be treated as a single homogeneous asset. A representative individual in the economy thus holds wealth in only two forms: real money balances, represented by $\frac{M}{P}$, and permanent income-streams from capital, represented by permanent income and denoted by $\hat{Y}$. The reader should note that $\hat{Y}$ is both a flow of expected income and a stock of expected income-streams. The individual's situation can be depicted on Figure 1. The real money stock is on the vertical axis and the level of permanent income, or stock of permanent income streams, is on the horizontal one. The individual's wealth is denoted by the line ab.

[3] Even when we measure capital by the perpetual income-stream it yields, the measure is not entirely independent of the rate of interest, except where the yield of the machine in question is constant in perpetuity. Where the yield varies over time, a change in the rate of interest will alter the weights attached to the yield at various times in the future. This will change the perpetual income-stream equivalent to any variable future income-stream. This problem also arises where capital is measured by the value of the machine, since the present value will also depend on the weights attached to the income from the machine at various points in the future. Thus, the stock of capital measured in this way would not vary exactly in proportion to the rate of interest.

FIGURE 1



Measured in units of real money balances, wealth can be expressed by

$$W = \frac{M}{P} + \frac{\hat{Y}}{\hat{i}}, \tag{1}$$

where, it will be noted, the price of a permanent income-stream in units of real money balances is the reciprocal of the rate of interest, denoted by $\hat{i}$. The individual will not be indifferent as to the mix of monetary and nonmonetary wealth in his portfolio. His tastes can be represented by a set of convex indifference curves. Given his wealth constraint ab, he will choose wealth-mix E. The interest rate facing him, given by the reciprocal of the slope of ab, is parametric.

While each individual can choose his desired wealth-mix, given his wealth restraint, all individuals taken together cannot. Suppose we

regard Figure 1 as applying to society as a whole. At the wealth-mix $\frac{M_0}{P_0}$ and $\hat{Y}_0$, there will be portfolio equilibrium at the interest rate $\hat{i}_0$. At the same wealth-mix and interest rate $\hat{i}_1$, as represented by the line cd, the desired wealth-mix would be J. While an individual, by himself, could trade money balances for capital and arrive at this point, all individuals taken together cannot. The attempt to purchase assets will drive the price of income streams up and the interest rate down, rotating the line cd about the point E until it becomes coincident with the line ab, and the interest rate becomes equal to $\hat{i}_0$. Likewise, it can be shown that every wealth-mix, as represented by a point in the two-dimensional space, has associated with it an interest rate which equals the reciprocal of the slope of the indifference curve through that point. The interest rate depends on the wealth-mix and on tastes:

$$\hat{i} = A\left(\frac{M}{P}, \hat{Y}\right). \tag{2}$$

This equation can be manipulated into the more convenient form

$$\frac{M}{P} = L(\hat{i}, \hat{Y}), \tag{3}$$

which is the familiar demand-for-money equation. For our purposes, it is sufficient to express permanent income as a function of current output $Z(Y)$, so that

$$\frac{M}{P} = L[\hat{i}, Z(Y)]. \tag{4}$$

In what follows, we will assume continuous full employment with output constant at Y_0. As is well known from contemporary monetary theory, the interest rate is fixed by the real forces in the economy (in simple models), so that the price level will adjust until the desired stock of money equals the actual stock. In Figure 1, for example, a full-employment interest rate of $\hat{i}_2$, as represented by the slope of the line kg and an initial wealth-mix of $\frac{M_0}{P_0}$ and $\hat{Y}_0$, will require a fall in prices and an upward shift of the wealth restraint until equilibrium is estab-

lished at the real money stock $\frac{M_0}{P_1}$ and the original full-employment level of output $\hat{Y}_0$.

Before proceeding further, it is appropriate to extend our results to include the possibility of a nonzero expected rate of inflation. The rate of interest that is relevant for the decision regarding the mix of wealth that the individual and the community will choose to hold is the money rate of interest which equals the real rate of interest plus the expected rate of increase in the price level. It is thus the money rate of interest that equals the reciprocal of the slope of the indifference curves in Figure 1.[4] If we denote the real rate of interest by i and the expected rate of increase of prices by R_p^*, we can express the money rate of interest as

$$\hat{i} = i + R_p^*, \tag{5}$$

and (4) can be rewritten

$$\frac{M}{P} = L[i + R_p^*, Z(Y)]. \tag{6}$$

These single-country results can be extended to incorporate imperfections in the market for human capital by the addition of a third axis. The three axes would then contain the real money stock, the permanent income-stream from physical capital, denoted by S, and the permanent income-stream from human capital, denoted by H. Because of imperfections in the market for human capital, human and physical capital are no longer perfect substitutes in portfolios. Given the wealth-mix in the economy as a whole, two real interest rates are generated—one on human capital, and one on physical capital. Only the latter interest rate concerns us, however, since it is assumed that no trade in human capital can occur within or between countries. The money rate of interest (which, as before, is the relevant one for portfolio decisions) is the real rate plus the expected rate of change of prices. The streams of income generated in the domestic economy by

[4] The maximum wealth position in the closed-economy case is given by the point N in Figure 1. This point, associated with a zero money rate of interest, can be attained by a negative rate of inflation equal to the real rate of interest, or by paying interest on money balances at the real rate. It is inappropriate to measure wealth in units of real money balances in this case, because the price of a unit of money balances is zero.

human and physical capital will depend upon the level of domestic output and the shares of output received by the two forms of capital. Under the assumption that the relative shares are constant (that the aggregate production function is Cobb-Douglas), the permanent income-streams from the two forms of capital will vary proportionately with permanent or expected output. Permanent output can be presumed to vary directly, though not proportionately, with current output. We can, therefore, express S and H as functions of Y:

$$S = f(Y) \tag{7}$$

and

$$H = g(Y). \tag{8}$$

The equation for portfolio equilibrium now becomes

$$i + R_p^* = A\left(\frac{M}{P}, S, H\right), \tag{9}$$

which, upon substitution of (7) and (8), yields

$$i = A\left[\frac{M}{P}, f(Y), g(Y)\right] - R_p^* \tag{10}$$

or

$$\frac{M}{P} = L[i + R_p^*, f(Y), g(Y)]. \tag{11}$$

In extending the analysis to include two countries, we assume that the domestic economy is so small in comparison with that of the rest of the world that the over-all desired wealth-mix in the world as a whole is not appreciably affected by the tastes of domestic residents, and the world stock of permanent income-streams is not appreciably affected by changes in the total stream of income generated in the domestic economy. This assumption, together with the assumption that the residents of both countries are indifferent as to whether they hold income streams from domestic or foreign-employed capital, implies that domestic residents can purchase or sell capital assets—i.e., income streams from physical capital—at what is essentially a fixed world

price.[5] The world real rate of interest, which is determined by conditions in the rest of the world, is thus virtually independent of what goes on in the domestic economy. A positive anticipated rate of domestic inflation would lead to a domestic money rate of interest in excess of the world real rate, and the domestic money rate would vary directly with these inflationary anticipations. Inflationary anticipations abroad would have no effect on the domestic money rate, because they do not erode the real value of the domestic nominal money stock or assets fixed in nominal value in domestic currency.[6]

As in the case of a closed economy, the demand for money will be a function of the real interest rate (now parametric), the anticipated rate of domestic inflation, and the stocks of permanent income-streams from physical and human capital owned by domestic residents. Unlike the closed-economy case, the stock of income streams from physical capital owned by domestic residents will now differ from the stock of income streams generated from physical capital employed in the domestic economy.

