NBER WORKING PAPER SERIES

ASSET MARKETS, EXCHANGE RATES AND THE BALANCE OF PAYMENTS

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Working Paper No. 1287

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

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ABSTRACT

This paper, written as a chapter for a Handbook of International Economics, reviews developments in the theory of international monetary economics from the late 1960's through the early 1980's. Following a review of the operation of the monetary mechanism of balance of payments adjustment in the context of the Mundell-Fleming model, the paper reviews the more modern analysis of the dynamics of balance of payments adjustment under fixed exchange rates and of exchange rate determination under flexible exchange rates. Beginning with a simple exposition of the monetary mechanism, the model is then extended to incorporate sluggish wage and output adjustments, endogenous monetary policy and sterilization operations, multiplicity of tradable and nontradable goods, large countries, capital mobility and portfolio balance. The review then turns to an exposition of exchange rate theory, starting with the monetary approach to exchange rate determination. Issues discussed in this context include purchasing power parities, nontraded goods, the real exchange rate, currency substitution and the interaction between real and monetary factors in effecting exchange rates. The paper proceeds with a presentation of a more general framework that views the question of exchange rate determination as part of the general theory of the determination of asset prices, and which highlights the unique role of expectations. The general framework is then applied to characterize the interaction between the balance of payments and the equilibrium real exchange rate. The paper concludes with a brief discussion of some empirical issues of exchange rate analysis.

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Introduction

This chapter reviews developments in international monetary economics from the late 1960's through the early 1980's. Since the world remained on a system of fixed exchange rates until 1973, most of the research in the earlier part of this period focused on monetary relationships and macroeconomic behavior of open economies under a system of fixed exchange rates. An issue of central importance in this research, including the extensive literature on the "monetary approach to the balance of payments," was the economic determinants of the behavior of the balance of payments, especially, the theoretical elaboration and empirical investigation of the dynamic mechanism of balance of payments adjustment. With the shift to a system of floating exchange rates among major currencies in 1973, there was a corresponding shift of research interests away from primary focus on the balance of payments and to principal concern with the economic determinants of the behavior of exchange rates. The unifying theme in much of this research was the "asset market approach to exchange rates" which emphasizes conditions for equilibrium in the markets for stocks of assets, especially national monies, as the proximate determinant of the behavior of exchange rates.

Three general features of the research surveyed in this chapter distinguish it, in general emphasis and broad outline, from the earlier work on international monetary economics surveyed in chapter 13 by Kenen. First, in the policy approach to open economy macroeconomics developed most extensively by Meade (1951), and extended by the important work of Mundell (1968c) and Fleming (1962), it is usually assumed that the level of national income is controlled by government policy, and that maintenance of full employment (or internal balance) is the paramount objective of economic policy. In this approach, the balance of payments is a "problem" because maintenance of balance of payments equilibrium (or external balance) constrains the use of macroeconomic policy for purposes of maintaining full employment. This problem can be satisfactorily resolved provided that governments have an adequate number of independent and effective policy instruments. More recent research on macro-economics, for both closed and open economies, expresses far less confidence in the ability of governments to systematically affect levels of national income and consistently maintain full employment through policy manipulation. This view is reflected in the more recent research on international monetary economics where the balance of payments and the exchange rate are regarded as important in their own right, rather than as subsidiary concerns of policy management.

Second, in much of the earlier work on international monetary economics, policy actions and economic disturbances were assumed to have essentially permanent effects on payments flows. It was recognized, of course, that the losses of foreign exchange reserves associated with official settlements deficits would imply a declining domestic money supply, unless the monetary effects of the reserve loss were sterilized by domestic credit expansion. It was also recognized that reserve losses sterilized by domestic credit expansion could not go on forever because a government would ultimately run out of reserves. However, relatively little attention was paid to the dynamic process that would operate if reserve losses (or gains) were allowed to affect the money supply, or to the long run equilibrium that would be established if this process were allowed to operate, or to the longer run consequences of changes in supplies of securities necessarily associated with policies of sterilizing reserve losses and gains. In contrast, in the research surveyed here, the dynamic interaction among asset stocks and payments flows is at the center stage of the analysis.

Third, in earlier work on exchange rate theory, the condition for equilibrium in the flow market for foreign exchange transactions (exports, imports, and capital flows) was usually regarded as the proximate determinant of the exchange rate. In some analyses, expectations of future exchange rates had an important influence on current exchange rates by affecting speculative capital flows. But, even in these analyses, expectations of future exchange rates were usually determined exogenously or by some ad hoc expectations mechanism. Recent research on the theory of exchange rates, in contrast, has focused more on the conditions for asset market equilibrium as the proximate determinant of equilibrium exchange rates, and has usually regarded expectations of future exchange rates as a critical factor affecting the conditions for equilibrium in the relevant asset markets. Moreover, by adopting the assumption of "rational expectations," many recent models of exchange rate behavior have allowed for endogenous determination of expectations of future exchange rates in a manner consistent with the structure of the economic system, and have thereby permitted explicit analysis of the role of information in forming and revising expectations critical to explaining the behavior of exchange rates.

Differences between the research surveyed in this chapter and earlier approaches to balance of payments analysis and exchange rate theory should not, however, be overemphasized. The theoretical models applied to balance of payments analysis in the late 1960's and early 1970's incorporate the same basic elements as earlier such models and, correspondingly, share many of the same properties and implications. This essential unity is emphasized in this survey by beginning our discussion, in section 2, with a review of the operation of the monetary mechanism of balance of payments adjustment in the context of the Meade-Mundell-Fleming model of open economy macroeconomics. We then turn in section 3 to the more mordern analysis of the dynamics of balance of payments adjustment under fixed exchange rates beginning with a simple exposition of the key elements of the monetary mechanism of balance of payments adjustment. The simple model is then extended to incorporate sluggish wage and output adjustments, endogenous monetary policy and sterilization operations, multiplicity of tradable and nontradable goods, the case of large countries with endogeneously determined terms of trade and, finally, capital mobility and portfolio balance.

Section 4 deals with the theory of flexible exchange rates. The evolution of the international monetary system from a regime of pegged exchange rates into a regime of flexible rates resulted in a renewed interest in the theory of exchange rate determination. Analogously to the characteristics of the modern theory of the balance of payments under fixed exchange rates, the modern theory of exchange rate determination has shifted the emphasis from the circular flow approach (that gained popularity with the Keynesian revolution) to considerations of portfolio choice and stock equilibrium. A consequence of this shift has been the development of the asset-market approach to the determination of exchange rates. Models which belong to the general category of the asset-market approach differ in their emphasis on the role of money and the other assets but they all highlight the roles of expectations and of stock equilibrium.

Our exposition of exchange-rate theory starts with a simple exposition of the monetary approach to exchange-rate determination. In this context we highlight the roles of purchasing power parities, non-traded goods, the real exchange rate, currency substitution, as well as the interaction between real and monetary factors which determine the equilibrium exchange rate. We then present a more general framework that views the question of exchange-rate determination as part of the general theory of the determination of asset prices. The broader framework highlights the unique role of expectations. The general framework is then used to characterize the interaction between the balance of payments and the equilibrium real exchange rate. This model shows that the current exchange rate depends on the entire expected future time paths of the relevant exogenous variables. The section concludes with a brief discussion of some empirical issues for exchange-rate analysis.

