

Any views expressed in the Departmental Memoranda (DM) Series represent the opinions of the authors and, unless otherwise indicated, should not be interpreted as official Fund views.

DM/85/60

INTERNATIONAL MONETARY FUND

Research Department

Long-Run Equilibrium in a Keynesian  
Model of a Small Open Economy

Prepared by Peter Montiel\*

Approved by Anthony Lanyi

September 24, 1985

Summary

The analysis of stabilization policies in developing countries was greatly enhanced by the development of the monetary approach to the balance of payments. Nevertheless, many theoretical expositions of the monetary approach employ "global monetarist" structural models that are designed to explain the domestic rate of inflation and the balance of payments in a full employment context. Short-run deviations of output from capacity can be incorporated into such models by postulating sluggish nominal wage adjustment. An earlier paper demonstrated the consistency of the resulting "Keynesian" model with the reserve-flow equation that is central to the monetary approach, though its short-run properties are quite different from those of "global monetarist" versions.

This paper analyzes the long-run properties of this Keynesian model and finds that many global monetarist results are restored, including the temporary nature of balance of payments deficits, an "offset coefficient" of -1 on changes in the stock of domestic credit, and the dependence of the effects of devaluation on the nature of the accompanying monetary policy. There is therefore no conflict between Keynesian and global monetarist models of small open economies in the long run. The key empirical question concerns, instead, the nature of the economy's short-run dynamics. This issue is an important one, since the social costs associated with a chosen set of policies--and hence both their desirability from the point of view of the authorities and their credibility from the point of view of the foreign and domestic private sectors--will depend on the particular path the economy travels during the transition to a new long-run configuration.

---

\* The author is grateful for comments from Omotunde Johnson and Luis Ramirez-Rojas.

## I. Introduction

Although the seminal papers that introduced the monetary approach to the balance of payments (MABP) are now more than a decade old, a workable synthesis between this approach and its "Keynesian" predecessor has not yet emerged. Many theoretical expositions of the MABP employ "global monetarist" structural models, and empirical implementations of the approach have been limited almost exclusively to testing this variant. Under fixed exchange rates, these models are designed to explain the domestic rate of inflation and the overall balance of payments. However, as recent experience with stabilization efforts in developing countries has emphasized, policy-makers also tend to be concerned with deviations of output from capacity. Casual empiricism suggests that underutilization of resources tends to be an important component of the adjustment process, at least in the short run. These temporary deviations of output from capacity constitute the analytical focus of Keynesian models. Thus, the analysis of stabilization policies in small open economies under fixed exchange rates would benefit from the construction of tractable models that reconcile the insights of the MABP with regard to the determination of the domestic rate of inflation and the overall balance of payments with Keynesian features that allow for the possible short-run under-utilization of resources.

There are several analytical models in the MABP tradition that embody Keynesian features. Early examples include Mussa (1976) and Rodriguez (1976). However, these tend to be very simple models with limited usefulness for policy purposes. More recently, an important paper by Frenkel, Gylfasson, and Helliwell (1980) explicitly proposes a synthesis of the Keynesian and monetary approaches. As the authors put it, though,

"The model we . . . use is short run in nature, and suppresses many elements of behavior that are potentially relevant. In particular, the wealth, portfolio balance, aggregate supply, and current account consequences of government debt issue, foreign capital flows, and domestic investment are all ignored. We thus bypass the important question of whether a short-run analysis can be made meaningful without an explicit incorporation of longer-run considerations" (p. 587).

Other limitations of their model cited by the authors are the dependence of capital flows on the levels of interest rates and the absence of a role for expectations. In addition, they retain the traditional Mundell-Fleming structure of production in which the domestic economy is completely specialized in its exportable commodity and has monopoly power in the market for its importable good. 1/

---

1/ See Mundell (1968) and Fleming (1962).

A more general model that avoids many of these limitations is presented in Montiel (1985). The purpose of that paper was to conduct a "monetary" analysis of the balance of payments for a small open economy--an analysis organized around the "reserve flow" equation of the MABP--in the context of a Keynesian structural model in which both the level of real output and the domestic rate of inflation are endogenous. The short-run consequences of stabilization policies and of a variety of external shocks for the level of real output, the domestic rate of inflation, and the balance of payments are examined. However, the dynamic considerations called for by Frenkel, Gylfasson, and Helliwell do not receive explicit treatment.

This paper extends that analysis by making explicit the dynamic structure of the model and examining the properties of its long-run equilibrium. The purpose is both to gain some insight into the path that the economy is likely to follow from its short-run equilibrium and to render the short-run analysis more meaningful by demonstrating that the model exhibits reasonable behavior in the long run. As we shall see, the model's short-run Keynesian flavor is consistent with long-run characteristics common to many "monetary" models of the balance of payments.

The remainder of the paper is organized into four sections. After the model is presented in Section II, its dynamic structure is discussed in detail in the following section. The model's long-run equilibrium is derived and its properties are compared to those of familiar "global monetarist" models. Section IV examines how the long-run equilibrium is affected by certain policy and external disturbances. The final section presents a brief summary and some conclusions.

## II. A Keynesian Model of a Small Open Economy

This section will present a slightly modified version of the model described in Montiel (1985). The model is modified in two respects. Both modifications are associated with the extension of the analysis to the long run, but neither change affects the essential conclusions of the previous paper. The section is organized into three subsections that describe in turn the determination of wages and prices, asset markets and goods markets.

### 1. Wages and prices

There are two production sectors in this model, producing traded and nontraded goods. A single variable input--labor--is employed in each sector, under conditions of diminishing marginal productivity. The sectoral production functions are:

$$(1a) \quad y^T = T(L^T); T' > 0, T'' < 0$$

$$(1b) \quad y^N = N(L^N); N' > 0, N'' < 0$$

where  $y^i$  and  $L^i$  denote real output and total employment, respectively, in sector  $i$ . Labor is homogenous and mobile between sectors. Thus workers in both sectors receive the same nominal wage  $W$ .

It is the behavior of the nominal wage that identifies the model as Keynesian. The wage is assumed to be "sticky," in the sense that it is a continuous function of time. Specifically, it adjusts only gradually over time in response to labor market disequilibrium, according to the Phillips curve relationship:

$$(2) \quad \dot{W} = g(L^T + L^N - \bar{L}) + \pi; g(0) = 0, g' > 0,$$

where  $\dot{W}$  is the rate of change of the nominal wage,  $\bar{L}$  is the "natural" level of employment, and  $\pi$  is the expected rate of inflation. A dot (.) over a variable denotes a time derivative, while a circumflex ( $\wedge$ ) denotes a proportional rate of change. As is conventional in Keynesian models, the level of employment is demand-determined in the short run. In other words, firms can satisfy their total labor demands  $L^T + L^N$  even if this exceeds the "natural" level of employment  $\bar{L}$ . <sup>1/</sup> As long as this is the

---

<sup>1/</sup> As will be seen below, the assumption that quantities are demand-determined when markets fail to clear also characterizes the market for nontraded goods. A more reasonable assumption in both cases would be that in the presence of disequilibrium, quantities are determined by the short side of the market. This will be inconsistent with the approach adopted here when excess demand exists in either the labor market or the market for nontraded goods. The recognition of such cases has given rise to an entire literature on general disequilibrium models (e.g., Barro and Grossman (1976) and Malinvaud (1977)). However, research on disequilibrium models for open economies is in its infancy. The state of the art can be examined in Cuddington, Johansson, and Löfgren (1984). The assumption made here is traditional in conventional Keynesian models. It simplifies the analysis essentially by assuming that behavior characteristic of the "Keynesian" region of wage-price space carries over into the "classical" and "repressed inflation" regions as well (see Malinvaud (1977)), thus obviating the need for separate analyses of those cases. Of course, to the extent that the deviations from long-run equilibrium in which we are interested involve short-run Keynesian unemployment, the assumption that quantities are demand-determined will be appropriate. In any case since, as shown in the next section, the model's long-run equilibrium is Walrasian, its long-run properties are not affected by this assumption.

case, however, according to equation (2), the nominal wage will rise faster than the expected rate of inflation.

The small country assumption ensures that firms are unconstrained in the market for traded goods--i.e., they face an infinitely elastic demand for their output at the domestic currency price  $P_T$ , derived from the world price  $P_{TF}$  via the law of one price:

$$(3) \quad P_T = e P_{TF},$$

where  $e$  is the nominal exchange rate defined as the domestic currency price of foreign exchange. Under these circumstances, the demand for labor by firms in the traded goods sector is derived by solving the first-order condition for profit maximization,  $T'(L^T) = w_T$ , where  $w_T = W/P_T$  is the product wage in the traded goods sector--i.e., the real wage measured in terms of traded goods. This yields:

$$(4) \quad L^T = L^T(w_T); L^{T'} = 1/T'' < 0$$

Firms in the nontraded goods sector set prices by applying a markup  $\alpha$  to nominal wages. Denoting the price of nontraded goods as  $P_N$ , this means:

$$(5) \quad P_N = \alpha W.$$

If the markup is itself "sticky," the stickiness of the nominal wage will cause the price of nontraded goods to behave in similar fashion. Thus  $P_N$  will not instantaneously clear the market for nontraded goods. Output in this sector is determined by aggregate demand for nontraded goods. This means that the effective demand for labor in the nontraded goods sector, denoted  $\tilde{L}^N$ , is found by inverting the production function (1b), yielding:

$$(6) \quad L^N = \tilde{L}^N(y^N); \tilde{L}^{N'} = 1/N' > 0.$$

The markup equation (5) determines the wage measured in terms of nontraded goods,  $w_N$ . Since  $w_N = W/P_N$ , (5) implies  $w_N = \alpha^{-1}$ . Since output is demand-determined, firms in the nontraded goods sector will be off their demand curves for labor whenever the nontraded goods market fails

to clear--i.e., they will not be selling their profit-maximizing level of output, which represents their "notional" supply (Barro and Grossman (1971)). This is illustrated in Figure 1. The curve  $N'(L^N)$  depicts the marginal product of labor. At the product wage  $w_{N0}$ , the profit-maximizing level of employment is  $L_0^N$ , which satisfies  $N'(L_0^N) = w_{N0}$  (at point A) and corresponds to a notional supply of output equal to  $y_0^N = N(L_0^N)$ . If demand for nontraded goods is deficient, say  $y_N < y_0^N$ ,

the firm will operate at B with employment equal to  $L_1^N = N^{-1}(y_1^N) < L_0^N$ . Since the marginal product of labor exceeds the real wage by the amount DB when  $L_1^N$  workers are employed, the firm could increase its profits--if the additional output could be sold--by expanding employment beyond  $L_1^N$ . Similarly, when demand is excessive, say at the level  $y_2^N > y_0^N$ , the firm operates at a point like C, where the real wage exceeds the marginal product of labor (by CE), so that profits could be increased by reducing employment.