The stock of income streams from physical capital owned by domestic residents will normally comprise some fraction of the stock of income streams from domestically employed physical capital plus some fraction of the stock of income streams from physical capital employed abroad. Since we are assuming that the residents of both parts of the world are indifferent as to whether they receive domestically generated income-streams, or foreign-generated income-streams, from physical capital, the inhabitants of either country would not care

[5] The basic results of the paper are unaffected by the introduction of private intermediate assets and government bonds. All that happens when private intermediate assets are introduced is that individuals have a wider range of choice as to the form in which permanent income-streams are to be held. Those who wish to avoid risk of loss of the nominal value of equities can hold their wealth in the form of bonds issued by other individuals, who, for a price, are willing to assume this risk. The size of the permanent income-stream from capital is unaffected; only the ownership of it changes. The introduction of government debt has the same effect as the introduction of private intermediate assets, as long as the future tax liabilities on this debt are fully capitalized.

[6] The interest rate at which the public will capitalize the perpetual income-stream arising from physical capital goods will be unaffected by the rate of inflation, since the rental of the machine and its price will inflate in proportion. The interest rate at which the income-stream from a debt fixed in nominal value is capitalized will adjust to include the expected rate of inflation. The former is the real, and the latter the nominal, interest rate. I would like to thank Anthony Lanyi for forcing me to clarify my argument at this point.

where the income streams they own are generated. We suppose, for the sake of convenience and determinacy, that there is some minor fixed cost to holding wealth abroad, so that the net-debtor country will never hold income streams outside its own borders.[7] We further assume that the domestic economy is a net debtor with respect to the rest of the world: domestic residents own some fraction, Q, of the total stream of income generated at home and none of the stream of income generated abroad. The remainder of the domestically generated income-stream and the entire income-stream generated abroad are owned by foreign residents.

Since there is no trade in human capital, H can be treated as a function of Y, as in the closed economy. The stream of income from physical capital owned by domestic residents will be some fraction, Q, of the total stream of income generated from physical capital employed in the domestic economy. Thus S should now be written

$$S = Qf(Y). \tag{12}$$

Substituting (8) and (12) into (9) and rearranging, we obtain

$$\frac{M}{P} = L[i_0 + R_p^*, Qf(Y), g(Y)], \tag{13}$$

where i_0 is the parametrically determined world rate of interest. This equation can be rearranged to give

$$Q = Q\left[\frac{M}{P}, Y, R_p^*\right], \tag{14}$$

where the interest rate is incorporated into the constant terms and dropped as an argument. This equation indicates the condition of equilibrium in the asset sector of the model. Given the stock of real money balances which they are forced to hold, and given the expected

[7] The basic reason why income-streams from domestically employed capital would not be perfect substitutes in portfolios for income-streams from foreign-employed capital is that the absence of a perfect correlation between domestic and foreign outputs leads to a gain from diversification. If the levels of output at home and abroad were perfectly correlated, there would be no basis for distinguishing between the income-streams of the two parts of the world. The assumption that there is some minor fixed cost to holding wealth abroad represents an attempt to treat the countries as separate entities, while at the same time avoiding the problem of imperfect substitutability of the two types of income-streams in portfolios.

rate of inflation and the world interest rate which they face, domestic residents will maintain portfolio equilibrium by purchasing or selling capital assets at the fixed world price. Initially, such purchases or sales of assets will involve a reduction or increase in nominal cash balances under a fixed exchange rate as the government sells or buys foreign-exchange reserves in order to preserve the external value of the currency. We assume, however, that the government always offsets the impact on the domestic money supply of these pegging operations by undertaking the appropriate open-market operations. These open-market operations are assumed to leave wealth unaffected, since the government rebates to the public the interest on any securities it owns. It is further assumed that the stock of foreign-exchange reserves is not regarded by the public as a component of wealth.

Equation (14) implies an equilibrium level of the domestic net foreign balance of indebtedness. As usually defined, the balance of indebtedness is equal to the value in current monetary units of the net ownership by foreigners of domestic capital assets or domestically generated permanent income-streams from capital. In the present context, it can be written

$$D = \frac{(1 - Q)f(Y_0)}{i_0}. \tag{15}$$

Given the parametrically determined world rate of interest and the full-employment level of domestic output, an equilibrium level of Q implies an equilibrium level of D. Shifts in the level of Q occurring at a point in time as a result of changes in the real money stock, or in the expected rate of domestic price-inflation, involve a once-for-all change in the balance of indebtedness at that point in time. This implies a one-shot capital movement induced by portfolio adjustment that must be financed either by a change in the stock of foreign-exchange reserves or by a temporary movement of the exchange rate and a temporary surplus of exports over imports.

Since equilibrium must hold through time as well as at a point in time, there will be an equilibrium time-rate of change of Q,

$$\frac{dQ}{dt} = \lambda_m \frac{M}{P}(R_m - R_p) - \lambda_y \frac{dY_0}{dt} + \lambda_r \frac{dR_p^*}{dt}, \tag{16}$$

where

$$\lambda_m = \frac{\partial Q}{\partial M/P},\ \lambda_y = -\frac{\partial Q}{\partial Y},$$

and

$$\lambda_r = \frac{\partial Q}{\partial R_p^*} \quad \text{from equation (14),}$$

and

$$R_m = \frac{1}{M}\frac{dM}{dt}.$$

and

$$R_p = \frac{1}{P}\frac{dP}{dt}.$$

Noting that $\frac{f(Y_0)}{i_0} = P_k K^*$, where K^* is the quantity of domestically employed capital goods measured in some arbitrary units, and P_k is the real price of a unit of capital goods, we can express the differential of (15) with respect to time as

$$\frac{dD}{dt} = (1-Q)P_k\frac{dK^*}{dt} + (1-Q)K^*\frac{dP_k}{dt} - P_k K^*\frac{dQ}{dt}. \qquad (17)$$

The rate of change through time in the balance of indebtedness is related to, though not identical with, the international flow of capital per unit time, as customarily measured. The flow of capital through the balance of payments does not involve the capital gains on existing net foreign indebtedness, indicated by the term $(1-Q)K^*\frac{dP_k}{dt}$. This term must therefore be subtracted from $\frac{dD}{dt}$ to obtain the net capital inflow. Substituting (16) into (17) and letting $P_k\frac{dK}{dt} = I(i_0)$, the level of domestic investment, and $P_k K^* = \frac{f(Y_0)}{i_0}$, the expression for the do-

mestic net capital inflow becomes

$$F = -\frac{f(Y_0)}{i_0}\left[\lambda_m \frac{M}{P}(R_m - R_p) - \lambda_y \frac{dY_0}{dt} + \lambda_r \frac{dR_p^*}{dt}\right] + [(1 - Q)I(i_0)]. \quad (18)$$

If the terms in the first set of brackets to the right of the equality sign vanish – that is, if $\frac{dQ}{dt} = 0$ – the capital inflow will be a constant fraction of the existing flow of new domestic investment. If $\frac{dQ}{dt} \neq 0$, an additional component to the capital flow will comprise the net sale of assets to foreigners, or purchase from foreigners, consequent upon the equilibrium rate of change of Q through time.