2. The Mundell-Fleming Model

The key development in the area of balance of payments analysis in the late 1960's and early 1970's was the theoretical elaboration and empirical investigation of the dynamic mechanism of balance of payments adjustment. The essential idea of this dynamic mechanism, which dates back to Hume's discussion of the price-specie-flow-mechanism, is that changes in asset stocks (especially the money supply) associated with payments imbalances alter the instantaneous equilibrium position of the economy over time and ultimately drive it to a long run equilibrium at which the payments imbalance is eliminated. In much of the literature on balance of payments theory and open economy macroeconomics of the 1950's and 1960's, this dynamic mechanism of balance of payments adjustment was either ignored or suppressed by assuming that the domestic monetary authority sterilized the monetary effects of foreign exchange reserve gains and loses. However, at least in Mundell's (1961) description of the international disequilibrium system, this dynamic mechanism was explicitly introduced into the standard model that represented the main line of development in this earlier literature.

As illustrated in figure 2.1, Mundell's analysis is based on the open economy extension of the IS-LM model, frequently referred to as the Mundell-

Fleming model. In this diagram, the positively sloped LM curves show combinations of national income, Y, and the domestic nominal interest rate, i, for which the real demand for domestic money, $L(Y, i)$ (where $\partial L/\partial Y > 0$ and $\partial L/\partial i < 0$), is equal to the real supply, M/P. The different LM curves are all drawn for the same, parametrically determined domestic price level, P, but for different levels of the domestic nominal money supply, M, with lower LM curves corresponding to larger domestic nominal money supplies. The negatively sloped IS curve indicates the combinations of Y and i for which the demand for national product is equal to national income. The demand for national product is the sum of domestic demand for domestic product, $D(Y, i; \tau)$ (where $\partial D/\partial Y > 0$, $\partial D/\partial i < 0$, and $\partial D/\partial \tau < 0$), plus foreign demand for domestic product, $I^*(\tau)$ (where $\partial I^*/\partial \tau < 0$; $\tau = P/S \cdot P^*$ is the terms of trade between domestic goods and foreign goods, where P^* denotes the foreign price of foreign goods and S denotes the exchange rate which is defined as the price of foreign exchange in terms of domestic currency. Alternatively, the demand for national product is the sum of total domestic expenditure, $E(Y, i)$ (where $1 > \partial E/\partial Y > \partial D/\partial Y > 0$, and $\partial E/\partial i < 0$) plus the trade balance surplus. In that alternative formulation, total domestic expenditure includes expenditure on imports, $I(Y, i; \tau) = E(Y, i) - D(Y, i; \tau)$, and, using this expression, the trade balance surplus is, $T(Y, i; \tau) = I^*(\tau) - I(Y, i; \tau)$, where $\partial T/\partial Y < 0$, $\partial T/\partial i > 0$, $\partial T/\partial \tau < 0$. The positively sloped FF curve shows combinations of Y and i for which the trade balance is zero.[1] The terms of trade, τ, is a parameter affecting the positions of the IS and FF curves.

At any moment of time, the instantaneous equilibrium position of the economy is determined by the intersection of the IS curve and the LM curve drawn for the current money supply. In particular, when the money supply is

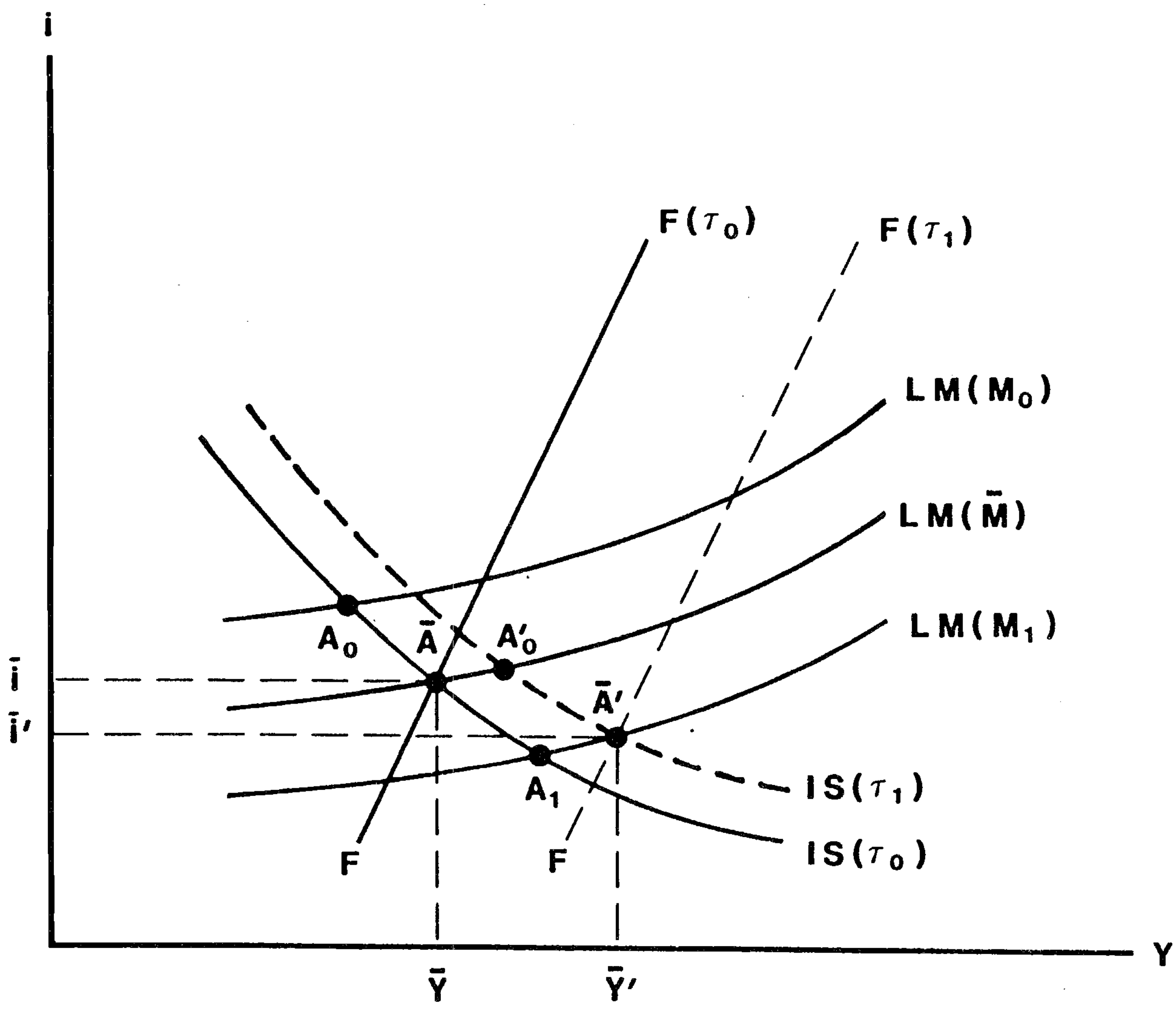

Figure 2.1: Monetary Policy and Devaluation in the Mundell-Fleming Model with Limited Capital Mobility