Although the firm may temporarily operate at points like B or C, it is unreasonable to expect it to continue to do so in the long run. Thus, the model of Montiel (1985), which assumed a fixed short-run markup, must be modified to permit the markup to respond to changes in demand in the long run. Firms will be assumed to increase the markup when demand exceeds their notional supply and to reduce it when demand falls short of notional supply. From the discussion of Figure 1, and recalling that the product wage in the nontraded goods sector is determined by the markup, this is equivalent to a reduction in the product wage  $w_N$  (an increase in  $P_N$ ) when the level of employment  $L^N(y^N)$  exceeds the firm's notional demand for labor  $L^N(w_N)$  (i.e., at a point like C in Figure 1) and an increase in the product wage (a reduction in  $P_N$ ) when employment falls short of the notional demand for labor (point B). That is:

$$(7) \quad \hat{\alpha} = -\hat{w}_N = h [L^N(y^N) - L^N(w_N)]; \quad h(0) = 0, \quad h' > 0$$

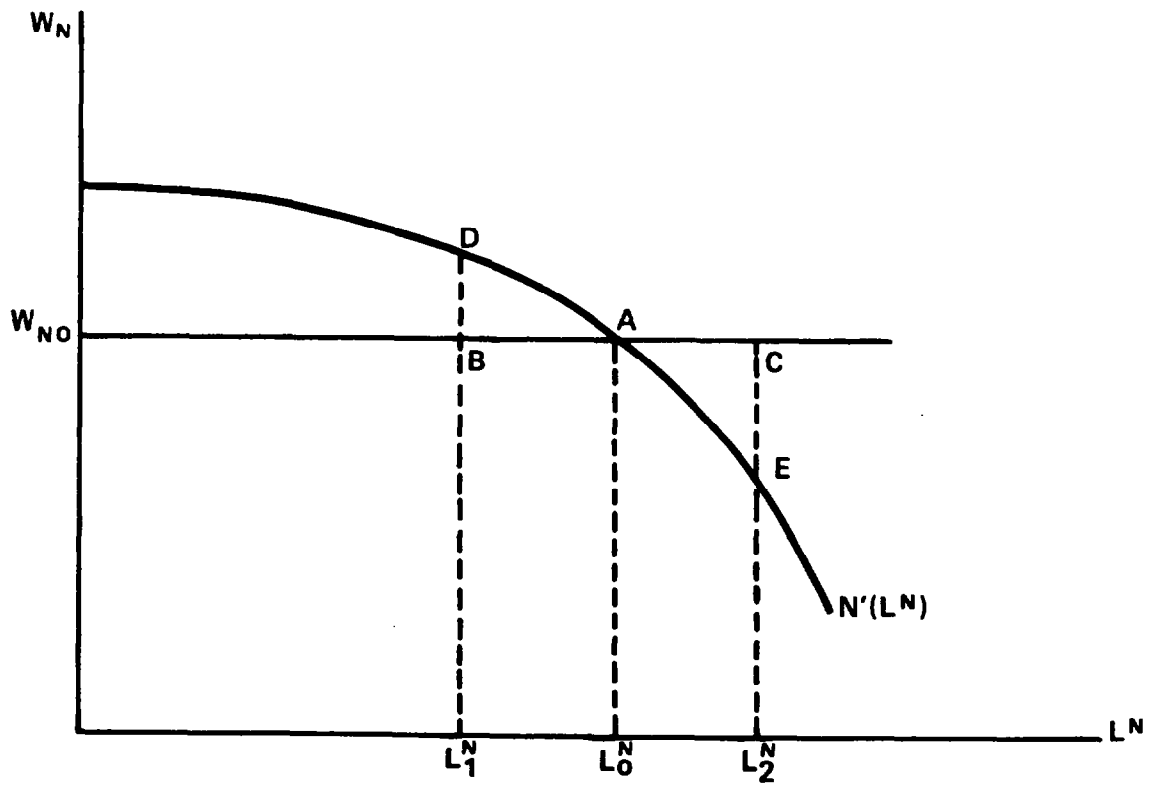
In the context of Figure 1, this means that the product wage will always be moving toward the marginal product of labor--i.e., toward points like D or C.

Using (5), (7) produces the conventional price equation:

$$(8) \quad \hat{P}_N = h [L^N(y^N) - L^N(w_N)] + \hat{w}$$

The weight of the empirical evidence on price equations (see Gordon (1971), Nordhaus (1972), Montiel (1976), and Parkin (1977)) indicates that the effects on the markup of changes in demand are at best weak. It is

Figure 1 EMPLOYMENT AND NOTIONAL LABOR DEMAND IN THE SHORT RUN





convenient to incorporate this in the model by means of an inequality that compares the derivative of  $h(\cdot)$  to the slope of the short-run Phillips curve: 1/

$$h' < g'.$$

The domestic price level is given by:

$$(9a) \quad P = P_N^\theta P_T^{1-\theta}$$

where  $\theta$  is the share of nontraded goods in private consumption. Therefore the domestic rate of inflation is:

$$(9b) \quad \hat{P} = \theta \hat{P}_N + (1-\theta) \hat{P}_T.$$

Price expectations are assumed to be formed with perfect myopic foresight, so:

$$(10) \quad \pi = \hat{P}$$

## 2. Asset markets

The model contains a simple financial structure. The central bank is the only financial institution. Its liabilities consist of non-interest paying money ( $M$ ), which is held by the private sector. Its assets consist of foreign exchange reserves held in the form of foreign securities with a foreign currency value of  $F_B$  and of credit extended to the private ( $D_p$ ) and public ( $D_G$ ) sectors. Its balance sheet is thus:

---

1/ Allowing for a variable markup has no effect on the qualitative conclusions in Montiel (1985). As is intuitively clear, adjustments in the markup increase the slope of the economy's short-run Phillips curve in  $\hat{P}_N - y^N$  space--i.e., they increase the sensitivity of the domestic rate of inflation to changes in the rate of capacity utilization. This can be directly verified through equation (8). This simply magnifies the short-run impact of stabilization policies and external shocks on domestic inflation and through inflation on the output of nontraded goods.

$$(11) \quad M \equiv eF_B + D_G + D_p$$

$$\equiv eF_B + D$$

where  $D = D_G + D_p$  is total domestic credit. The central bank exercises direct control over  $D_G$  and  $D_p$ . To defend the exchange parity, it stands ready to trade  $M$  and  $F_B$  with the private sector at price  $e$ .

In addition to holding money and credit, the private sector also holds foreign securities with foreign currency value  $F_p$ . Net private financial wealth, denoted  $N_p$ , is therefore:

$$(12) \quad N_p \equiv M + eF_p - D_p.$$

The private sector must allocate its portfolio among  $M$ ,  $F_p$ , and  $D_p$  subject to the balance sheet constraint (12). It considers domestic credit and foreign securities to be perfect substitutes. Thus, if  $r_F$  is the external nominal interest rate and  $r$  is the interest rate on domestic credit, the interest parity condition  $r = r_F$  must hold continuously under fixed exchange rates. The private sector's portfolio allocation decision is summarized by its demand for money, which takes the form:

$$(13) \quad M^D = PL(y, r_F); L_1 > 0, L_2 < 0,$$

where  $y$  represents real GDP and is defined as:

$$(14) \quad y = (P_T/P)y^T + (P_N/P)y^N.$$

The demand for foreign securities then follows from the balance sheet constraint (12):

$$(15) \quad eF_p^D = N_p + D_p - PL(y, r_F)$$

In a second departure from the previous version of this model, we shall assume that portfolio equilibrium is instantaneously achieved, that is:

$$(16) \quad M = M^D.$$

The purpose of this modification is to simplify the stability analysis slightly. Neither the model's short-run internal equilibrium nor its long-run equilibrium will be affected. However, since the speed of adjustment in asset markets will affect capital flows, the expression for the balance of payments will differ from that in Montiel (1985). Defining the balance of payments in domestic currency as  $BOP \equiv e\dot{F}_B$ , differentiating (11), (13) and (16) with respect to time, and making the appropriate substitutions, we have:

$$(17) \quad BOP = (PL_1\dot{y} + \dot{PM}) - \dot{D}$$

where  $r_F$  has been assumed constant. As before, this is the "reserve flow" equation familiar from the MABP. The first term on the right-hand side is the flow demand for money, or "hoarding," and the second is the flow supply of domestic credit.

Finally, the government also borrows from the domestic banking system and purchases foreign securities. Its net worth is:

$$(18) \quad N_G \equiv eF_G - D_G.$$

Note from (11), (12) and (18) that national wealth, denoted  $N$ , is:

$$\begin{aligned} (19) \quad N &\equiv N_p + N_G \\ &\equiv e(F_B + F_p + F_G) \\ &\equiv eF \end{aligned}$$

where  $F = F_B + F_p + F_G$ .

### 3. Goods markets

Private and government financial wealth represent the cumulative savings of these sectors. Private saving is the difference between private disposable income and private consumption:

$$(20) \quad \dot{N}_p = Py + r_F(N_p - M) - Pt_p - Pc$$

where  $t_p$  is real taxes paid by the private sector, and  $c$  is real private consumption. Real private consumption is in turn determined by:

$$(21) \quad c = c(y - t_p, r_F - \hat{P}, N_P/P); \quad 0 < c_1 < 1, \quad c_2 < 0, \quad c_3 > 0$$

The signs of the partial derivatives of  $c(\quad)$  are conventional. If holdings of net nonmonetary assets are positive ( $N_P - M > 0$ )--which shall be taken to be the standard case here--an increase in net financial wealth increases both disposable income (equation (20)) and consumption. To ensure that the net effect on saving is negative--i.e., that an increase in household wealth reduces saving--the restriction  $c_3 > r_F - \hat{P}$  will also be imposed.