3 CAPITAL MOVEMENTS AND PORTFOLIO EQUILIBRIUM IN A FULLY EMPLOYED ECONOMY

THE basic principles of asset equilibrium developed above can now be incorporated in a full-employment model depicting a small country embedded in a larger trading world. The full model contains three sectors, the asset sector, the income-expenditure sector, and the balance-of-payments sector, with an equation for each sector. The world real rate of interest and the price level in the rest of the world are parametric. Both domestic and foreign output are parametric by virtue of the assumption of full employment.

The conditions of equilibrium in the asset sector are given by equation (14) above. The equation determines an equilibrium level of Q for each level of the domestic nominal money-stock, prices, and expected rate of inflation. Since the equation holds at all points in time, domestic residents are also accumulating physical capital assets at an equilibrium rate relative to real money balances.

Equilibrium in the real goods market implies that planned saving minus planned investment equals the balance of trade:

$$Y - C = I + B_T, \quad (19)$$

where C is domestic consumption and B_T is the balance of trade. Although output is fixed at the full-employment level, domestic income is not. It is equal to the portions of output accruing to domestic residents. That is,

$$Y^* = Qf(Y_0) + g(Y_0), \tag{20}$$

where Y^* is the level of income and Y_0 is the full-employment level of output.

The domestic trade balance is a function of the level of domestic income and the ratio of the price of domestic goods to the price of foreign goods, with both prices measured in domestic currency. That is,

$$B_T = B_T[P/r, Qf(Y_0) + g(Y_0), \alpha_T], \tag{21}$$

where r is the exchange rate, α_T is a shift parameter, and the foreign price level is normalized at unity.

Similarly, the consumption function can be written as

$$C = \alpha + \beta[Qf(Y_0) + g(Y_0)], \tag{22}$$

where β is the marginal propensity to consume.

Upon substitution of (21), (22), and the investment function $I = I(i_0)$ into (19), we obtain the condition of equilibrium in the market for real goods. A shift parameter α_d is introduced to represent a shift in expenditure on domestic goods and the shift parameter in the consumption function is dropped:

$$Y_0 = \alpha_d + \beta[Qf(Y_0) + g(Y_0)] + I(i_0) + B_T[P/r, Qf(Y_0) + g(Y_0), \alpha_T]. \tag{23}$$

Finally, the balance of payments is equal to the sum of the balance of trade in goods and services and the net capital inflow minus the repatriation of the stream of income on domestically employed capital owned by foreigners. The latter equals $(1 - Q)f(Y_0)$. We can therefore write

$$B = B_T[P/r, Qf(Y_0) + g(Y_0), \alpha_T] - (1 - Q)f(Y_0) + (1 - Q)I(i_0) - \frac{f(Y_0)}{i_0}\left[\lambda_m \frac{M}{P}(R_m - R_p) - \lambda_y Y_0 R_{y0}\right] \tag{24}$$

where B is the excess supply of foreign exchange and $\frac{dR_p^*}{dt}$ is assumed to be equal to zero.[8]

The system of three equations, (14), (23), and (24), can be solved for the three variables, P, Q, and B or r, depending upon whether the exchange rate is fixed or flexible. At this point, let us simplify it by substituting the asset equation into the other two, obtaining

$$Y_0 = \alpha_d + I(i_0) + \beta g(Y_0) + \beta Q\left(\frac{M}{P}, Y_0, R_p^*\right) f(Y_0) + B_T[P/r, g(Y_0) + Q\left(\frac{M}{P}, Y_0, R_p^*\right) f(Y_0), \alpha_T] \quad \text{(I)}$$

and

$$B = B_T[P/r, g(Y_0) + Q\left(\frac{M}{P}, Y_0, R_p^*\right) f(Y_0), \alpha_T] - \left[1 - Q\left(\frac{M}{P}, Y_0, R_p^*\right)\right] f(Y_0) - \frac{f(Y_0)}{i}[\lambda_m \frac{M}{P}(R_m - R_p) - \lambda_y Y_0 R_{y0}] + \left[1 - Q\left(\frac{M}{P}, Y_0, R_p^*\right)\right][I(i_0)]. \quad \text{(II)}$$

The first equation gives the combinations of r and P for which both the asset markets and the real-goods market are in equilibrium, given the values of the exogenous variables M, R_p^*, α_d and α_T. The second equation gives the combinations of r and P for which the asset markets are in equilibrium and the balance of payments is in surplus by an amount B, given the values of the exogenous variables M, R_m, R_p, R_p^*, α_d, and α_T. If we hold $B = 0$ in this equation, it represents the combinations of P and r for which the asset markets and the foreign-exchange market are in equilibrium.

We proceed to solve the system for the relative changes in the equilibrium values of the dependent variables associated with changes in the exogenous variables. Differentiating equations (I) and (II) totally, holding $B = 0$, and translating the differentials into relative changes, we obtain

[8] The assumption that the expected rate of inflation is constant through time will be justified in some detail later on.

$$\frac{dP}{P} = \frac{1}{\psi + \theta} d\alpha_d + \frac{\delta}{\psi + \theta} d\alpha_T + \frac{\psi}{\psi + \theta} \frac{dr}{r} + \frac{\theta}{\psi + \theta} \frac{dM}{M} + \frac{\rho}{\psi + \theta} dR_p^* \quad \text{(I')}$$

and

$$\frac{dr}{r} = -\frac{\delta}{\psi} d\alpha_T + \frac{\psi + \xi}{\psi} \frac{dP}{P} - \frac{\xi}{\psi} \frac{dM}{M} - \left(\frac{\gamma}{\psi}\right) dR_p^* + \frac{\mu}{\psi}(dR_m - dR_p), \quad \text{(II')}$$

where

$$\psi = -\left(\frac{\partial B_T}{\partial P/r}\right) P/r,$$

$$\theta = \left(\beta + \frac{\partial B_T}{\partial Y^*}\right) f(Y_0)\lambda_m \frac{M}{P},$$

$$\delta = \frac{\partial B_T}{\partial \alpha_T},$$

$$\rho = \left(\beta + \frac{\partial B_T}{\partial Y^*}\right) f(Y_0)\lambda_R,$$

$$\xi = \left(1 + \frac{\partial B_T}{\partial Y^*}\right) f(Y_0)\lambda_m \frac{M}{P} - \frac{f(Y_0)}{i} \frac{M}{P} \lambda_m(R_m - R_p) - (I(i_0))\lambda_m \frac{M}{P},$$

$$\gamma = \left[\left(1 + \frac{\partial B_T}{\partial Y^*}\right) f(Y_0) - I(i_0)\right]\lambda_R,$$

and

$$\mu = \frac{f(Y_0)}{i_0} \lambda_m \frac{M}{P}.$$

The effects of shifts in the exogenous variables on the level of prices under a fixed exchange rate can be read directly from equation (I'), holding $\frac{dr}{r} = 0$. The effect on Q can be obtained by substituting this result into the total differential of (14).