M_O and the terms of trade is τ_O, the instantaneous equilibrium point is at A_O in figure 2.1. At this instantaneous equilibrium, the trade balance is in surplus, as indicated by the fact that A_O is above and to the left of the FF curve. Since the present analysis assumes an absence of private capital flows, it follows that for the government to maintain a fixed exchange rate, it must purchase foreign exchange reserves at a rate equal to the trade surplus at A_O. If the government does not sterilize the monetary effects of this reserve accumulation, the domestic nominal money supply will grow at a rate equal to the rate of accumulation of foreign exchange reserves, valued in domestic money. Growth of M gradually shifts the LM curve in figure 2.1 downward and to the right, moving the instantaneous equilibrium point along the IS curve away from A_O and toward the point $\bar{A}$ determined by the intersection of the IS and FF curves. When the instantaneous equilibrium point (and the LM curve) reach $\bar{A}$, the trade balance is zero accumulation of foreign exchange reserves ceases, and economy is in long run equilibrium. The dynamic mechanism which drives the economy from A_O (or any other initial instantaneous equilibrium position) to long run equilibrium at $\bar{A}$ is the monetary mechanism of balance of payments adjustment. The total accumulation of foreign exchange reserve (the cumulative official settlements surplus) associated with the movement from A_O to $\bar{A}$, valued in domestic money, is determined by the difference between the initial nominal money supply, M_O, and the long run equilibrium level of the money supply, $\bar{M} = P_O \cdot L(\bar{Y}, \bar{i})$, where $\bar{Y}$ and $\bar{i}$ are the long run equilibrium levels of Y and i that are associated with the long run equilibrium point $\bar{A}$.

Starting at the instantaneous equilibrium A_O, if the money supply were increased by a domestic credit expansion to the extent of the difference between M_O and $\bar{M}$, the result would be an immediate shift of the LM curve to its long run equilibrium position and an immediate jump of national income and the domestic interest rate to their respective long run equilibrium values. As a consequence of this domestic credit expansion, therefore, the government would forego the increase in foreign exchange reserves that would otherwise occur as a consequence of the natural adjustment process of the economy in moving from A_0 to $\bar{A}$, but would gain a more immediate increase in the level of national income. Alternatively, if the government expanded domestic credit starting from a situation of long run equilibrium, it would temporarily shift the LM curve downward and to the right, creating an instantaneous equilibrium at a point like A_1 corresponding to the higher quantity of money, M_1. At A_1, there would be a balance of payments deficit, and the gradual adjustment of the domestic money supply implied by losses of foreign exchange reserves would ultimately drive the instantaneous equilibrium point back to $\bar{A}$. In the long run, therefore, the increase in the domestic credit component of the money supply would be fully offset by an equal loss of foreign exchange reserves, and the stimulative effect of the domestic credit expansion on national income would only be temporary. If the government attempted to maintain national income at a level above its long run equilibrium level by sterilizing foreign exchange reserve losses through offsetting domestic credit expansions, it could do so for a while, but ultimately it would run out of reserves.

A devaluation from an initial equilibrium at $\bar{A}$ increases S and reduces τ from τ_0 to τ_1 (since in this analysis P and P^* are assumed to be given) shifting both the IS and FF curves to the right to I'S' and F'F', respectively. The new <u>long run</u> equilibrium is at $\bar{A}'$, with a higher long run equilibrium level of national income, $\bar{Y}'$, and a lower long run equilibrium level of the domestic interest rate, $\bar{i}'$.[2] If at the time of this devaluation, the money supply was at the long run equilibrium level appropriate for the old exchange rate, the impact effect of the devaluation will be to move the instantaneous equilibrium point up along the LM curve passing through $\bar{A}$ to the intersection between this LM curve and the new IS curve as illustrated by point A_0'. The impact effect of devaluation, therefore, is to increase domestic income and the domestic interest rate and to create a balance of payments surplus. These impact effects of devaluation, however, are not the permanent, long-run effects of devaluation. Increases in the money supply resulting from payments surpluses that are the short run consequence of the devaluation drive the economy to its new long run equilibrium $\bar{A}'$ at which domestic income is higher and the domestic interest rate is lower than A_0' and at which the (flow) balance of payments surplus initially created by the devaluation is eliminated. With respect to the balance of payments, therefore, the long run effect of devaluation is a permanent, cumulative change in the level of reserves equal to increase in the long run equilibrium size of the nominal money supply from $\bar{M} = L(\bar{Y}, \bar{i})$ to $\bar{M}' = L(\bar{Y}', \bar{i}')$, but not a permanent surplus in the flow magnitude of the balance of payments.

When privately held financial assets are internationally mobile, this analysis of the balance of payments adjustment mechanism needs to be modified to take account of the effects of capital movements on reseve holdings and national money supplies. Specifically, with perfect capital mobility, the FF curve indicating balance of payments equilibrium becomes a horizontal line at the level of the world interest rate, i^*, as indicated in figure 2.2. In this situation an instantaneous equilibrium at a point like A_0, determined by the IS curve and the LM curve for a domestic money supply of M_0, is not sustainable as an instantaneous equilibrium because a domestic interest rate