The expenditure shares  $\theta$  and  $1-\theta$  from equation (9a) will be assumed constant. <sup>1/</sup> Consequently, consumption of traded ( $c^T$ ) and nontraded goods ( $c^N$ ) must be:

$$(22a) \quad c^T = (1-\theta)P_c/P_T$$

$$(22b) \quad c^N = \theta P_c/P_N.$$

Letting  $g$  represent real government purchases of goods and  $t_g$  denote real profits of the central bank (assumed to be transferred to the government), government savings are:

$$(23) \quad \dot{N}_G \equiv e\dot{F}_G - \dot{D}_G \equiv P(t_p + t_B) + r_F(eF_G - D_G) - Pg.$$

The government's real net worth will be assumed to be constant in the long run. That is, only temporary changes in the fiscal deficit will be contemplated below.

Real government spending is divided into spending on traded ( $g^T$ ) and nontraded ( $g^N$ ) goods, so that:

$$(24) \quad g \equiv (P_T/P)g^T + (P_N/P)g^N.$$

---

<sup>1/</sup> Thus the representative consumer's utility function is Cobb-Douglas.

It is assumed that the government initially devotes a fraction  $\theta$  of its spending to nontraded goods. Central bank profits are given by:

$$(25) \quad t_B \equiv r_F (eF_B + D)/P$$

Summing the private and public budget constraints (20) and (23), and using (11) and (25), we can derive the expression for the real value of the current account (ca):

$$(26) \quad ca \equiv \frac{\dot{N}}{P} \equiv (y + r_F eF) - (c + g)$$

This is, of course, the familiar income minus absorption identity. The real balance of trade  $b$  is:

$$(27) \quad b \equiv y - (c + g)$$

or, using our assumption that output in the nontraded goods sector is demand-determined, i.e.:

$$(28) \quad y^N = c^N + g^N,$$

we have, from (14), (22), and (24):

$$(29) \quad b = (P_T/P) (y^T - c^T - g^T).$$

That is, the trade balance is the difference between domestic production of traded goods and domestic demand for traded goods.

## II. Long-Run Equilibrium

The model of the previous section can be solved for a short-run equilibrium which expresses the endogenous variables as functions of the exogenous variables for given values of the "state" variable--i.e., those endogenous variables that are continuous functions of time. The

system will also generate a set of dynamic equations which determines the rate at which the state variables are evolving in a given short-run equilibrium. Unless the economy's configuration is such that the dynamic equations imply stable values for the state variables, the short-run equilibrium will be temporary--i.e., evolution of the state variables will produce a succession of new short-run equilibria over time, even if the exogenous variables are unchanged. If the system is stable, it will converge to a short-run equilibrium that is consistent with no further change in the state variables. In the absence of further shocks, this will represent the economy's long-run equilibrium. This section carries out this dynamic analysis for the model of Section II and describes some properties of its long-run equilibrium. Discussion of the effects on this equilibrium of changes in exogenous variables is postponed to the next section.

#### Derivation of long-run equilibrium

To conduct this analysis, it is useful to begin by defining the real exchange rate  $e_R$  as:

$$(30) \quad e_R \equiv P_T/P_N.$$

Thus,  $e_R$  is the relative price of traded goods in terms of nontraded goods. Using equation (9a), we have:

$$(30a) \quad P_T/P \equiv e_R^\theta$$

$$(30b) \quad P_N/P = e_R^{\theta-1}.$$

without loss of generality, units are chosen so that initially  $e_R = 1$ .

The economy's short-run equilibrium can be described in terms of equations that determine the level of real output  $y$ , the domestic rate of inflation  $\dot{P}$ , and the level of output of nontraded goods,  $y^N$ . Substituting (4) in (1a) and using the result together with (30a) and (30b) in (14) allows  $y$  to be expressed as:

$$(31) \quad y = e_R^\theta y^T(w_T) + e_R^{\theta-1} y^N.$$

The domestic rate of inflation is determined by equation (9b). Substituting into this equation from equation (8), and using (2), (4), (6), and (10), along with the definitions (30a) and (30b), produces:

$$(32) \quad \hat{P} = \frac{\theta}{1-\theta} [g(L^T[w_T] + \tilde{L}^N[y^N] - \bar{L}) + h(\tilde{L}^N[y^N] - L^N[w_T e_R])] + \hat{P}_T.$$

Finally, to solve for the level of output of nontraded goods, substitute (21), into (22b), and the result into (28). Once again making use of the definitions (30a) and (30b) we have:

$$(33) \quad y^N = e_R^{1-\theta} c[y - t_p, r_F - \hat{P}, e_R^\theta n_{PT}] + g^N,$$

where  $n_{PT}$  is real private financial wealth measured in terms of traded goods.

Real GDP ( $y$ ), the domestic rate of inflation ( $\hat{P}$ ), and the level of output of nontraded goods ( $y^N$ ) are all endogenous in the short run. Using equations (31) - (33), they can be solved in terms of the exogenous variables, consisting of the policy variables  $g^N$  and  $t_p$  and the external variables  $r_F$  and  $\hat{P}_T$ , on the one hand, and the state variables  $n_{PT}$  (real private financial wealth),  $e_R$  (the real exchange rate), and  $w_T$  (the real wage measured in terms of traded goods), on the other. The model's short-run equilibrium was discussed in detail in Montiel (1985), and that analysis will not be repeated here. The properties of the short-run equilibrium can usefully be summarized as:

$$(34) \quad y = y(w_T, y^N)$$

$$(35) \quad \hat{P} - \hat{P}_T = P(e_R, w_T, y^N)$$

$$(36) \quad y^N = \phi(g^N, t_p, r_F; n_{PT}, e_R, w_T),$$

where  $\rho_F = r_F - \hat{P}_T$  is the external real interest rate. The signs of the partial derivatives are indicated under the respective variables in each equation. 1/

The next step is to derive the dynamic equations for the state variables. Substituting equations (13) and (21) into the private saving function (20), we have:

$$(37) \quad \dot{n}_{PT} = e_R^{-\theta} (y - t_P - c[y - t_P, \rho_F - (\hat{P} - \hat{P}_T), e_R^{\theta} n_{PT}] - (\rho_F + \hat{P}_T)L[y, \rho_F + \hat{P}_T]) + \rho_F n_{PT}.$$

To derive the dynamic equation for the real exchange rate, differentiate equation (30) with respect to time. Dividing the result by  $e_R$  yields:

$$\hat{e}_R = \hat{P}_T - \hat{P}_N$$

Using (9b):

$$(38) \quad \hat{e}_R = -\theta^{-1} (\hat{P} - \hat{P}_T).$$

Finally, substituting from (32):

$$(39) \quad \hat{e}_R = \frac{-1}{1-\theta} [g(L^T[w_T] + \tilde{L}^N[y^N] - \bar{L}) + h(\tilde{L}^N[y^N] - L^N[w_T e_R])]$$

The final dynamic equation describes the behavior over time of the real wage measured in terms of traded goods. Substituting (4), (6), and (10) in (2), using (32) and simplifying, produces:

---

1/ The partial derivatives rely on the assumption that the marginal propensity to save is positive. This ensures that an increase in the supply of nontraded goods reduces excess demand in that market. In addition, the slopes of the labor demand curves in the traded and nontraded sectors are initially assumed to be equal.

$$(40) \quad \dot{\bar{w}}_T = (1-\theta)^{-1} g(L^T[w_T] + \tilde{L}^N[y^N] - \bar{L}) + \theta(1-\theta)^{-1} h(\tilde{L}^N[y^N] - L^N[w_T e_R])$$

Equations (38), (39), and (40) describe the evolution over time of real private financial wealth, the real exchange rate, and the real wage in terms of traded goods. Changes in  $n_{PT}$ ,  $e_R$ , and  $w_T$  depend on the current values of these variables (the "state" of the system (37), (39), and (40)), on the exogenous variables, and on the economy's current short-run equilibrium configuration, as summarized by  $y$ ,  $\bar{P}$  and  $y^N$ . Since the latter in turn depend on the exogenous and state variables (through equations (34) - (36)), the current rates of change of the state variables ultimately depend on the exogenous variables and the state of the system.

As long as at least one of  $\dot{n}_{PT}$ ,  $\dot{e}_R$ , or  $\dot{w}_T$  is non-zero, one or more of the state variables will be changing and the economy will be moving through a succession of different short-run equilibria. Long-run equilibrium thus implies  $\dot{n}_{PT} = \dot{e}_R = \dot{w}_T = 0$ . The particular configuration of  $(n_{PT}, e_R, w_T)$  which satisfies these conditions depends on the values assumed by the exogenous variables. This relationship will be investigated in the next section.

#### Properties of the long-run equilibrium

An examination of the properties of the model in long-run equilibrium--i.e., when  $\dot{n}_{PT} = \dot{e}_R = \dot{w}_T = 0$  yields, inter alia, the following propositions:

1. In the long run, employment will be at its "natural" (full employment) level, and the market for nontraded goods will be in equilibrium--i.e., all firms will be on their "notional" supply curves.

This proposition states that the model's long-run equilibrium is Walrasian. To see that it must be true, set  $\dot{e}_R = \dot{w}_T = 0$  in (39) and (40). This implies:

$$0 = g(\quad) + h(\quad)$$

$$0 = g(\quad) + \theta h(\quad)$$

Since  $\theta < 1$ , these conditions can only hold simultaneously if  $g(\quad) = h(\quad) = 0$ . But  $h(\quad) = 0$  implies

$$\tilde{L}^N(y^{N*}) = L^N(w_T^* e_R^*),$$

where asterisks denote the long-run values of the relevant variables. That is, the actual level of employment equals its desired (profit-maximizing) level—firms are on their labor demand curves. Inverting  $\tilde{L}^N$ , we have:

$$y^{N*} = y^N(w_T^*, e_R^*),$$

i.e., demand for nontraded goods output equals notional supply and firms are on their "notional" supply curves. Similarly,  $g(\quad) = 0$  implies:

$$L^T(w_T^*) + \tilde{L}^N(y^{N*}) = \bar{L}$$

Applying the previous result to substitute for  $y^{N*}$ :

$$L^T(w_T^*) + L^N(w_T^*, e_R^*) = \bar{L}$$

Thus, the level of employment is at its "natural" full-employment level.