The direction of the effects of shifts in the exogenous variables on the steady-state balance of payments under fixed exchange rates can be obtained by first solving equations (I') and (II') simultaneously

for $\frac{dP}{P}$ and $\frac{dr}{r}$, and then noting that the direction of the change in the equilibrium level of r is the opposite of the effect on the balance of payments at the initial exchange rate. The solutions for $\frac{dP}{P}$ and $\frac{dr}{r}$ are

$$\frac{dP}{P} = \frac{1}{\theta - \xi} d\alpha_d + \frac{dM}{M} + \frac{\rho - \gamma}{\theta - \xi} dR_p^* + \frac{\mu}{\theta - \xi} (dR_m - dR_p), \quad \text{(I'')}$$

and

$$\frac{dr}{r} = \frac{\psi + \xi}{\psi(\theta - \xi)} d\alpha_d - \frac{\delta}{\psi} d\alpha_T + \frac{dM}{M} + \frac{\rho(\psi + \xi) - \gamma(\psi + \theta)}{\psi(\theta - \xi)} dR_p^* + \frac{\mu(\psi + \theta)}{\psi(\theta - \xi)} (dR_m - dR_p). \quad \text{(II'')}$$

The first equation gives the effect of the shifts in the exogenous variables on the price level where the exchange rate is allowed to adjust. The second gives the change in the equilibrium exchange rate. If $\frac{dr}{r}$ in this equation is positive, then the shift in the exogenous variable in question will produce a deficit in the balance of payments under a fixed exchange rate. If $\frac{dr}{r}$ is negative, a surplus in the balance of payments will be produced when the exchange rate is fixed.

Since the level of prices in the model is determined, among other things, by the level of the nominal money stock, it is wholly inappropriate to treat the percentage rate of change of prices through time as exogenous. Obviously, it will be determined partly by the percentage rate of change of the nominal money stock. Moreover, just as the relative change in the level of prices associated with given changes in the exogenous variables is different under fixed and flexible exchange rates, so the percentage rate of change of prices through time will be different under fixed and flexible rates. The equilibrium percentage rate of change of prices under a fixed exchange rate is given by equation (I'), where the derivatives are taken with respect to time, rather than with respect to some arbitrary constant at a point in time. Letting $\frac{d\alpha_d}{dt} = \frac{d\alpha_T}{dt} = \frac{1}{r}\frac{dr}{dt} = \frac{dR_p^*}{dt} = 0$, we have $\frac{1}{P}\frac{dP}{dt} = \frac{\theta}{\psi + \theta}\frac{1}{M}\frac{dM}{dt}$, the dif-

ferential of which becomes

$$dR_p = \frac{\theta}{\psi + \theta} dR_m. \qquad (III a)$$

When the exchange rate is flexible and $\frac{1}{r}\frac{dr}{dt}$ therefore may be non-zero, the equilibrium percentage rate of change of prices through time is given by equation (I″), where the derivatives are taken with respect to time, rather than with respect to some arbitrary parameter at a point in time. Letting $\frac{d\alpha_d}{dt} = \frac{d\alpha_T}{dt} = \frac{dR_p^*}{dt} = 0$, as before, we have

$$R_p = R_m + \frac{\mu'}{\theta - \xi}\left(\frac{dR_m}{dt} - \frac{dR_p}{dt}\right).$$

This equation is satisfied by $R_m = R_p$, so that,[9] where the exchange rate is flexible,

$$dR_p = dR_m. \qquad (III b)$$

Upon substitution of either (III*a*) or (III*b*) into (I″) and (II″) we can obtain the relative change in the price level and the equilibrium exchange rate associated with changes in the level and percentage rate of growth of the nominal money supply or exogenous changes in expenditure on domestic goods and the balance of trade. If (III*a*) is substituted, we get the results under a fixed rate or adjustable peg; if (III*b*) is substituted, we obtain the results under a flexible rate.

A DIAGRAMMATIC TREATMENT

Equations (I) and (II) can be portrayed graphically, as in Figure 2. The exchange rate is on the vertical axis and the price level is on the horizontal one. The *PP* curve gives the combinations of the price level and exchange rate for which the markets for assets and real

[9] In both equations (III*a*) and (III*b*), the rate of change in prices through time is determined solely by the rate of expansion of the nominal stock of money. If we assume that the percentage rate of expansion of nominal money balances through time is a constant determined by government policy, then the percentage rate of growth of prices is also a constant. In this event, the assumption of a constant expected rate of change of prices through time is quite appropriate.

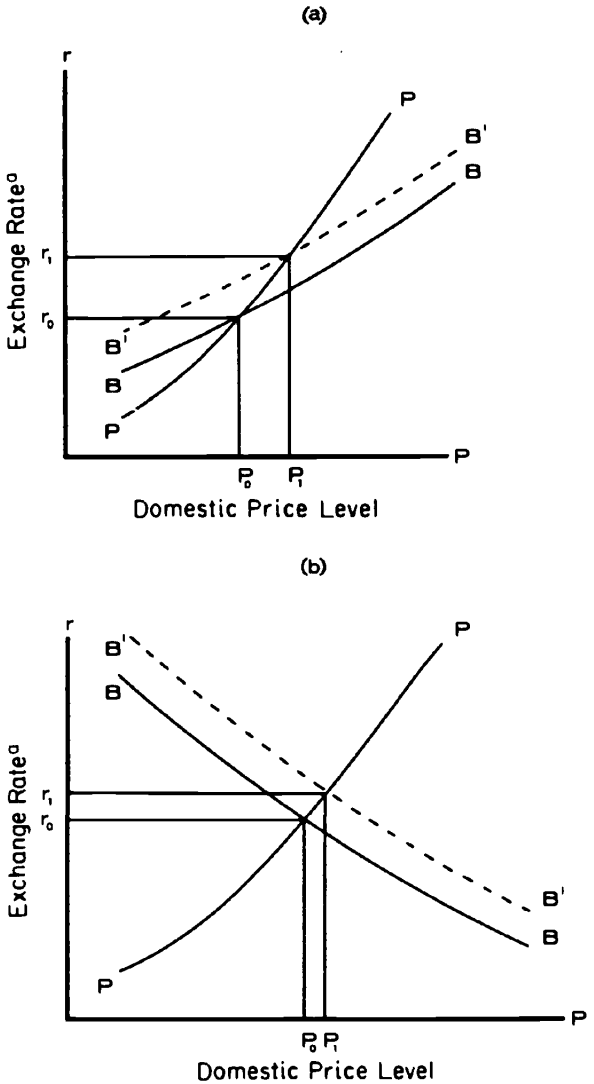
goods are in equilibrium; it represents equation (I). The *BB* curve gives the combinations of the exchange rate and the price level for which the markets for assets and foreign exchange are in equilibrium; it represents equation (II). The intersection of the two curves gives the full equilibrium of the model.