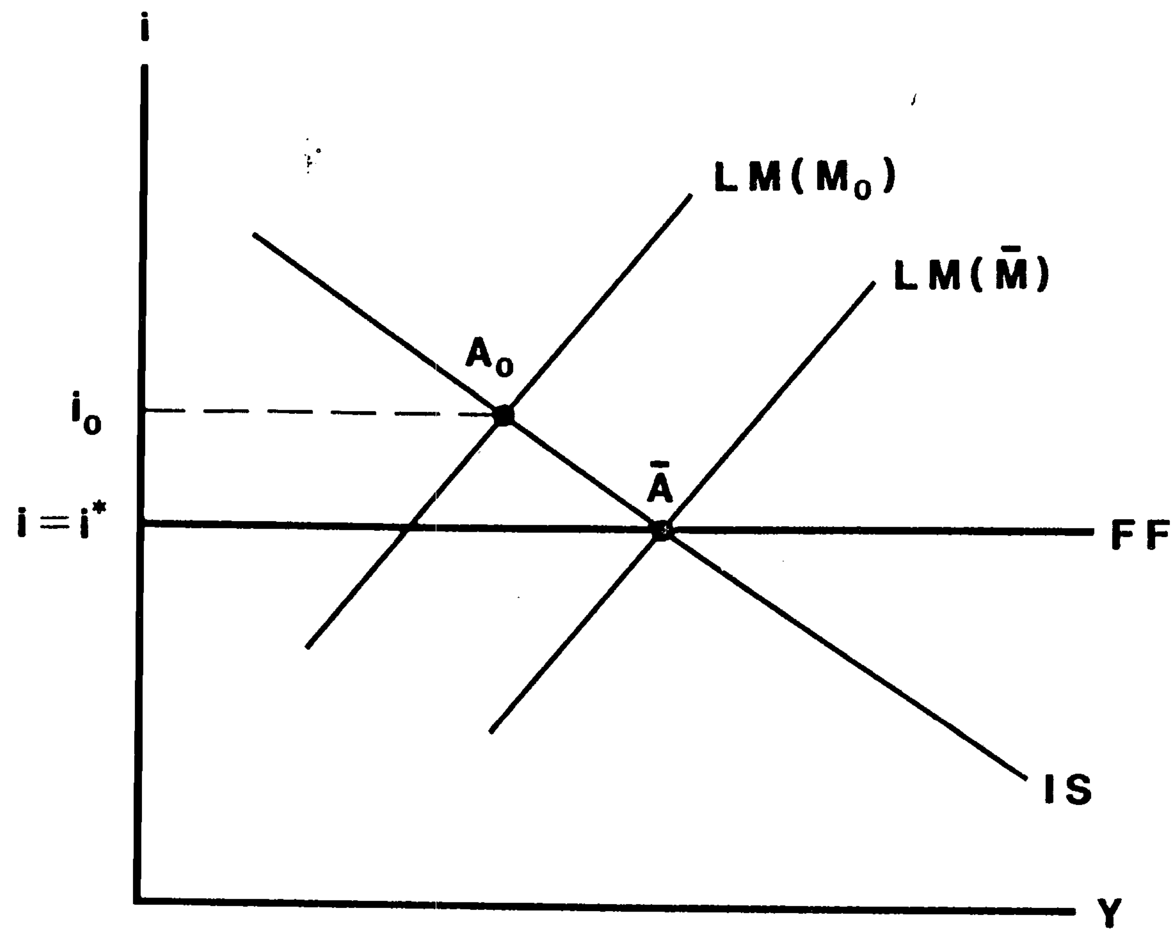

Figure 2.2: The Mundell-Fleming Model with Perfect Capital Mobility

i_0 that is above the world interest rate i^* would induce a huge capital inflow. Domestic residents would sell securities to foreigners in order to increase their money balances to the level consistent with $i = i^*$. The increase in reserves implied by this capital inflow causes the LM curve to jump until it passes through the long run equilibrium point $\bar{A}$ determined by the intersection of the IS curve with the FF curve. Thus, with perfect capital mobility, the balance of payments adjustment process is not a gradual process in which money supply gradually adjusts to reserve gains and losses associated with trade imbalances, but rather an instantaneous adjustment process in which the level of reserves adjusts immediately in response to international capital movements.

The essential elements in this analysis of the mechanism of balance of payments adjustment, including the analysis of the cumulative effects on the balance of payments of changes in domestic credit or the exchange rate and of the consequences of international capital mobility are also central in the literature on balance of payments theory that developed during the late 1960's and early 1970's. In this literature, however, less reliance is placed on the Keynesian assumptions of rigid domestic prices and demand determined output levels as the relevant assumptions for balance of payments analysis, and more attention is devoted to explicit modelling of the dynamics of the balance of payments adjustment process. The analysis in section 3 focuses on these issues.

3. The dynamics of balance of payments adjustment under fixed exchange rates

3.1. Adjustment in a small open economy without capital mobility

To illustrate the monetary mechanism of balance of payments adjustment consider first a small open economy facing given world relative prices of all (tradeable) goods produced and consumed by domestic residents. Using the Hicksian aggregation principle, domestic real income (equal to domestic output), Y, and domestic real expenditure, E, are measured in common units of a composite tradeable good. Domestic real income is constant at the level determined by full employment of domestic resources. Domestic real expenditure depends on domestic real income, the domestic real interest rate, r, and the real value of privately held domestic assets, A/P;

$$E = E(Y, r, A/P), \quad \partial E/\partial Y > 0, \quad \partial E/\partial r < 0, \quad \partial E/\partial(A/P) \geq 0. \qquad (3.1)$$

Privately held domestic assets consists of domestic money, M, and domestic interest bearing securities, B, which are denominated in units of domestic money and have an infinitesimal maturity (like call loans);

$$A = M + B. \qquad (3.2)$$

In the absence of international mobility of capital, these assets are assumed to be non-tradable internationally. The real value of these assets depends on the domestic price level, P, which is equal to the foreign price, P^*, multiplied by the exchange rate, S:

$$P = S \cdot P^*. \qquad (3.3)$$

The domestic money supply (under the simplifying assumption that the money multipler is unity) is high powered money issued by the domestic central bank and is equal to the sum of the domestic money value of the foreign exchange reserves of the central bank, $S \cdot R$, domestic securities held by the central bank, B_g, and the fiat issue (the "net worth") of the central bank, J;

$$M = S \cdot R + B_g + J. \qquad (3.4)$$

The fiat of the central bank designates a balance sheet entry which represents the "net worth" of the central bank--that is, the difference between the value of the central bank's monetary liabilities, M, and the value of its reserves and domestic security holdings, $S \cdot R + B_g$. An increase in the domestic currency value of foreign exchange reserves due to an increase in S that is not monetized by the central bank is offset by a corresponding decline in J.

Interest bearing securities and national monies are not internationally tradeable. The total stock of domestic securities issued by the domestic government, $\bar{B}$, is held either by domestic residents or by the central bank[3]

$$B + B_g = \bar{B}. \tag{3.5}$$

Since the asset demands of domestic residents for domestic money and domestic securities must satisfy the balance sheet constraint, the condition for asset market equilibrium in this country can be expressed as the condition for money market equilibrium:

$$L(Y,\ i,\ A/P) = M/P; \quad \partial L/\partial Y > 0, \quad \partial L/\partial i < 0, \quad 1 > \partial L/\partial(A/P) > 0, \tag{3.6}$$

where $L(Y, i, A/P)$ is the real demand for domestic money, and where i denotes the domestic nominal interest rate that is equal to the real rate, r, plus the expected rate of inflation. In what follows we assume that the expected rate of inflation is zero and, therefore, we identify r with the nominal rate of interest. The condition of asset market equilibrium implicitly determines the equilibrium of the domestic interest rate so that

$$r = \tilde{r}(M/P,\ B/P,\ Y), \quad \partial\tilde{r}/\partial(M/P) < 0, \quad \partial\tilde{r}/\partial(B/P) > 0, \quad \partial\tilde{r}/\partial Y > 0. \tag{3.7}$$

Given the interest rate (which is implicitly determined by the requirement of asset market equilibrium), the level of real domestic expenditure becomes a reduced form function of the real money supply, real private security holdings, and domestic real income:

$$E = \tilde{E}(M/P,\ B/P,\ Y) \equiv E(Y,\ \tilde{r}(M/P,\ B/P,\ Y),\ (M/P + (B/P))). \tag{3.8}$$

An increase in M/P increases $\tilde{E}$ both because it reduces $\tilde{r}$ and because it increases A/P. An increase in B/P has an ambiguous effect on $\tilde{E}$ because the effect on $\tilde{r}$ works in the opposite direction of the effect on A/P. An increase in Y may be presumed to increase $\tilde{E}$ provided that the direct effect, $\partial E/\partial Y$, is stronger than indirect interest rate effect, $(\partial E/\partial r)\cdot(\partial \tilde{r}/\partial Y)$. The indirect interest rate effect, however, should be sufficient to insure that $\partial \tilde{E}/\partial Y < 1$, even if $\partial E/\partial Y > 1$.

In accord with the basic equation of the absorption approach to the balance of payments, the home country's real trade balance, T, must equal the excess of domestic real income (equal to domestic output) over domestic real expenditure; that is, $T = Y - E$ [see Alexander (1952)]. Using the reduced form expenditure function $\tilde{E}$, it follows that

$$T = \tilde{T}(M/P,\ B/P,\ Y) \equiv Y - \tilde{E}(M/P,\ B/P,\ Y). \qquad (3.9)$$

An increase in M/P raises spending and worsens the real trade balance since $\partial\tilde{T}/\partial(M/P) = -\partial\tilde{E}/\partial(M/P) < 0$. An increase in B/P has an ambiguous effect on the real trade balance because its influence on spending, i.e., the sign of $\partial\tilde{E}/\partial(B/P)$ is ambiguous. An increase in Y improves the real trade balance because it raises income by more than spending since $\partial\tilde{T}/\partial Y = 1 - \partial\tilde{E}/\partial Y$ is presumably positive.