## 2. Purchasing-power parity holds in the long run

This proposition follows directly from the long-run constancy of the real exchange rate ( $\dot{e}_R = 0$ ). Equation (9b) can be written in the form:

$$\hat{P} = \hat{P}_T - \theta \hat{e}_R.$$

Since  $\hat{P}_T = \hat{e} + \hat{P}_{TF}$ , this means:

$$\hat{e} = \hat{P} - \hat{P}_{TF},$$

i.e., the rate of depreciation of the exchange rate is equal to the difference between the domestic and foreign inflation rates. This is simply a statement of "relative" purchasing-power parity (see Officer (1976)). Note that causation runs from the rate of depreciation (a policy variable) to the domestic inflation rate, as is conventional in the MABP tradition.

In fact, the model has a decidedly "global monetarist" flavor in the long run. Whitman (1975) characterized "global monetarist" models by their assumptions of full employment, purchasing power parity, and uncovered interest parity. Although the model presented here does not necessarily satisfy the first two of these properties in the short run, Propositions 1 and 2 have established that both properties hold in the long run. Since uncovered interest parity is assumed to hold continuously through the assumptions of perfect capital mobility and the perfect substitutability of domestic credit and foreign securities, all three "global monetarist" properties hold for the model of Section II in the long run. It is therefore not surprising that the model exhibits some familiar "global monetarist" properties in the long run. For example, equation (17) can be written in the familiar "global monetarist" form:

$$(17a) \quad \frac{\dot{BOP}}{M} = \frac{\dot{eF_B}}{M} = \hat{P} + \eta_{LY} \hat{y} - \frac{D}{M} \hat{D}$$

where  $\eta_{LY}$  is the income elasticity of the demand for money (see, e.g., Johnson (1976)). Although the equation holds continuously in the model, the endogenous variables  $\hat{P}$ ,  $\hat{y}$ , and  $M$  can only be treated as constant, in "global monetarist fashion," in the long run. This equation permits us to establish some familiar "global monetarist" results:

3. Under fixed exchange rates, and in the absence of external inflation and domestic credit creation, balance of payments deficits are inherently temporary.

With  $\hat{P}_T = 0$ , nonzero values of  $\hat{P}$  and  $\hat{y}$  can only be observed in the short run. In the long run,  $\dot{n}_{PT} = \dot{e}_R = \dot{w}_T = 0$  implies  $\hat{P} = \hat{y} = 0$  if  $\hat{P}_T = 0$ . If in addition  $\hat{D} = 0$ , this means  $BOP = 0$ .

4. Changes in the stock of domestic credit are exactly offset by changes in the foreign exchange reserves.

In this model, changes in the stock of domestic credit are brought about through temporary changes in the flow of credit. Consider a situation in which initially  $\hat{P}_T = \hat{D} = 0$ . Now suppose that there is an increase in the flow of domestic credit either to the private sector or to finance government purchases of traded goods. From equations (34) - (36), the economy's short-run equilibrium is unaffected. Thus  $\hat{P} = \hat{y} = 0$

holds continuously. From equation (17), the increase in  $\hat{D}$  results in an exactly offsetting balance of payments deficit for as long as it

lasts. When  $\hat{D}$  is again to zero, the deficit will disappear, but

foreign exchange reserves will have been reduced by the cumulative credit expansion. All other variables will remain undisturbed. 1/

If the credit expansion finances an increase in government purchases of nontraded goods or a reduction in taxation, the dynamics are more complicated. This is because temporary changes in  $g^N$  or  $t_p$  affect the economy's short-run equilibrium (equations (34) - (36)) and thus  $P$  and  $y$  will not remain at zero. However, since the changes in  $g^N$  and/or  $t_p$  are temporary, when the original levels are restored  $P$  and  $y$  must return to their original values. Thus  $M$  will return to its original value, and the stock expansion in  $D$  must be exactly offset by a contraction in  $eF_B$ .

5. An exchange rate devaluation will have no long-run effect on the balance of payments. In the absence of changes in the stock of domestic credit, its only long-run effect will be to increase the stock of foreign exchange reserves. If the stock of domestic credit is increased in proportion to the devaluation, foreign exchange reserves will remain unchanged.

This familiar "global monetarist" proposition follows from the fact that no real variables in the system (37), (39), and (40) are affected by changes in  $P_T = e P_{TF}$ . Thus the economy will return to its initial long-run real configuration ( $n_{PT}^*$ ,  $e_R^*$ ,  $w_T^*$ ) after a devaluation. Since the real exchange rate is unaffected, the domestic price level will rise in proportion to the devaluation. Given that the original level of real GDP( $y$ )--and thus the original real demand for money--will be restored, the nominal demand for money will increase in proportion to the devaluation. To the extent that the central bank does not meet this increased demand for money through an expansion of credit, the private sector will only be able to add to its money balances by selling foreign exchange to the central bank, thereby augmenting exchange reserves. Using the subscripts 0 and 1 to denote pre- and post-devaluation values of the variables, we have, using equation (11):

$$e_1 F_{B1} - e_0 F_{B0} = (M_1 - M_0) - (D_1 - D_0)$$

---

1/ It can easily be shown that if the credit expansion finances an increase in  $g^T$  the balance of payments deterioration will occur in the trade balance, whereas if the expansion is directed at the private sector, the capital account will deteriorate.

After some manipulation, this can be written:

$$\begin{aligned} e_1 (F_{B1} - F_{B0}) &= \left( \frac{e_1}{e_0} - 1 \right) (M_0 - e_0 F_{B0}) - (D_1 - D_0) \\ &= \frac{e_1}{e_0} D_0 - D_1, \text{ from (11).} \end{aligned}$$

Thus, if  $D_1 = D_0$ ,  $e_1 (F_{B1} - F_{B0}) = (e_1/e_0 - 1) D_0 > 0$  for a devaluation ( $e_1 > e_0$ ), so that reserves increase. If, on the other hand,  $D_1 = (e_1/e_0) D_0$  (credit is expanded in proportion to the devaluation), we will have  $F_{B1} = F_{B0}$ .

The precise path that the economy will follow in returning to its initial long-run equilibrium after a devaluation depends on the instantaneous response of nominal wages. If wages immediately adjust in proportion to the devaluation, the domestic price level would immediately rise in the same proportion.  $e_R$  and  $w_T$  would initially be unaffected, and only  $n_{PT}$  would initially diverge from its long-run equilibrium  $n_{PT}$ .  $n_{PT}$  would initially fall somewhat less than in proportion to the devaluation, which would act as a capital levy on the private sector's financial wealth. From (34), domestic output would initially be depressed, causing a reduction in domestic inflation. Initially, financial savings would increase, while the real exchange rate would depreciate and the product wage in the traded sector would fall. <sup>1/</sup> If the long-run equilibrium is stable, the latter two effects will eventually be reversed.

On the other hand, to the extent that the nominal wage rises initially by less than in proportion to the devaluation, the decline in  $n_{PT}$  will be muted, the real exchange rate will rise, and the product wage in the traded goods sector will fall. As can be seen from equation (34), all of these effects tend to mitigate the short-run contractionary effects of devaluation.

6. In the presence of external inflation, the balance of payments will be in surplus in the long run if net foreign exchange reserves are positive. In this case, if the country's non-bank sectors are net

---

<sup>1/</sup> The direction of these effects will be discussed in the next section.

international creditors, a capital account deficit is more than offset by a surplus in the current account.

A long-run balance of payments surplus in a small open economy is familiar from monetarist analyses of the optimum balance of payments deficit (see Mundell (1972)). Assume that all countries expand domestic credit at the rate  $\dot{D} = \hat{P}_{TF}$ . Then, from equation (17a), the long-run balance of payments is:

$$\begin{aligned} BOP &= \hat{P}_{TF} M - \hat{P}_{TF} D \\ &= \hat{P}_{TF} e F_B > 0 \quad (\text{using (11)}) \end{aligned}$$

since  $\hat{P} = \hat{P}_{TF}$  and  $\hat{y} = 0$  in long-run equilibrium. Note that, unlike in Mundell (1972), this surplus does not represent a seignorage payment from the home country to the rest of the world. This is because reserves are held in the form of securities, rather than non-interest-bearing currency. Instead, the surplus represents the "inflationary" component of the central bank's interest receipts on its holdings of foreign reserves. To derive the long-run current account surplus, recall that in the long run,  $\dot{n}_{PT} = \dot{n}_G = 0$ , so that  $\dot{n} = 0$ , where  $n = N/P$ . Now, using (26) and (19):

$$ca = \frac{\dot{N}}{P} = \dot{n} + \hat{P}_{TF} \frac{N}{P} = \hat{P}_{TF} \frac{eF}{P} > 0$$

Since, under the conditions of this proposition,  $F > F_B$ , the current account surplus exceeds the balance of payments surplus. Thus the capital account must be in deficit. In effect, the inflationary component of interest receipts on holdings of foreign securities by all sectors is saved and used to acquire a flow of new securities sufficient to maintain the real value of each sector's existing stock. The total of these receipts represents the aggregate current account surplus, whereas purchases of new securities by the private sector and the government represent a capital outflow. Finally, the acquisition of new securities by the central bank constitutes the balance of payments surplus. It is clear that similar propositions could be formulated for cases in which at least one of  $F_B$ ,  $F_P + F_G$ , or  $F$  is negative.

We conclude that the Keynesian model of Section II is "global monetarist" in the long run. It possesses a long-run Walrasian equilibrium characterized by full employment, profit maximization, and the usual international parity conditions in goods and assets markets. A non-zero long-run balance of payments can be observed only in the presence of external inflation, and the long-run value of the balance of payments in this case can be derived from the "reserve flow" equation. In addition, "global monetarist" predictions with regard to the effects of domestic credit expansion and devaluation are upheld. Changes in the stock of domestic credit affect the stock of foreign exchange reserves with an "offset coefficient" of -1, regardless of the type of spending with which the change in credit is associated. Finally, the effect of devaluation depends critically on the nature of the accompanying monetary policy.