It is clear from the facts that both ψ and θ are positive, that the *PP* curve is positively sloped. This results from the fact that a devaluation improves the trade balance and thereby increases aggregate demand. Because $\xi \gtreqless 0$, the *BB* curve may be positively or negatively sloped, as in Figures 2(*a*) and 2(*b*), respectively. The sign of its slope hinges on the effect of a rise in the price level on the balance of payments. The curve *BB* is positively sloped if a rise in prices will deteriorate the balance of payments, requiring a rise in r (devaluation) to preserve equilibrium; it is negatively sloped if a rise in P will improve the balance of payments, requiring a fall in r (upward valuation) to maintain equilibrium. The usual view of economists is that a rise in the price level will hurt the balance of payments because it worsens the balance of trade. This view does not consider the effect of the price rise on the capital flow. The increase in the price level reduces the real money stock, leading to a portfolio adjustment which takes the form of sales of assets to foreigners against additions to foreign-exchange reserves. This leads to a reduction in the fraction of domestically employed physical capital owned by domestic residents and an increase in the fraction owned by foreign residents. This increase in the fraction owned by foreigners will imply, ceteris paribus, that a larger fraction of the flow of new domestic investment will be sold to foreigners. This will improve the balance of payments and may offset the effect of the rise in the level of prices on the balance of trade. The over-all effect of a rise in the price level on the balance of payments will therefore be ambiguous.[10]

Stability of the system implies that a rise in r improves the balance

[10] At this point, it is important to notice that the area above the *BB* curve represents the combinations of r and P for which there is a surplus in the balance of payments (since at any P, r is too high), and the area below the curve represents the combinations for which there is a deficit. Similarly, the area to the left of the *PP* curve represents conditions of excess demand in the real goods market (since at any r, P is too low), while the area to the right gives the combinations of r and P for which there is excess supply.

FIGURE 2



[a] Price of foreign currencies in units of domestic currency.

of payments. This result will occur as long as the BB curve is either negatively sloped, or positively sloped and flatter than the PP curve. In terms of the mathematics of our model, this requires that $\theta - \xi > 0$.

4 THE ROLE OF GOVERNMENT POLICY IN DETERMINING DOMESTIC PRICES

THIS section is devoted to an analysis of the comparative-static results, focusing first on the effects of monetary, commercial, and fiscal policies, and secondly upon the ability of the domestic government to control the price level and the balance of payments in the face of inflationary pressure from abroad.

MONETARY POLICY

There are two forms of monetary policy that are relevant in a world described by our model: a change in the rate of monetary expansion and a change in the level of the money stock. An increase in the rate of *real* domestic monetary expansion ($dR_m - dR_p$) will leave the PP curve unaffected, because it does not in any way affect aggregate demand. The anticipated rate of domestic inflation is assumed to be unaffected. Since both μ and ψ are positive, the BB curve will be shifted upward. The reason for this is that the greater flow of additions to the real money stock of domestic residents will require a greater flow of additions to their stocks of nonmonetary wealth in order to maintain portfolio balance continuously through time. This reduces the net capital inflow, worsening the balance of payments and raising, for every level of prices, the exchange rate that will produce equilibrium in the foreign-exchange market. These results are shown in Figures 2(a) and 2(b).

Two possibilities arise with respect to the effect of an increase in the rate of expansion of nominal money balances on the rate of expansion of real money balances. If the exchange rate is fixed, equation

(III*a*) implies that $dR_m - dR_p = \frac{\psi}{\theta + \psi} dR_m$ and, since θ and ψ are both positive, an increase in the rate of nominal money expansion will result in a less than proportional increase in the rate of real money expansion. If the exchange rate is flexible, equation (III*b*) implies that $dR_p = dR_m$, so that the rate of real monetary expansion is unaffected by the rate of nominal money expansion. In this case, there are no effects on the *BB* curve in Figures 2(*a*) and 2(*b*), and an increase in the rate of nominal expansion will raise the rate of price inflation and of reduction in the exchange value of the currency but will have no effect on the level of prices or on the level of the exchange rate, as long as the increased rate of inflation is unanticipated.

In the case of a fixed exchange rate, it can be seen from Figures 2(*a*) and 2(*b*) that the level of prices will be unaffected by the monetary policy. A long-run deficit in the balance of payments will result, as evidenced by the fact that the domestic currency is overvalued at r_0. There will be a continuous *rate of loss* of foreign-exchange reserves. Since the real money stock is unaffected at the point in time under consideration (only its rate of change through time is increased) there will be no portfolio adjustment.

If the exchange value of the domestic currency is reduced to remove the long-run disequilibrium, the trade balance will improve, aggregate demand will increase, and the price level will rise. This reduces the real money stock, leading to a once-for-all sale of assets to foreigners and, hence, a one-shot capital inflow, as portfolio equilibrium is reestablished. Thus, while an exchange rate of r_1 will produce long-run balance-of-payments equilibrium, it will be too high in the short-run while the resulting portfolio adjustment is occurring, and there will be a one-shot accumulation of foreign-exchange reserves.

As long as the exchange rate is held at r_0, however, no portfolio adjustment and no price changes will result from an increase in the rate of nominal money expansion. Changes in the rate of increase in the money supply are thus effective and costless ways of maintaining external balance in the short-run. They are not a costless way of maintaining external balance in the long run, however, for two reasons.

First, any increased rate of expansion of the nominal money stock, and the associated increased rate of expansion of prices, will eventu-

ally become anticipated and the *expected* rate of inflation will increase. This will make money balances less attractive than other assets and lead to a net purchase of assets abroad by domestic residents. Since the community's capital assets are increased in exchange for foreign-exchange reserves (which are not a part of wealth), permanent income and aggregate demand will increase. The *PP* curve will thus shift to the right. This is indicated by the fact that ρ, ψ, and θ are positive in equation (I'). The effect of the increase in the expected rate of inflation on the balance of payments at the initial level of prices is ambiguous. The increase in Q resulting from the purchase of capital abroad will reduce the flow of repatriated income to foreigners and improve the balance of payments. This effect may be more than offset, however, by the reduction in the flow of sales of new capital to foreigners, resulting from the fact that foreigners now own a smaller equilibrium share of the stock of domestically employed capital. The *BB* curve can therefore shift either up or down. The increase in the rate of monetary expansion would thus raise the domestic level of prices if the resulting increase in the *rate* of inflation were anticipated, and the stability of domestic prices would thereby be sacrificed in controlling the balance of payments by manipulating the rate of nominal money expansion. Furthermore, since the *BB* curve may shift in either direction, it is uncertain whether an increase in the rate of monetary expansion would, under these circumstances, improve the balance of payments at the initial exchange rate. The second reason why manipulation of the rate of monetary expansion would lead to longer-term changes in prices is that a higher rate of change of prices for some period implies a higher level of prices at the end of that period.

An increase in the level of the nominal money stock at a point in time will increase the level of aggregate demand and shift the *PP* curve to the right, as evidenced by the fact that ψ and θ are positive in equations (I') and (II'). This result follows from the fact that the rise in M stimulates a purchase of securities abroad in return for foreign-exchange reserves. Permanent income rises and, with it, aggregate demand and the price level. It should be noted that the rise in prices will, under conditions of constancy of the exchange rate, be less than proportional to the increase in the nominal money stock, so that the real money stock will increase. This result follows from the fact that the rise in the price level not only reduces aggregate demand for the

same reason that the rise in M increases it, but reduces it, in addition, by worsening the balance of trade.