Since, by assumption, trade imbalances cannot be financed by private capital flows or by changes in private holdings of foreign monies, they must be financed by a flow of international reserves which the domestic central bank is compelled to absorb or supply in order to maintain the fixed exchange rate. The magnitude of this reserve flow is given by

$$\dot{R} = P^{*}\cdot T \qquad (3.10)$$

where $\dot{R}$ denotes the rate of change of international reserves, i.e., $\dot{R} \equiv dR/dt$. Assuming that the central bank does not alter its domestic security holdings or fiat issue, either to sterilize the foreign exchange flow or for any other reason, the rate of change of the domestic nominal money supply, $\dot{M}$, must equal the nominal value of the trade balance:

$$\dot{M} = P\cdot\tilde{T}(M/P,\ B/P,\ Y). \qquad (3.11)$$

This result captures four essential features of the monetary mechanism of balance of payments adjustment.

First, there is a natural equilibrating process through which foreign exchange reserve flows associated with trade imbalances adjust the domestic money supply to its long run equilibrium level and simultaneously bring equilibrium to the trade balance. The nature of this equilibrating process is illustrated in figure 3.1 where the $P \cdot \tilde{T}(M/P, B/P, Y)$ curve shows the relationship between the rate of change of the domestic money supply and the level of the domestic money supply, given constant values of B, Y and P. This $P \cdot \tilde{T}(M/P, B/P, Y)$ curve is negatively sloped because an increase in M reduces the trade balance surplus or increases the trade balance deficit. The unique intersection of this curve with the M axis occurs at the long run equilibrium level of the domestic money demand, $\bar{M}(Y, B, P)$, which is determined implicitly by the requirement that

$$\tilde{T}(M/P, B/P, Y) = 0. \tag{3.12}$$

When M is less than $\bar{M}(Y, B, P)$, the relatively high level of the domestic interest rate and the relatively low level of privately held domestic assets induce a level domestic real expenditure that is less than domestic real income and, correspondingly, a trade balance surplus. The reserve inflow implied by this trade surplus gradually raises the domestic money supply and ultimately drives the economy to its long run equilibrium where $M = \bar{M}(Y, B, P)$, and the trade balance is zero. The opposite process occurs if M is initially larger than $\bar{M}(Y, B, P)$.[4]

Second, any change in the supply of domestic money that is not offset by a change in the long run equilibrium level of domestic money demand leads to an equivalent change in foreign exchange reseves and to a corresponding cumulative payments surplus (or deficit). This change in reserves and

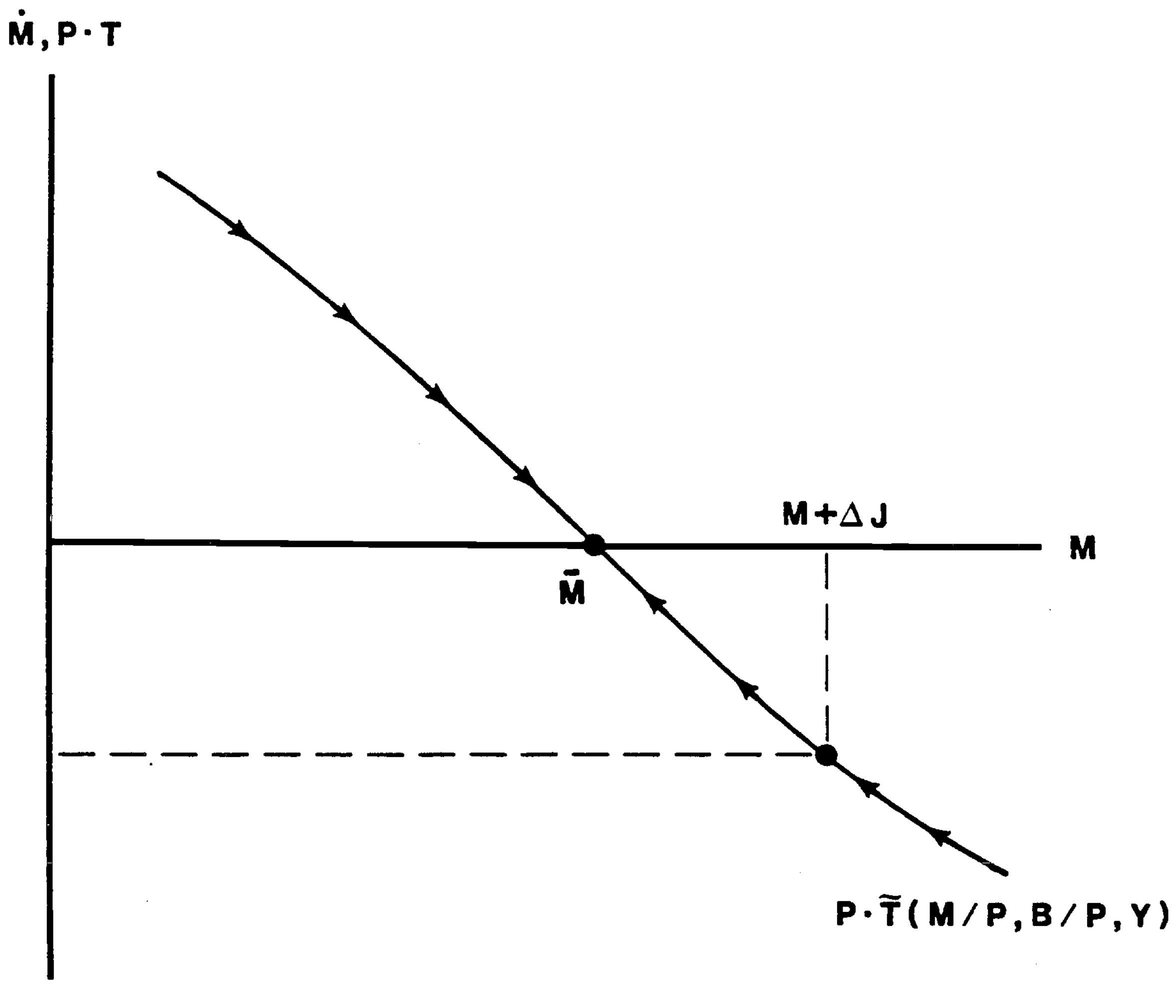

Figure 3.1: The Dynamics of Monetary Adjustment

cumulative payments surplus must be measured relative to the long run level of reserves and cumulative payments position that would have resulted in the absence of the initiating change in the money supply. For example, suppose that starting with a money supply of $\bar{M}$, there is an increase ΔJ in the fiat issue of the central bank. Immediately after this increase in fiat, M will exceed $\bar{M}$ by ΔJ and, as illustrated in figure 3.1, there will be a trade deficit corresponding to the nominal value of the induced excess of domestic real expenditure over domestic real income. From the figure it is clear that the cumulative magnitude of nominal trade deficits during the process of convergence back to $\bar{M}$ must equal the initial fiat increase in the domestic money supply.[5]

Third, any change in the long run equilibrium level of domestic money demand that is not offset by changes in the domestic assets component of the money supply ultimately leads to corresponding change in the foreign exchange reserve component of the money supply and to a corresponding cumulative payments surplus (or deficit). For example, suppose that economic growth increases domestic real income from Y_0 to Y_1, thereby increasing the long run equilibrium level of money demand from $\bar{M}_0 = \bar{M}(Y_0, B, P)$ to $\bar{M}_1 = \bar{M}(Y_1, B, P)$.[6] If there are no changes in the other components of the money supply, then relative to what would have happened in the absence of the increase in domestic income, there must be net inflow of foreign exchange reserves and a corresonding cumulative payments surplus equal to $\bar{M}_1 - \bar{M}_0$.