These familiar "global monetarist" propositions hold for our model regardless of the particular long-run equilibrium configuration ( $n_{PT}$ ,  $e_R$ ,  $w_T$ ) which is in effect--i.e., regardless of the values of the exogenous variables. The relationship between the exogenous variables and the model's long-run equilibrium configuration is the subject of our next section.

### III. Determinants of the Long-Run Equilibrium Configuration

The previous section analyzed properties which are satisfied by all possible long-run equilibria in this model. This section first investigates how the model determines which particular long-run equilibrium is generated and then examines how the equilibrium configuration is affected by certain exogenous shocks.

#### The configuration of the economy in long-run equilibrium

As indicated in the previous section, equations (37), (38), and (40) imply that the evolution of the variables  $n_{PT}$ ,  $e_R$ , and  $w_T$  at a moment in time depend on the values of these variables at that moment, on the vector of exogenous variables ( $g^N$ ,  $t_P$ ,  $\rho_F$ ,  $\hat{P}_T$ ), and on the short-run endogenous variables ( $y$ ,  $\hat{P}$ ,  $y^N$ ). But the equations of short-run equilibrium (34) - (36) indicate that the short-run endogenous variables themselves depend on the state variables  $n_{PT}$ ,  $e_R$ , and  $w_T$  and on the vector of exogenous variables. Substituting (34) - (36) in (37), (38), and (40) produces a set of equations of the form:

$$(37a) \quad \dot{n}_{PT} = n(n_{PT}, e_R, w_T; g^N, t_P, \rho_F, \hat{P}_T)$$

$$(39a) \quad \dot{e}_R = e(n_{PT}, e_R, w_T; g^N, t_P, \rho_F, \hat{p}_T)$$

$$(40a) \quad \dot{w}_T = w(n_{PT}, e_R, w_T; g^N, t_P, \rho_F, \hat{p}_T)$$

Thus, the rate of change of the state variables depends only on the state  $(n_{PT}, e_R, w_T)$  of the system and the vector of exogenous variables.

A long-run equilibrium is a state  $(n_{PT}^*, e_R^*, w_T^*)$  that satisfies  $\dot{n}_{PT} = \dot{e}_R = \dot{w}_T = 0$ . By imposing these conditions on equations (37a), (38a) and (40a), we can solve for the economy's long-run configuration  $(n_{PT}^*, e_R^*, w_T^*)$  as a function of the vector of exogenous variables  $(g^N, t_P, \rho_F, \hat{p}_T)$ . The purpose of this section is to investigate how each of the exogenous variables affects the configuration of the economy's long-run equilibrium.

As a first step, note that the conditions  $\dot{e}_R = 0$  and  $\dot{w}_T = 0$  are equivalent to clearing of both the labor market and the market for nontraded goods, in the sense that  $\dot{e}_R = 0$  and  $\dot{w}_T = 0$  are necessary and sufficient for both of these markets to clear. The market-clearing conditions are:

$$(41) \quad L^T(w_T) + L^N(w_T e_R) = \bar{L} \quad (\text{labor market})$$

$$(42) \quad y^N = N(w_T e_R) \quad (\text{market for nontraded goods})$$

The first proposition of the previous section established sufficiency--i.e., if  $\dot{e}_R = \dot{w}_T = 0$ , then both the labor market and the nontraded goods market are in equilibrium. That these conditions are also necessary follows directly by imposing the market-clearing conditions (41) and (42) on equations (38a) and (40a). Since  $g(0) = h(0) = 0$ , doing so produces  $\dot{e}_R = \dot{w}_T = 0$ . We can therefore replace the characterization of long-run equilibrium  $\dot{n}_{PT} = \dot{e}_R = \dot{w}_T = 0$  by the alternative one  $\dot{n}_{PT} = 0$ ,  $y^N = N(w_T e_R)$ , and  $L^T + L^N = \bar{L}$ .

Secondly, it can be shown that if the slopes of the labor demand curves in the traded and nontraded goods sectors are equal at the initial long-run equilibrium, the level of real output must be constant in the vicinity of this equilibrium. To do so, note first that the labor-market clearing condition (41) defines a relationship that must hold between  $w_T$  and  $e_R$  in long-run equilibrium.

$$(43) \quad w_T = \sigma(e_R).$$

The derivative of  $\sigma$  is:

$$\sigma' = \frac{-L^{N'} w_T}{L^{T'} + L^{N'} e_R} = \frac{-w_T}{L^{T'}/L^{N'} + e_R} = -\frac{1}{2} w_T$$

The last equality follows from the assumption that initially  $e_R = 1$  and  $L^{T'} = L^{N'}$ . Next, using equations (30a) and (30b), together with the equilibrium condition (42) in the definition of real GDP given by equation (14) yields:

$$y = e_R^\theta y^T(w_T) + e_R^{\theta-1} y^N(w_T e_R).$$

Therefore, using (43):

$$\begin{aligned} \frac{dy}{de_R} &= \theta e_R^{\theta-1} y^T + (\theta-1) e_R^{\theta-2} y^N + e_R^\theta T' \sigma' + e_R^{\theta-1} N' (w_T + \sigma' e_R) \\ &= e_R^{-1} [\theta y - e_R^{\theta-1} y^N] + e_R^\theta [T' \sigma' + e_R^{-1} N' (w_T + \sigma' e_R)]. \end{aligned}$$

The first term is zero, because initially both households and government devote a fraction  $\theta$  of their spending to nontraded goods. The second term is shown to be zero by substituting  $e_R = 1$ ,  $T' = N'$ , and  $\sigma' = -w_T/2$ . Thus the long-run value of  $y$ , denoted  $y^*$ , is constant.

Using this restriction, our characterization of long-run equilibrium becomes:

$$\begin{aligned}
 (37b) \quad n(n_{PT}, e_R; t_P, \rho_F, \hat{P}_T) &= e^{-\theta} (y - \hat{t}_P - c[y^* - t_P, \rho_F, e_R^{\theta} n_{PT}]) \\
 &\quad - (\rho_F + \hat{P}_T) L[y^*, \rho_F + \hat{P}_T] + \rho_F n_{PT}^* \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 (45) \quad \phi(n_{PT}, e_R, w_T; g^N, t_P, \rho_F) &= e^{1-\theta} \theta c[y^* - t_P, \rho_F, e_R^{\theta} n_{PT}] + \\
 &\quad + g^N - N[w_T e_R] \\
 &= 0
 \end{aligned}$$

together with equation (43). Equation (37b) imposes the condition  $\dot{n}_{PT} = 0$

on equation (37a) and uses (37) to write the function  $n(\quad)$  explicitly. The long-run equilibrium properties  $y = y^*$  and  $\hat{P} - \hat{P}_T = 0$  (for the latter, see the second proposition in Section III) are incorporated into (37) to produce (37b). Equation (45) is the Walrasian equilibrium condition in the market for nontraded goods, i.e., the condition  $y^N = y^N(w_T^* e_R^*)$ . It is derived by substituting (21) into (28) and the result into (42). Use of the long-run equilibrium properties  $y = y^*$ ,  $\hat{P} - \hat{P}_T = 0$  yields (45). Equations (37b), (43), and (45) thus state that in long-run equilibrium private wealth must be constant, the market for nontraded goods must clear, and the economy must be at full employment.

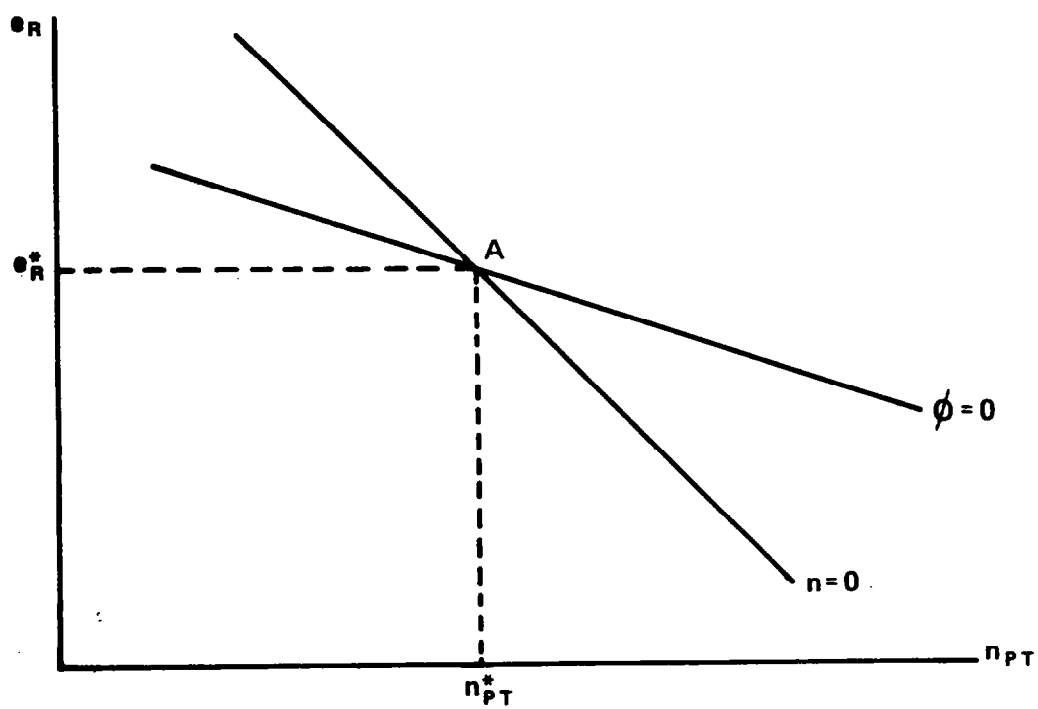
These equations can be used to examine how the long-run configuration  $(n_{PT}^*, e_R^*, w_T^*)$  is affected by changes in the exogenous variables on the assumption that the long-run equilibrium is stable. The appendix derives a set of conditions that are sufficient to guarantee local stability. These involve strong wealth and substitution effects on consumption (see page 34).