Because $\xi \gtreqless 0$, an increase in the nominal money stock may have either effect on the BB curve. The increase in permanent income resulting from the rise in Q will lead to a reduction in the income from domestically employed capital repatriated abroad. This will tend to improve the balance of payments. However, the fall in $(1 - Q)$ will also reduce the fraction of the current flow of new investment being sold to foreigners, tending to deteriorate the balance of payments.

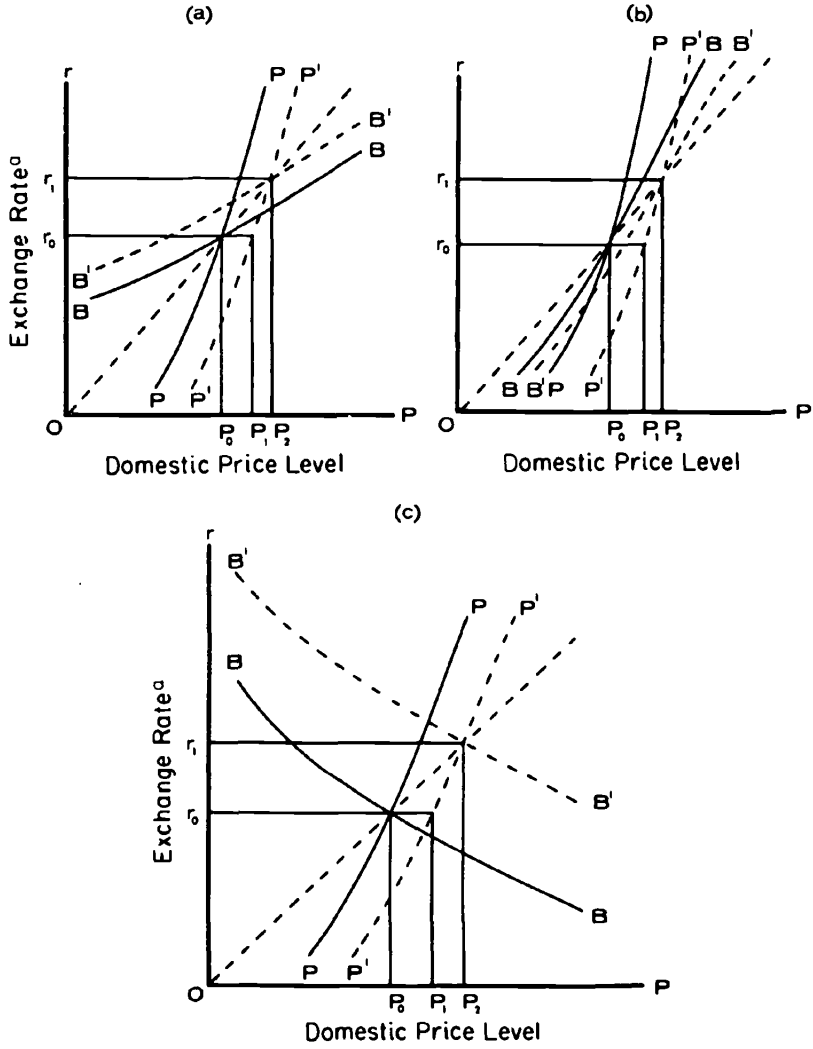
As can be seen from an examination of Figures 3(a), 3(b), and 3(c), the price level will rise from P_0 to P_1 if the exchange rate is fixed. On the basis of the directions of the shifts of the PP and BB curves, it is not possible to say whether the balance of payments would improve or deteriorate, whether the equilibrium exchange rate would be higher or lower, or whether the price level would rise, on balance, if the exchange rate were flexible. However, from equations (I″) and (II″), the changes in the equilibrium levels of P and r associated with a relative change in M can be shown to equal

$$\frac{dP}{P} = \frac{dr}{r} = \frac{dM}{M}.$$

This implies that the shifts in the PP and BB curves will be such that the equilibrium combinations of P and r will always fall on a ray through the origin.

An increase in the level of the money stock will thus produce a long-run deficit in the balance of payments. The change in the price level at the initial exchange rate is associated with a once-for-all purchase by domestic residents of capital assets from foreigners, financed by a one-shot decline in the stock of foreign-exchange reserves. The domestic foreign-exchange authority will also suffer thereafter a continuous rate of decline in the stock of foreign-exchange reserves through time. If the foreign-exchange peg is adjusted upward to r_1 to eliminate the deficit, the price level will rise further to P_2, lowering the real money stock to its initial level and wiping out both the portfolio adjustment and the long-term flow deficit in the balance of payments.

FIGURE 3



[a] Price of foreign currencies in units of domestic currency.

It is clear that, if the exchange rate is flexible, the increase in the nominal money stock merely results in a proportional rise in the level of domestic prices and a proportional fall in the external value of the domestic currency.

We can conclude that the government, through manipulation of the level of the money stock, has full control over the price level under a flexible exchange rate and at least some control under a fixed rate. This control is limited, in the case of a fixed exchange rate, by the government's willingness and ability to have its foreign-exchange reserves fluctuate.

The only reason why the domestic government has any control at all over the price level under a fixed exchange rate is that a rise in the nominal money stock results in a purchase of productive assets abroad in return for "unproductive" foreign-exchange reserves, leading to a change in income, consumption, and aggregate demand. Surely this overstates the change in wealth, since foreign-exchange reserves should, to some extent, be considered as wealth. The fact that the reserves are held involuntarily, however, implies that the members of the community, as individuals, would not choose to hold them if confronted with the alternative of trading them for capital. Thus, while a reduction of these reserves in return for income streams from physical capital would increase wealth, it would do so by less than the value of physical capital assets obtained. The changes in the price level under fixed exchange rates would therefore presumably be much smaller than indicated in the above analysis.[11]

COMMERCIAL POLICY

The term commercial policy refers to policies which directly affect exports and/or imports. A government-induced reduction in expenditure on imports results in an improvement of the trade balance and can be interpreted in our model as a positive change in α_T. Since

[11] If one was to assume that the level of wealth is unaffected by a change in the stock of foreign-exchange reserves, the *PP* curve would become a ray through the origin and would not shift with changes in the level of the money stock. Aside from the fact that the level of domestic prices would be independent of the domestic money stock under a fixed exchange rate, the results obtained earlier would still hold.