Another example is a devaluation that raises the exchange rate, S, and hence the domestic price level, $P = S \cdot P^*$. The elasticity of the long run equilibrium level of money demand with respect to the domestic price level (and hence the exchange rate) is given by

$$(P/\bar{M}) \cdot \partial\bar{M}/\partial P = 1 + (B/\bar{M}) \cdot [\partial\tilde{T}/\partial(B/P)/\partial\tilde{T}/\partial(M/P)]. \quad (3.13)$$

If $\partial\hat{T}/\partial(B/P) = -\,\partial\hat{E}/\partial(B/P) < 0$, then a devaluation will result in a more than proportional increase in the long run equilibrium level of money demand and in a corresponding increase in foreign exchange reserves and cumulative payments surplus. If the effect of the rise in the rate of interest is sufficiently strong so as to result in $\partial\hat{T}/\partial(B/P) > 0$, then (when the system is stable so that $(B/\bar{M})\cdot[\partial\hat{T}/\partial(B/P)/\partial\hat{T}/\partial(M/P)] > -1$), a devaluation will result in a less than proportional increase in the long run equilibrium level of money demand and in a correspondingly smaller increase in foreign exchange reserves and cumulative payments surplus. The reason why the long run equilibrium level of money demand may not rise proportionately with the increase in the exchange rate (as it does in some simple monetary models of devaluation) is that the nominal stock of bonds, B, is a parameter affecting the long-run equilibrium level of money balances. This non-neutrality of exchange rate changes disappears if domestic bonds are denominated in real goods rather than in domestic money, or if private residents see through the government budget constraint and regard government debt as completely and perfectly offset by expected future tax liabilities.[7] An import tariff, in contrast to a devaluation, generally has non-neutral effects because a tariff alters relative commodity prices, in addition to affecting the general level of domestic prices, and this alteration of relative prices may influence the long run equilibrium level of real money balances.[8]

Fourth, the factors that influence the path of convergence of the money supply toward long run equilibrium and hence the flow magnitude of payments surpluses and deficits are to a large extent distinct from the factors that influence the cumulative payments surplus or deficit that results from a change in the long run equilibrium level of money demand or in the in the components of the money supply other than foreign exchange reserves. For example, the speed of convergence to long run equilibrium and the magnitude of the payments flow resulting from an increase in the fiat issue of the central bank are determined by the slope of the $p \cdot \hat{T}$ curve in figure 3.1:

$$\partial\hat{T}/\partial(M/P) = -\ \partial E/\partial(A/P) - (\partial E/\partial r)\cdot\left[\frac{1 - \left(\partial L/\partial(A/P)\right)}{\partial L/\partial r}\right]. \qquad (3.14)$$

High responsiveness of desired spending to the real value of privately held assets and to the interest rate, and low responsiveness of money demand to these same variables all contribute to produce a high speed of convergence to long run equilibrium and hence a rapid loss of foreign exchange reserves in response to an increase in the fiat issue of the central bank. In contrast, the long-run, cumulative response of the balance of payments to an increase in the fiat issue of the central bank does not depend on any of these properties of the desired expenditure function and the money demand function, but only on the property that a change in the fiat issue does not alter the long run equilibrium level of money demand.

3.2 Extensions of the simple model

The preceding analysis of the monetary mechanism of balance of payments adjustment for a small open economy employed a number of restrictive assumptions that have been the focus of much of the criticism of the monetary approach to the balance of payments.[9] Some of the critics of the monetary approach have argued that some of its simplifying assumptions lack realism. Among the assumptions that were singled out were (i) the reliance on some form of real balance effect, (ii) the assumption that commodity and factor prices adjust instantaneously to clear commodity and factor markets and maintain full employment, (iii) the assumption that central banks do not systematically offset foreign exchange reserve flows through sterilization operations, (iv) the assumption that all goods are internationally traded, (v) the small country assumption that implies that the economy takes the relative prices of all goods, or at least of all traded goods, as fixed by world conditions and (vi) the neglect of international capital mobility in many of the simple expositions of the monetary approach. The next section presents extensions of the simple model. It is shown that these simplifying assumptions can be relaxed without altering significantly the fundamental characteristics of the monetary approach to the balance of payments.

3.2.1.. The real balance effect

The model examined in the preceding section incorporates a "real balance effect" through the assumption that desired real spending depends positively on the real value of assets, which includes the real value of money balances. This real balance effect, however, is not necessary to deriving the critical reduced form relationship $\dot{M} = P \cdot \tilde{T}$ of the type illustrated in figure 3.1. The essential features of the monetary mechanism of balance of payments adjustment remain unchanged even if the real balance effect is absent. In that case the reduced form effect of an increase in M on $\dot{M}$ depends exclusively on the effect of the increase in M on the rates of interest and, thereby, on desired expenditure.

Alternatively, the model of the preceding section could be modified so that the only channel through which changes in M affect the trade balance and $\dot{M}$ is through a special form of the real balance effect known as the "hoarding function" [see Dornbusch (1973a, 1973b)]. If there are no domestic interest bearing securities (and financial capital is not internationally mobile), all saving and dissaving must take the form of accumulation and decumulation of money balances. Under these conditions, it is plausible to suppose that desired real saving, which equals the excess of domestic real income over domestic real expenditure, depends on the divergence between the long run desired level of real money balances, $\bar{L}(Y)$, and the actual level of real money balances, M/P;

$$T = Y - E = H\big(L(Y) - (M/P)\big) \tag{3.15}$$

where H( ) is the "hoarding function" which has the properties that $H(0) = 0$ and $H' > 0$ [see Dornbusch and Mussa, (1975)]. Since the trade surplus (or deficit) must be financed by an inflow (or outflow) of foreign exchange reserves, and since these reserve flows alter the domestic money supply in the absence of offsetting changes in other assets of the central bank, it follows that

$$\dot{M} = P \cdot T = P \cdot H\big(L(Y) - (M/P)\big). \tag{3.16}$$

The key point of this exercise is that the reduced form relationship $\dot{M} = P \cdot H\big(L(Y) - (M/P)\big)$ has the same critical properties as the reduced form relationship $\dot{M} = P \cdot \hat{T}(M/P,\ B/P,\ Y)$ examined in the preceding section. It follows that the specification of a hoarding function yields all of the essential features of the monetary mechanism of balance of payments adjustment discussed in the preceding section. But, neither this special form of the assumption of a real balance effect, nor any other form of that assumption is necessary to the derivation of the essential features of this adjustment mechanism.