Note that the function  $n(\quad)$  depends only on  $n_{PT}$ ,  $e_R$ , and the exogenous variables. Substituting (43) into (45), we derive a function

$$\phi(n_{PT}, e_R, \sigma(e_R); g^N, t_P, \rho_F) = 0$$

that also depends only on  $n_{PT}$ ,  $e_R$ , and exogenous variables. These equations describe a pair of loci in  $(e_R, n_{PT})$  space, as depicted in Figure 2. The slopes of these loci are:

Figure 2 DETERMINATION OF THE ECONOMY'S LONG-RUN EQUILIBRIUM



$$\left. \frac{d e_R}{d g^N} \right|_{\phi = 0} = \frac{-1}{\theta^2 n_{PT} c_3 + (1-\theta)\theta c + \frac{N'}{2} w_T^*} < 0$$

This is shown as the new locus  $\tilde{\phi} = 0$  in Figure 3. As the figure shows, the effect is to appreciate the real exchange rate to shift private excess demand away from nontraded goods to make room for the additional government demand. Since under our assumption that  $c_3 > \rho_F$  this real appreciation increases private saving, private wealth must rise to satisfy  $\dot{n}_{PT} = 0$ . Thus the real appreciation must be sufficiently large to reduce private excess demand in spite of the positive effects on private demand arising from the increase in wealth. The effect on the product wage in the traded goods sector follows directly from the decline in  $e_R$  and equation (43).

8. An increase in government spending on traded goods financed by an increase in taxation on the private sector results in a real depreciation and a reduction in real private financial wealth.

An increase in taxation reduces private saving. The locus  $n = 0$  shifts to the left by:

$$\left. \frac{dn_{PT}}{dt_P} \right|_{n = 0} = \frac{1-c_1}{\rho_F - c_3} < 0.$$

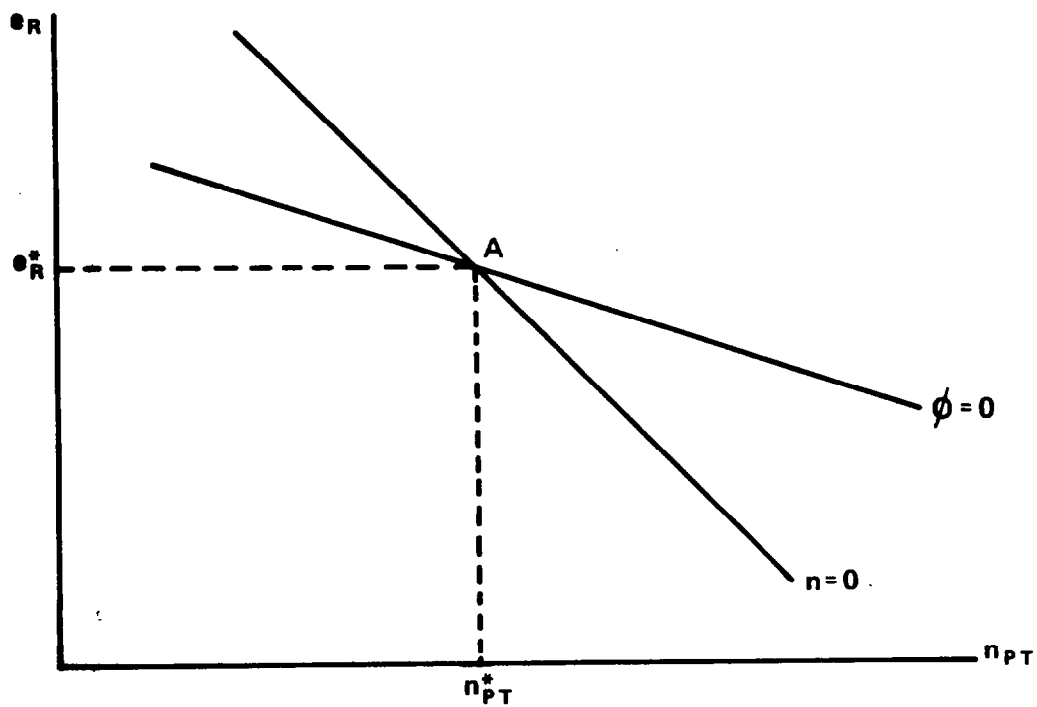
On the other hand, since private demand for nontraded goods decreases, the locus  $\phi = 0$  shifts up by:

$$\left. \frac{d e_R}{d t_P} \right|_{\phi = 0} = \frac{\theta c_1}{\theta^2 n_{PT} c_3 + (1-\theta)\theta c + N'w_T^*/2} > 0$$

The new loci are labelled  $\tilde{n} = 0$  and  $\tilde{\phi} = 0$  in Figure 4. The long-run equilibrium moves from A to B. A reduction in private wealth and a real devaluation are required to simultaneously restore the level of private saving and to restore equilibrium in the market for nontraded goods.

9. Turning to external disturbances, the effects of an increase in the foreign real interest rate are a long-run real exchange appreciation together with an increase in real private financial wealth.

Figure 2 DETERMINATION OF THE ECONOMY'S LONG-RUN EQUILIBRIUM





$$\left. \frac{d e_R}{d n_{PT}} \right|_{n=0} = - \frac{\rho_F - c_3}{(\rho_F - c_3) \theta n_{PT}} = \frac{-1}{\theta n_{PT}} < 0$$

$$\left. \frac{d e_R}{d n_{PT}} \right|_{\phi=0} = - \frac{\theta c_3}{\theta^2 n_{PT} c_3 + (1-\theta) \theta c + \frac{N'}{2} w_T} = \frac{-1}{\theta n_{PT} + (1-\theta) \frac{c}{c_3} + \frac{N' w_T}{2 \theta c_3}} < 0$$

Since  $(1-\theta)c/c_3 + N'w_T/2\theta c_3 > 0$ , we also have:

$$\left. \frac{d e_R}{d n_{PT}} \right|_{\phi=0} > \left. \frac{d e_R}{d n_{PT}} \right|_{n=0}$$

that is, the locus  $n = 0$ , along which private financial wealth is constant, is steeper than the locus  $\phi = 0$ , along which the nontraded goods market is in Walrasian equilibrium, as depicted in Figure 2. The long-run equilibrium configuration  $(n_{PT}^*, e_R^*)$  is determined by the intersection of these loci at A.

#### Effects of exogenous shocks

With this apparatus in hand, we can now establish the following propositions:

7. A switch in government spending from traded to nontraded goods leads in the long run to an appreciation of the real exchange rate, an increase in real private financial wealth, and an increase in the product wage in the traded goods sector.

A switch of government spending from traded to nontraded goods has no effect on private saving, but shifts the locus  $\phi = 0$  downward by the amount:

$$\left. \frac{d e_R}{d g^N} \right|_{\phi = 0} = \frac{-1}{\theta^2 n_{PT} c_3 + (1-\theta)\theta c + \frac{N'}{2} w_T^*} < 0$$

This is shown as the new locus  $\tilde{\phi} = 0$  in Figure 3. As the figure shows, the effect is to appreciate the real exchange rate to shift private excess demand away from nontraded goods to make room for the additional government demand. Since under our assumption that  $c_3 > \rho_F$  this real appreciation increases private saving, private wealth must rise to satisfy  $\dot{n}_{PT} = 0$ . Thus the real appreciation must be sufficiently large to reduce private excess demand in spite of the positive effects on private demand arising from the increase in wealth. The effect on the product wage in the traded goods sector follows directly from the decline in  $e_R$  and equation (43).

8. An increase in government spending on traded goods financed by an increase in taxation on the private sector results in a real depreciation and a reduction in real private financial wealth.

An increase in taxation reduces private saving. The locus  $n = 0$  shifts to the left by:

$$\left. \frac{dn_{PT}}{dt_P} \right|_{n = 0} = \frac{1-c_1}{\rho_F - c_3} < 0.$$

On the other hand, since private demand for nontraded goods decreases, the locus  $\phi = 0$  shifts up by:

$$\left. \frac{d e_R}{d t_P} \right|_{\phi = 0} = \frac{\theta c_1}{\theta^2 n_{PT} c_3 + (1-\theta)\theta c + N' w_T^*/2} > 0$$

The new loci are labelled  $\tilde{n} = 0$  and  $\tilde{\phi} = 0$  in Figure 4. The long-run equilibrium moves from A to B. A reduction in private wealth and a real devaluation are required to simultaneously restore the level of private saving and to restore equilibrium in the market for nontraded goods.

9. Turning to external disturbances, the effects of an increase in the foreign real interest rate are a long-run real exchange appreciation together with an increase in real private financial wealth.