δ, ψ, and θ are positive, the effect will be to shift the *PP* curve to the right and the *BB* curve down. The improvement of the trade balance increases aggregate demand, raises prices, and improves the balance of payments at the initial exchange rate. The rise in prices reduces the real money stock and leads to a sale of capital assets to foreigners by domestic residents as portfolio equilibrium is reestablished. There will thus be a one-shot increase in the stock of foreign-exchange reserves in the short-run, as well as a continuous rate of accumulation through time, thereafter. To determine which way the price level will move if the exchange rate is allowed to adjust, we must refer to equations (I″) and (II″). It can be seen that for any given change in α_T

$$\frac{dP}{P} = 0 \text{ and } \frac{dr}{r} = -\frac{\delta}{\psi} < 0.$$

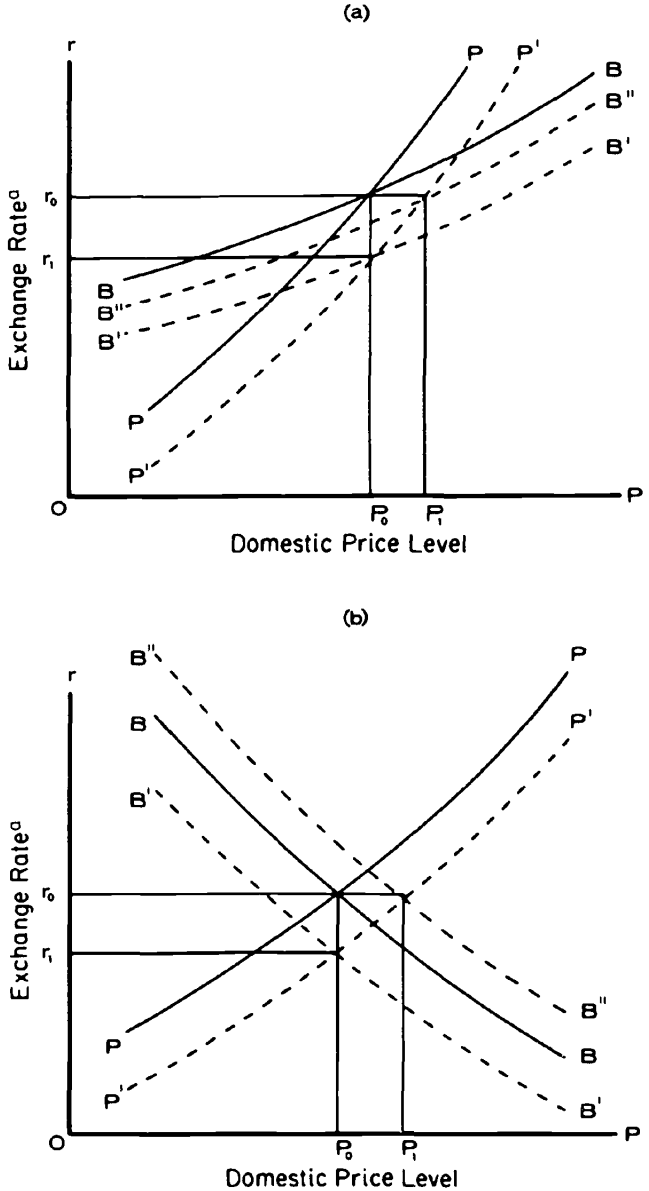
As shown in Figures 4(*a*) and 4(*b*), the commercial policy can be viewed as shifting both curves downward by the same amount. If the exchange rate is flexible (or is adjusted downward to eliminate the surplus), the balance of trade, flow of capital, stock of capital domestically owned, and domestic price level all remain at (or return to) their initial positions.

FISCAL POLICY

Finally, we will define fiscal policy as a government-induced shift in the domestic demand for domestically produced goods.[12] An expansionary shift is represented by a positive change in α_d in our model. Aggregate demand increases and the *PP* curve shifts to the right. The *BB* curve remains unchanged because the balance of trade is, by assumption, unaffected. A rise in the price level occurs at the initial exchange rate, reducing the real money stock and leading to a one-shot sale of capital assets to foreigners. This short-run accumulation of foreign-exchange reserves will be followed in the long run by either accumulation or decumulation, depending upon whether the *BB* curve is positively or negatively sloped. If the exchange rate is flexible, its

[12] If the demand for foreign goods is also directly affected, we would interpret the policy as a combination of fiscal and commercial policy.

FIGURE 4



[a] Price of foreign currencies in units of domestic currency.

long-run equilibrium level may be higher or lower. But since the price level always rises and a one-shot capital inflow always occurs, the short-run position of the rate will always be below its long-run position.

FOREIGN INFLATION AND THE DOMESTIC ECONOMY

We can now analyze the effects of inflation abroad on the domestic price level and the ability of the government to offset it. A once-for-all increase in the nominal money stock in the rest of the world, occurring either at a point in time or over an interval of time, will lead to a temporary fall in the world interest rate and an increase in investment. This drives up the foreign price level, returning the interest rate to its initial level and eliminating the increase in investment. Since the world interest rate does not ultimately change, the level of domestic investment will remain at (or return to) its former level. The rise in the foreign price level will lead to an increase in domestic exports and a reduction in imports. This shifts the BB curve down and the PP curve to the right, as in Figures 4(a) and 4(b). The results are identical with those of a positive shift of α_T, so as we have already shown, an appreciation of the domestic currency from r_0 to r_1 will reestablish equilibrium without a change in the domestic price level. The domestic government will thus have no problem of inflation in the face of inflation abroad as long as the exchange rate is flexible. Since none of the real variables, at home or abroad, are affected, there will be no portfolio adjustment.

As shown in Figures 4(a) and 4(b), under a fixed exchange rate the improvement of the trade balance will create excess aggregate demand in the domestic economy and increase the price level from P_0 to P_1. The rise in the domestic price level increases imports relative to exports, moderating the improvement in the balance of trade induced by the rise in prices abroad. In addition, it reduces the real money stock, leading to a one-shot sale of assets abroad. In the long run, the fall in the fraction of domestically employed capital assets owned domestically leads to a rise in the proportion of new domestic investment being purchased by foreigners, and results in an increase in the continuous inflow of capital.

The domestic government is now confronted with two problems: a problem of inflation, and the problem of a payments surplus. The latter problem is significant because the surplus implies that wealth is being transferred to other countries every time a dollar of foreign-exchange reserves is accumulated.

The continuous payments surplus can be relieved for a short period by an increase in the rate of monetary expansion, which would—in order for portfolio equilibrium to be maintained continuously through time—reduce the flow of sales of capital assets abroad. This would shift the BB curve to BB'' in Figures 4(a) and 4(b), equilibrating the long-term balance of payments. However, nothing would be done to reverse the one-shot gain of foreign-exchange reserves associated with the portfolio adjustment. Nor would there be any immediate effect on the domestic price level.

The balance-of-payments problem can better be handled by an increase in the level of the money stock at a point in time or over an interval of time. This would reduce the steady-state-equilibrium surplus in the balance of payments and create a portfolio adjustment that would bring about a net purchase of assets and a one-shot reduction in the stock of foreign-exchange reserves. The payments surplus, both short run and long run, will be offset when Q, the fraction of domestically employed assets owned by domestic residents, has returned to its initial (pre-foreign-inflation) level. For this to occur, all real variables must return to their initial preinflation levels. The fact that the balance of trade must return to its initial level implies that the domestic price level must rise proportionately with the initial rise in the foreign price level. For the real money stock to be returned to its preinflation level, therefore, the domestic nominal money stock must be increased proportionately with the initial rise in the foreign money stock. The domestic government has validated the inflationary pressure on the domestic economy from abroad by increasing the domestic money stock in proportion. The problem with this policy is that it sacrifices the objective of eliminating the inflation in favor of eliminating the surplus in the balance of payments.