3.2.2 Wage and output dynamics

The assumption of instantaneous adjustment of commodity and factor prices to clear all markets and maintain full employment is easily modified without altering the essential features of the monetary mechanism of balance of payments adjustment. A simple, alternative assumption is that the domestic nominal wage rate, W, is at least temporarily fixed, and that the level of employment is determined by the quantity of labor that domestic producers demand at this nominal wage rate [see Rodriguez (1976a) and Leiderman (1979)]. With this assumption about the labor market, domestic output is determined by an aggregate supply function,

$$Y = Y^s(P/W), \qquad \partial Y^s/\partial(P/W) > 0. \tag{3.17}$$

Allowing for the endogenous determination of domestic output modifies the reduced form relationship describing the rate of change of the domestic money supply,

$$\dot{M} = P \cdot \tilde{T}\left(M/P,\ B/P,\ Y^s(P/W)\right). \tag{3.18}$$

If the nominal wage rate is determined parametrically, rather than adjusted endogenously, the process of adjustment of the domestic money supply through reserve flows toward its long run equilibrium level is exactly as described in section 3.1. Moreover, changes in the fiat issue of the central bank, in private securities holdings, or in the long run equilibrium level of money demand that do not involve changes in W or P have exactly the same long run and short run effects as in section 3.1. A change in W, holding P constant, changes Y and has exactly the same long run and short run effects as a change in Y in section 3.1. The only significant modification of previous results is with respect to the effects of a devaluation which raises, proportionately, the domestic price level. Previously, the long run effect of devaluation on the stock of foreign reserves reflected the typical proportional effect of a rise in the price level on the long run equilibrium level of money demand, supplemented by the effect of a reduction in the real value of privatley held securities on the long run equilibrium level of money demand. Allowing for the endogenous determination of domestic output through the function $Y^s(P/W)$ and assuming that nominal wages are given, increases the effect of devaluation in expanding the stock of foreign exchange reserves because it introduces an additional channel, an increase in domestic output, through which a devaluation increases the long run equilibrium level of money demand.

If the nominal wage rate adjusts endogenously, modifications of the analysis of section 3.1 are more substantial, but the essential features of the monetary mechanism of balance of payments adjustment remain intact. Abstracting from anticipated inflation and anticipated changes in produtivity that would contribute a trend component to the rate of change of the nominal wage rate, suppose that W adjusts at a rate that is proportional to the divergence between its equilibrium value, $\bar{W}$, and its current value, W;

$$\dot{W} = \delta \cdot (\bar{W} - W), \quad \delta > 0. \tag{3.19}$$

The equilibrium nominal wage rate is the value of W that would keep aggregate output at its full employment level, $\bar{Y}$; it is proportional to the domestic price level and is determined implicitly by the requirement that

$$Y^s(P/\bar{W}) = \bar{Y}. \tag{3.20}$$

The dynamic system that jointly determines the evolution of the domestic money supply (resulting from reserve flows) and the adjustment of the domestic nominal wage rate consists of the differential equations (3.18) and (3.19). The behavior of this dynamic system (for given values of the parameters B, P, $\bar{W}$, B_g and J) is illustrated in the phase diagram shown in figure 3.2. The horizontal line along which $W = \bar{W}$ shows the combinations of M and W for which $\dot{W} = 0$. Above this line $\dot{W}$ is negative, and below this line $\dot{W}$ is positive. The negatively sloped schedule labled $\dot{M} = 0$ shows the combinations of M and W for which $P \cdot \tilde{T}\left(M/P,\ B/P,\ Y^s(P/W)\right) = 0$, for the given values of B and P. This line is negatively sloped because an increase in M which makes $\dot{M} < 0$ needs to be offset by a decrease in W which makes $\dot{M} > 0$ in order to keep $\dot{M} = 0$. Above and to the right of the $\dot{M} = 0$ line $\dot{M}$ is negative, and below and to the left of this line $\dot{M}$ is

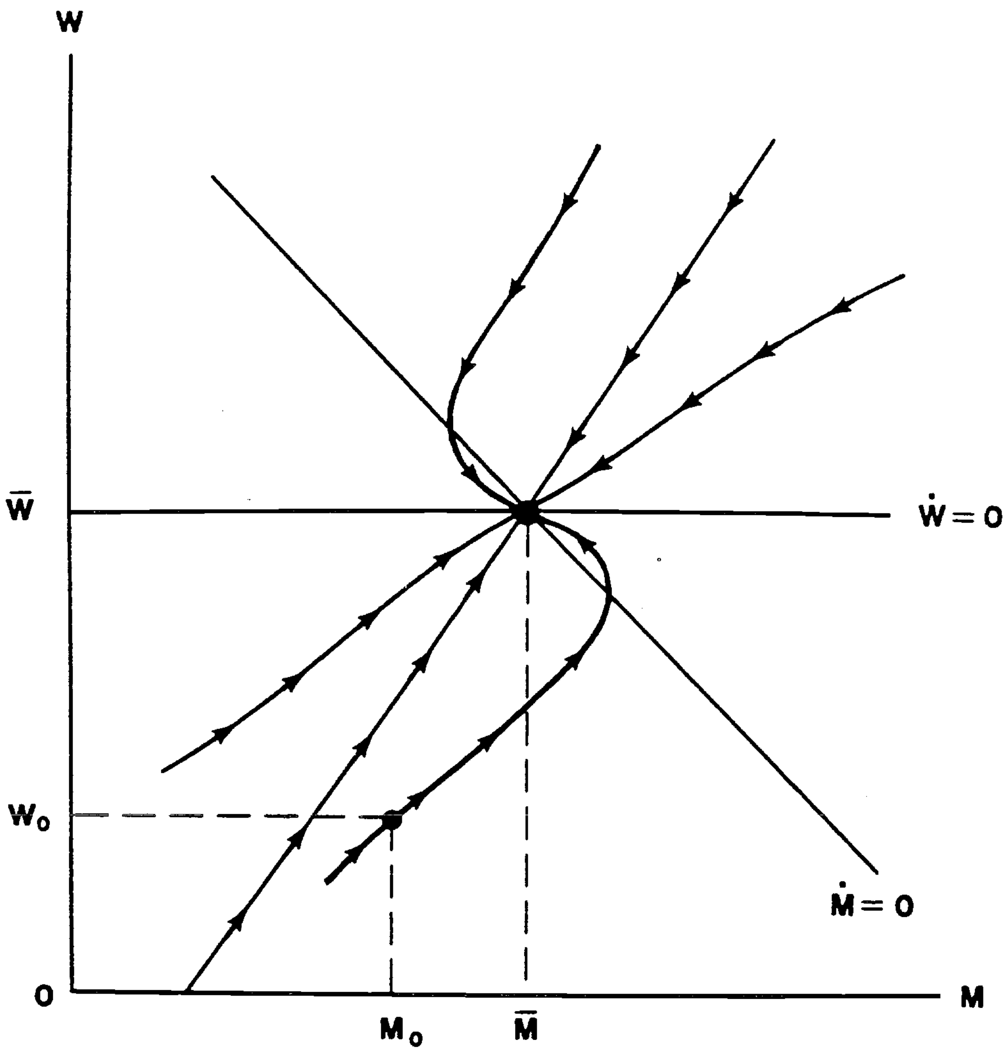

Figure 3.2: The Dynamics of Monetary and Wage Adjustment

positive. The intersection of the $\dot{W} = 0$ and $\dot{M} = 0$ schedules occurs at the long run equilibrium point where $W = \bar{W}$, as determined by (3.20), and the nominal money supply is equal to the long run equilibrium level of money demand, $\bar{M}(\bar{Y}, B, P)$ as determined by (3.12) with $Y = \bar{Y}$.