Figure 3 EFFECT OF AN INCREASE IN GOVERNMENT SPENDING ON  
NONTRADED GOODS ON LONG-RUN EQUILIBRIUM

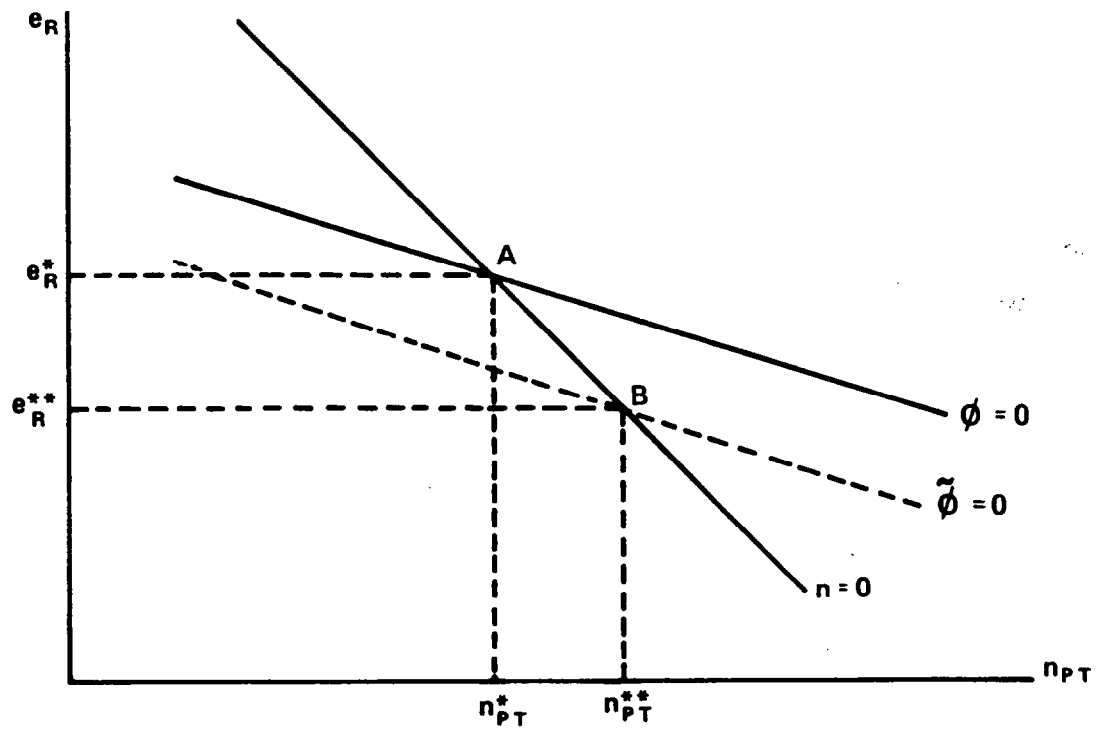
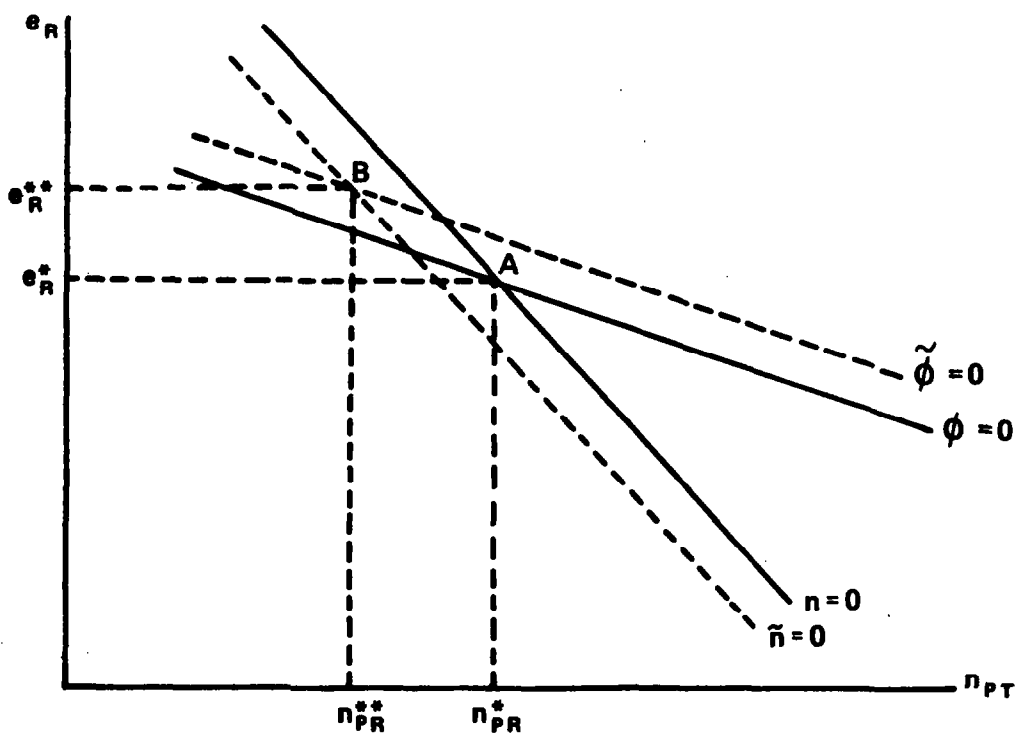




Figure 4 EFFECTS OF AN INCREASE IN TAXES ON LONG-RUN EQUILIBRIUM



THE UNIVERSITY OF CHICAGO

1962

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO

An increase in the external real interest rate reduces private consumption and thus private demand for nontraded goods. At the same time, the increase in real interest rates increases private disposable income both by increasing interest receipts on existing asset holdings (as long as private net worth exceeds the demand for real cash balances, which has been assumed to be the case) and by causing a portfolio reallocation from money to interest-bearing assets. Thus the  $n = 0$  locus shifts rightward by the amount

$$\left. \frac{dn_{PT}}{d\rho_F} \right|_{n=0} = - \frac{(n_{PT}-L) - r_F L_2 - c_2}{\rho_F - c_3} > 0$$

The locus  $\phi = 0$  shifts upward by:

$$\left. \frac{de_R}{d\rho_F} \right|_{\phi=0} = \frac{-\theta c_2}{\theta^2 n_{PT} c_3 + (1-\theta)\theta c + N'w_T/2} > 0.$$

Since both  $n = 0$  and  $\phi = 0$  shift to the right in Figure 5, it may appear that the final effects on  $e_R^*$  and  $n_{PT}^*$  are ambiguous. However, it can be shown that the rightward shift in  $n = 0$  to  $\tilde{n} = 0$  must exceed the shift from  $\phi = 0$  to  $\tilde{\phi} = 0$ . <sup>1/</sup> Thus a real appreciation and an increase in private wealth combine to restore equilibrium in the market for nontraded goods while maintaining  $\dot{n}_{PT} = 0$ .

10. Finally, the effects on  $e_R^*$  and  $n_{PT}^*$  of an increase in the external inflation rate depend on the interest elasticity of the demand for money.

---

<sup>1/</sup> The rightward shift in  $n = 0$  is given above. The shift in  $\phi = 0$  is:

$$\left. \frac{dn_{PT}}{d\rho_F} \right|_{\phi=0} = - \frac{\theta c_2}{\theta c_3} = - \frac{c_2}{c_3} < \frac{-c_2 + [(n_{PT}-L) + r_F L_2]}{c_3 - \rho_F} = \left. \frac{dn}{d\rho_F} \right|_{n=0}$$

Under present assumptions, the market for nontraded goods is unaffected. <sup>1/</sup> Differentiating (37b) with respect to  $\hat{P}_T$  shows that effects on private saving depend on what happens to the inflation tax on real cash balances--i.e., on the interest elasticity of the demand for money. If this elasticity is greater than one, the inflation tax falls, disposable income increases, and saving increases. The locus  $n = 0$  shifts to the right and the equilibrium configuration  $(e_R^*, n_{PT}^*)$  move to the southeast along  $\phi = 0$ , resulting in an increase in private wealth coupled with a real appreciation to maintain equilibrium in the nontraded goods market. If the interest elasticity of the demand for money is less than one, the inflation tax rises and the preceding results are reversed.

This analysis has focused on the effects of the various disturbances considered here on the economy's internal equilibrium. To conclude this section, it may be useful to examine briefly the implications of these disturbances for the balance of payments in the long run. Only changes in the external variables will affect the long-run real balance of payments or the long-run stock of real reserves. This is evident from equation (17a). In the long run it takes the form:

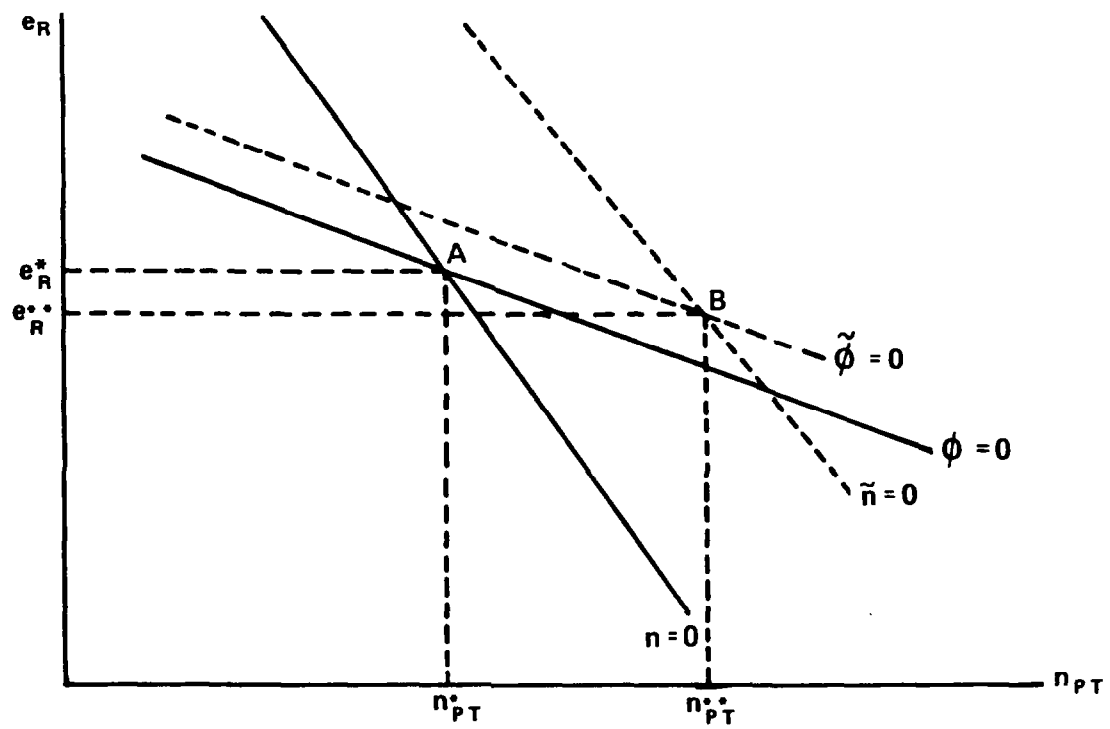
$$\frac{BOP}{P} = \hat{P}_T L(y^*, \rho_F + \hat{P}_T)$$

since  $\hat{y} = 0$  and, under the various measures discussed above,  $\hat{D}$  remains unchanged at its initial value of zero. Changes in taxes or in the composition of government spending have no effects on the determinants of  $BOP/P$  in the long run. Increases in the foreign real interest rate reduce the long-run real balance of payments surplus by reducing the demand for money. Finally, as is evident from inspection of the expression for  $BOP/P$ , the balance-of-payments effects of changes in the external inflation rate  $\hat{P}_T$  depend on the interest elasticity of the demand for money.

---

<sup>1/</sup> This is because the rate of return on money was not permitted to affect private consumption. Allowing for a positive effect of inflation on consumption would not qualitatively affect other results, since this effect is already included via the real interest rate. It would, however, affect this last exercise by increasing the likelihood that saving would fall and simultaneously increasing the demand for nontraded goods.