To eliminate the rise in the price level would require a contraction of the nominal money stock at a point in time or over an interval of time. The fall in prices is accomplished, however, at the cost of fur-

ther capital inflows in both the short run and long run and a further rise in the stock of foreign-exchange reserves.[13] The reason for this is that the reduction in the money stock leads to a sale of capital assets abroad in order to maintain portfolio equilibrium, resulting in a further short-term capital inflow and accumulation of foreign-exchange reserves. The resulting fall in Q and equivalent increase in $(1 - Q)$ increases the fraction of the flow of current domestic investment being sold to foreigners, further accentuating the long-term capital inflow and the rate at which foreign-exchange reserves will accumulate in the long run.

An alternative policy would be to attempt to control the domestic price level by reducing government expenditure on domestic goods. This would reduce aggregate demand, shifting the *PP* curve to the left in Figures 4(*a*) and 4(*b*). If there was no leakage to imports, the *BB* curve would be unaffected. The price level would fall, eliminating for the time being the problem of inflation. The real money stock would rise, leading to a portfolio disequilibrium that would be eliminated by a purchase of assets abroad by domestic residents. This would cause a one-shot loss of foreign-exchange reserves that would tend to offset the initial accumulation consequent upon the foreign inflation. The government could, therefore, accomplish its objective of reducing the price level and, at the same time, reduce its excess stock of foreign-exchange reserves. In the long run, however, the surplus in the balance of payments and the *rate* of accumulation of reserves may either increase or decrease, depending upon whether the *BB* curve is positively or negatively sloped. Thus, while the short-run balance-of-payments problem is eliminated, this policy could accentuate the long-run balance-of-payments problem. It should be noted, in addition, that if the foreign inflation continues over a long period, this method of control over the domestic price level will, in the long run, imply regular additional cuts in government expenditure. Such a contraction of the government sector may be unacceptable.[14]

Finally, the government could prevent the foreign inflation from

[13] If the public regards a dollar's worth of foreign-exchange reserves as equivalent in portfolios to a dollar's worth of capital, it would not be possible to reduce the price level by reducing the nominal money stock.

[14] The alternative fiscal course of increasing taxes operates through effects on wealth, which are ruled out in the model used here.

raising the domestic price level and causing an inflow of capital by applying direct controls to the trade balance. This would have the same effect on prices and the balance of payments as a devaluation. Indeed, it is a devaluation which is not applied to all goods in proportion to their prices, but rather to individual commodities on a selective basis.

5 CONCLUSIONS

THE central concern here has been the construction of a portfolio-balance model of international capital movements and its application to a small, fully employed economy embedded in a large trading world. The paper's main contribution lies in its ability to explain both the international allocation of the existing stock of ownership claims to physical capital and the international allocation of the flow of additions to that stock in a single model.

A major conclusion that arises out of this formulation is that there are two distinct types of international movements of ownership claims to capital: first, once-for-all portfolio shifts arising from changes in the level of the nominal money stock or the level of prices at a point in time; and second, continuous capital flows through time arising out of the requirement that portfolio equilibrium be maintained through time in the face of positive (or negative) rates of expansion of the nominal money stocks, prices, and the level of real output. The treatment of international capital movements as a function of interest-rate differentials, a formulation that is common in much of the current literature, is inconsistent with the theory of portfolio equilibrium developed in this paper.

The effects of monetary and fiscal policy differ in fundamental ways from the standard zero-capital-flow analysis. The usual theorem that an increase in the nominal money stock results in a proportional rise in the domestic price level and, if the exchange rate is flexible, in a proportional depreciation of the domestic currency, still holds, as does the theorem that an increase in the money stock or an expansionary fiscal policy will result in a rise in prices and a deficit in the balance of payments. But the details of the process by which these results arise

are fundamentally different. In the analysis assuming zero capital flow, an increase in the nominal money stock results in a temporary fall in the interest rate, which is removed by a proportional rise in prices. The balance of payments deteriorates via a worsening of the balance of trade. If the exchange rate is flexible, the domestic currency falls in inverse proportion to the increases in the money stock and price level, eliminating the deterioration of the trade balance and the balance of payments deficit. Once the assumption of zero flow of capital is dropped and interdependence between domestic and foreign portfolio equilibria is introduced, a rise in the money stock does not result in a proportional rise in the price level at the initial exchange rate. It results in a portfolio disequilibrium that is resolved by a purchase of assets abroad. The interest rate does not change. The only reason that the price level rises at all is that the sale of foreign-exchange reserves for capital assets raises wealth, and this raises spending. To the extent that the domestic price level rises, the trade balance deteriorates; and to the extent that foreigners now own a smaller equilibrium fraction of the stock of domestically employed capital, they will be purchasing a smaller fraction of the flow of new additions to that capital stock. On both these counts, the balance of payments will deteriorate in long-run equilibrium. This deterioration is accentuated in the short-run by the one-shot purchase of capital required to maintain portfolio equilibrium. Where the exchange rate is flexible, the depreciation required to eliminate the payments deficit puts upward pressure on prices, which reverses the portfolio adjustment resulting from the rise in the nominal money stock. Prices rise until the real money stock has returned to its initial level, at which point the short-term portfolio adjustment and the increase in the long-term capital flow are completely reversed. The deterioration of the trade balance resulting from the rise in prices is prevented by the depreciation of the currency. All real variables are thus unaffected by the monetary expansion: only the nominal magnitudes, the price level and the exchange rate, are affected.

In the typical models where no trade in ownership claims to capital is allowed, a change in the rate of monetary expansion changes only the rate of price change through time and the rate at which the balance of payments is deteriorating. The introduction of trade in ownership claims to capital and the specification of conditions of portfolio

equilibrium through time result in a direct relation between the rate of monetary expansion and the level of the balance of payments. More specifically, if the rate of expansion of the nominal stock of money is increased, and domestic residents are therefore being forced to add to their stock of money balances at a more rapid rate, the maintenance of portfolio equilibrium through time will require that they add to their ownership of capital at a higher rate. This will result in a greater flow of purchases of ownership claims to new capital from foreigners and a deficit in the balance of payments under a fixed exchange rate. Since aggregate demand and the level of prices are unaffected, changes in the rate of monetary expansion are a simple way of maintaining balance in foreign payments in the short run. Such changes will not be effective in the long run, both because changes in the *rate* of price increase will become capitalized into expectations, and because a change in the *rate* of price increase will result in a different, and possibly undesirable, level of prices at some time in the future.

Finally, the results of this paper suggest that the conflict between domestic and foreign stability inherent in systems of fixed exchange rates and adjustable pegs may pose even greater problems than is currently thought. Since changes in the exogenous variables in the system result in short-term portfolio shifts, as well as long-term "fundamental" disequilibria, one might expect a rather variable path of balance-of-payments adjustment to exogenous changes. Substantial short-term movements of capital among countries may be caused by nonspeculative forces alone. Since we know nothing about the timing of these short-term portfolio adjustments, nor about speculative capital movements that might accompany them, the problem of predicting the equilibrium level of the exchange rate and any required readjustment of the peg may be even more difficult than we now think.

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