Figure 5 EFFECTS OF AN INCREASE IN THE EXTERNAL REAL INTEREST RATE  
ON LONG-RUN EQUILIBRIUM





#### IV. Conclusions

To the extent that applying the monetary approach to the balance of payments involves the use of the "reserve-flow" equation, a previous paper (Montiel (1985)) showed that the model of Section II reconciles the monetary approach with the use of a fairly conventional Keynesian structural model in the short run. Thus, reconciling monetary and Keynesian approaches does not require extending the analysis to the economy's long-run equilibrium.

This paper has gone one step further by showing that the Keynesian model of Section II can be reconciled not only with the monetary approach per se in the form of the "reserve-flow" equation, but also with the particular structural model most commonly associated with that approach--i.e., the "global monetarist" model. This does require extending the analysis to the long run, since the reconciliation takes the form of demonstrating that the Keynesian model of Section I has "global monetarist" properties in the long run. That is, it is characterized in the long run by full employment, purchasing power parity, and uncovered interest parity. It is therefore not surprising that, as demonstrated in Section III, familiar "global monetarist" results are produced by the long-run configuration of our Keynesian model. These include the temporary nature of balance of payments deficits in the absence of inflation, an "offset coefficient" of -1 on changes in the stock of domestic credit, and the dependence of the effects of devaluation on the nature of the accompanying monetary policy. These properties characterize the model's long-run equilibrium regardless of which long-run configuration the economy settles into--i.e., regardless of the values of the exogenous variables. The actual long-run configuration, in turn, depends on the values taken by policy variables and by variables that describe the external environment.

The operational content of this model depends on the empirical relevance of its dynamic structure. As long as changes in production and employment are rapid in the real world relative to changes in aggregate wage and price levels, short-run stabilization policy in small open economies may best be formulated within a Keynesian framework. A recent paper by Chopra (1985) supports the empirical relevance of gradual price adjustment--i.e., "Keynesian" dynamics--for several developing countries. Earlier analysis demonstrated that adopting such a Keynesian view of the structure of the economy need not require eschewing the "reserve-flow" equation characteristic of the monetary approach. This paper has demonstrated that such a view is also not in contradiction with the intuitively appealing market-clearing and parity conditions underlying "global monetarist" models nor with the fundamental conclusions of such models, as long as their relevant domain is understood to be the long run.

Stability Conditions

The stability of the model in the vicinity of the long-run equilibrium can be examined by linearizing equations (37a), (39a), and (40a) around  $(n_{PT}^*, e_R^*, w_T^*)$ . This produces:

$$(46) \begin{bmatrix} \dot{n}_{PT} \\ \dot{e}_R \\ \dot{w}_T \end{bmatrix} = \begin{bmatrix} n_1 & n_2 & n_3 \\ e_1 & e_2 & e_3 \\ w_1 & w_2 & w_3 \end{bmatrix} \begin{bmatrix} dn_{PT} \\ de_R \\ dw_T \end{bmatrix}$$

Where:

$$\begin{aligned} n_1 &= \rho_f - c_3 + n\phi_4 \\ n_2 &= (\rho_f - c_3)\theta n_{PT} + c_2 P_1 + n\phi_5 \\ n_3 &= c_2 P_2 + (\eta - c_2 P_3) w_T L^T + n\phi_6 < 0 \\ e_1 &= -P_3\phi_4/\theta < 0 \\ e_2 &= -(P_1 + P_3\phi_5)/\theta < 0 \\ e_3 &= -(P_2 + P_3\phi_6)/\theta < 0 \\ w_1 &= (g'\hat{L}^{N'} + P_3)\phi_4 < 0 \\ w_2 &= P_1 + (g'\hat{L}^{N'} + P_3)\phi_5 > 0 \\ w_3 &= g'\hat{L}^{N'} + P_2(g'\hat{L}^{N'} + P_3)\phi_6 > 0 \end{aligned}$$

and  $\eta = 1 - c_1 + c_2 P_3 - r_F L_1$  is the marginal propensity to save. The signs of  $n_1$  and  $n_2$  are ambiguous on the basis of assumptions in the text.

The Routh-Hurwitz necessary and sufficient conditions for stability in the neighborhood of  $(n_{PT}^*, e_R^*, w_T^*)$  are:

a.  $n_1 + e_2 + w_3 < 0$

b.  $n_2 e_3 w_1 + n_3 e_1 w_2 - n_1^2 w_3 + n_1 n_3 w_1 - 2 n_1 e_2 w_3 - n_1 w_3^2$   
 $+ n_3 w_1 w_3 + n_1 (n_2 e_1 - n_1 e_2) + e_2 (n_2 e_1 - n_1 e_2) + e_2 (e_3 w_2 - e_2 w_3)$   
 $+ w_3 (e_3 w_2 - e_2 w_3) > 0.$

c.  $n_1 (e_2 w_3 - e_3 w_2) + n_2 (e_3 w_1 - e_1 w_3) + n_3 (e_1 w_2 - e_2 w_1) < 0.$

On the basis of assumptions made in the text it can be shown that:

$$e_3 w_2 - e_2 w_3 < 0$$

$$e_3 w_1 - e_1 w_3 < 0$$

$$e_1 w_2 - e_2 w_1 > 0.$$

It can also be shown that if  $n_1$  is negative, the expression  $(n_2 e_1 - n_1 e_2)$  must also be negative. Applying these results together with the partial derivatives derived previously to the Routh-Hurwitz conditions (a)-(c), it follows that  $n_1 < 0$  and  $n_2 > 0$  are jointly sufficient to guarantee the local stability of the system (46). By substituting for  $\phi_5$  in the expressions for  $n_1$  and  $n_2$ , we find that these signs will hold if:

$$(47a) \quad c_3 > \rho_F / (1 - \frac{\theta \eta}{\beta})$$

$$(47b) \quad c^N > - \frac{\beta}{\eta (1-\theta)} [(\rho_F - \frac{[1-\theta\eta]}{\beta} c_3) \theta n_{PT} - \frac{(1-\theta\eta)}{\beta} c_2 P_1],$$

Where  $\beta = 1 - \theta c_1 + \theta c_2 P_3 > 0$  is the inverse of the Keynesian multiplier for this model. The first expression stipulates that wealth effects on consumption are sufficiently strong that an increase in real wealth reduces saving. The second requires substitution effects on consumption to exceed a threshold value to ensure that a reduction in the price of nontraded goods (an increase in  $e_R$ ) will increase private saving. With our assumption of constant expenditure shares and initial  $e_R = 1$ , this substitution effect is given by  $(1-\theta)\theta c$ , or  $(1-\theta)c^N$ . This increase in consumption of nontraded goods increases real saving by  $\eta\beta^{-1} (1-\theta)c^N$ . Inequality (47b) requires that this positive effect on saving exceed negative effects due to an increase in real wealth given by  $\theta n_{PT}$  and a decrease in the domestic real interest rate equal to  $P_1$ .

References

- Barro, Robert J., and Herschel I. Grossman, "A General Disequilibrium Model of Income and Employment," American Economic Review, Vol. 61 (March 1971), pp. 82-93.
- \_\_\_\_\_, Money, Employment, and Inflation, (Cambridge, England: Cambridge University Press, 1976).
- Chopra, Ajai, "The Speed of Adjustment of the Inflation Rate: A Cross-Country Study of the Role of Inertia," (unpublished, IMF, 1985).
- Cuddington, John T., Per-Olov Johansson, and Karl-Gustaf Löfgren, Disequilibrium Macroeconomics in Open Economies (Oxford, England: Basil Blackwell, 1984).
- Fleming, J. Marcus, "Domestic Financial Policies Under Fixed and Under Floating Exchange Rates," Staff Papers, International Monetary Fund (Washington), Vol. 9 (November 1962), pp. 369-379.
- Frenkel, Jacob A., Thorvaldor Gylfasson and John F. Helliwell, "A Synthesis of Monetary and Keynesian Approaches to Short-Run Balance-of-Payments Theory," Economic Journal, Vol. 90 (September 1980), pp. 582-92.
- Gordon, Robert J., "Inflation in Recession and Recovery," Brookings Papers on Economic Activity, Vol. 1 (1971), pp. 105-58.
- Johnson, Harry G. "The Monetary Approach to Balance-of-Payments Theory," in Jacob A. Frenkel and Harry G. Johnson (eds.), The Monetary Approach to the Balance of Payments (London: George Allen and Unwin, 1976), pp. 147-167.
- Malinvaud, Edmund, The Theory of Unemployment Reconsidered (New York: John Wiley and Sons, 1977).
- Montiel, Peter J. "Do Prices Have a Life of Their Own?" (unpublished, M.I.T., 1976).
- \_\_\_\_\_, "A Monetary Analysis of a Small Open Economy With a Keynesian Structure," Staff Papers, International Monetary Fund (Washington), Vol. 32 (June 1985), pp. 179-210.
- Mundell, Robert A., International Economics (New York: Macmillan Publishing Co., 1968).
- \_\_\_\_\_, "The Optimum Balance of Payments Deficit," in Emil Claassen and Pascal Salin, Stabilization Policies in Interdependent Economies (Amsterdam: North Holland, 1972), pp. 69-90.

- Mussa, Michael, "Tariffs and the Balance of Payments: A Monetary Approach," in Jacob Frenkel and Harry G. Johnson, The Monetary Approach to the Balance of Payments (London: George Allen and Unwin, 1976), pp. 187-221.
- Nordhaus, William D., "Recent Developments in Price Dynamics," in Otto Eckstein (ed.), The Econometrics of Price Determination Conference (Washington, 1972).
- Officer, Lawrence H., "The Purchasing-Power Parity Theory of Exchange Rates: A Review Article," Staff Papers, International Monetary Fund, Vol. 23 (Washington, 1976), pp. 1-60.
- Parkin, Michael, "The Causes of Inflation: Recent Contributions and Current Controversies," in Michael Parkin and A.R. Nobay (eds.), Current Economic Problems (Cambridge University Press, 1975), pp. 243-291.
- Rodriguez, Carlos A., "Money and Wealth in an Open Economy Income-Expenditure Model," in Jacob A. Frenkel and Harry G. Johnson (eds.) The Monetary Approach to the Balance of Payments (London: George Allen and Unwin, 1976), pp. 222-236.
- Whitman, Marina N., "Global Monetarism and the Monetary Approach to the Balance of Payments," Brookings Papers on Economic Activity, Vol. 3 (1975), pp. 491-556.