Since the dynamic system illustrated in figure 3.2 is stable, for any positive speed of adjustment of the nominal wage rate, the domestic money supply will ultimately adjust to $\bar{M}$ through reserve flows associated with trade imbalances. Further, given any initial divergence of the domestic money supply from the long run equilibrium level of money demand, the cumulative payments surplus or deficit that occurs along the path of convergence to the long run equilibrium point in figure 3.2 must entail a cumulative gain or loss of foreign exchange reserves just sufficient to bring the domestic money supply to equality with $\bar{M}$. This conclusion also applies to any divergence between M and $\bar{M}$ that is created by a change in the non-reserve assets of the central bank or in factors that determine the long run equilibrium level of money demand. Thus, the modifications of monetary mechanism of balance of payments adjustment implied by simultaneous endogenous adjustment of the domestic nominal wage rate do not affect the stability of this mechanism or the conclusions concerning the long run, cumulative effects of disturbances to the money supply or to the long run equilibrium level of money demand.

These modifications affect only the details of the behavior of the money supply and the balance of payments along the path of convergence to long run equilibrium. In particular, in the analysis of section 3.1, convergence of the domestic money supply to the long run equilibrium level of money demand was always monotonic. With endogenous adjustment of the domestic nominal wage rate, however, the money supply need not converge monotonically to its long run equilibrium value. For example, if we start at the point (M_0, W_0) in figure 3.2, with $M_0 < \bar{M}$ and W_0 well below $\bar{W}$, the path of convergence to long run equilibrium is one along which the money supply rises above its long run equilibrium level through a series of trade surpluses and reserve inflows, and then falls back to $\bar{M}$ through a series of trade deficits and reserve outflows.[10]

3.2.3 Endogenous monetary policy and sterilization

Sterilization is a form of endogenous monetary policy in which a central bank offsets all or part of the changes in the money supply resulting from foreign exchange reserve flows by countervailing changes of its non-reserve assets. A simple form of sterilization policy is described by the rule

$$\dot{J} = -\phi \cdot S \cdot \dot{R}, \quad 0 < \phi < 1, \tag{3.21}$$

where the sterilization coefficient ϕ indicates the fraction of foreign exchange changes that the central bank offsets by varying its fiat issue, and where the rate of change in the domestic currency value of foreign exchange reserves, $S \cdot \dot{R}$, is determined by the nominal trade surplus, $P \cdot \tilde{T}(M/P, B/P, Y)$.

This form of sterilization policy does not affect the long run equilibrium level of money demand, but it does slow down the convergence of the money supply to the long run equilibrium level. Specifically, with the sterilization policy (3.22), we have

$$\dot{M} = S \cdot \dot{R} + \dot{J} = (1 - \phi) \cdot S \cdot \dot{R} = (1 - \phi) \cdot P \cdot \tilde{T}(M/P, B/P, Y) \tag{3.22}$$

This slowdown in the speed of convergence to long run equilibrium comes at the expense of a greater cumulative change in foreign exchange reserves. If the initial divergence between the long run equilibrium level of money demand and the actual domestic money supply is ΔM, the cumulative change in foreign exchange reserves in the process of convergence to long run equilibrium is

$$\Delta R = (\Delta M/S)/(1 - \phi). \tag{3.23}$$

and it is apparent that a policy of complete sterilization is not feasible.

If a central bank attempts to set $\phi = 1$, then any small divergence between M and $\bar{M}$ will ultimately lead either to an infinite gain in foreign exchange reserves or an infinite loss of such reserves.[11]

In addition to sterilization, it is possible to analyze other forms of endogenous monetary policy. One such policy might be directed at moderating movements in the domestic interest rate. If the only cause of interest rate fluctuations, other than variations in the domestic money supply, were changes in the long run equilibrium level of money demand, then such a monetary policy might contribute to economic stability and reduce the need for variations in foreign exchange reserves. However, if fluctuations in interest rates were caused by disturbances other than fluctuations in the long run equilibrium level of money demand, then an interest rate stabilization rule for monetary policy would probably exacerbate fluctuations in foreign exchange reserves and might destabilize the economic system [see Frenkel and Mussa (1981)].

3.2.4 Nontraded goods

The assumption that a small country produces and consumes only traded goods with relative prices determined in world markets is easily modified by allowing the country to produce and consume its own nontraded good.[12] Equilibrium in the market for this nontraded good requires that

$$N^d(E, Q) = N^s(Q); \quad \partial N^d/\partial E > 0, \quad \partial N^d/\partial Q < 0, \quad \partial N^s/\partial Q > 0, \tag{3.24}$$

where N^d is demand for the nontraded good, N^s is supply of the nontraded good, E is total real expenditure (measured in traded goods), and $Q = P_N/P_X$ is the relative price of nontraded goods (whose domestic nominal price is P_N) in terms of traded goods (whose domestic nominal price is P_X). The supply of nontraded goods, $N^s(Q)$, and the supply of traded goods, $X^s(Q)$, are determined by the point on the economy's transformation curve at which the slope of this curve, relative to the N-axis, is equal to Q. Domestic income (measured in traded goods) is given by

$$Y = Y^s(Q) = X^s(Q) + Q \cdot N^s(Q), \quad \partial Y^s/\partial Q = N^s(Q) \geq 0. \tag{3.25}$$

Domestic demand for traded goods, $X^d(C, Q)$, is related to domestic demand for nontraded goods through the expenditure constraint,

$$X^d(E, Q) = E - Q \cdot N^d(E, Q); \quad \partial X^d/\partial E > 0, \quad \partial X^d/\partial Q \gtrless 0. \tag{3.26}$$

Desired real expenditure (measured in traded goods) depends on domestic real income (measured in traded goods), Y, on the domestic interest rate, r, and on the real value of privately held assets (measured in traded goods), $(A/P_X) = (M/P_X) + (B/P_X)$ through an expenditure function $E(Y, r, A/P_X)$ with the same properties of the expenditure function introduced in section 3.1. The condition of asset market equilibrium is expressed by the requirement

$$L(Y, r, Q, A/P_X) = M/P_X; \quad \partial L/\partial Y > 0, \quad \partial L/\partial r < 0, \quad \partial L/\partial Q > 0, \quad 0 < \partial L/\partial(A/P_X) < 1, \tag{3.27}$$

where L is the real demand for domestic money and M/P_X is the real supply, each measured in traded goods. The relative price of nontraded goods enters the money demand function because the general level of domestic prices, $P = P(P_X, P_N)$, is a linear homogeneous function of the domestic money prices of both traded and nontraded goods.

Replacing the variable Y with $Y^s(Q)$ in the real money demand function and substituting $E(Y^s(Q), r, A/P_X)$ for the variable E in the nontraded goods market equilibrium condition, yields equilibrium conditions for the asset market and the nontraded goods market that jointly determine the instantaneous equilibrium values of Q and r as functions of M/P_X and B/P_X;

$$Q = \hat{Q}(M/P_X, B/P_X); \quad \partial\hat{Q}/\partial(M/P_X) > 0, \quad \partial\hat{Q}/\partial(B/P_X) \gtrless 0, \tag{3.28}$$

$$r = \hat{r}(M/P_X, B/P_X); \quad \partial\hat{r}/\partial(M/P_X) < 0, \quad \partial\hat{r}/\partial(B/P_X) > 0. \tag{3.29}$$

The domestic nominal price of traded goods is determined by the fixed exchange rate, S, and the world market price for such goods, P_X^*, through the arbitrage condition

$$P_X = S \cdot P_X^* . \tag{3.30}$$

Given the domestic nominal price of traded goods, the domestic nominal price of nontraded goods and the general domestic price level are determined by

$$P_N = \hat{P}_N(M, B, P_X) = P_X \cdot \hat{Q}(M/P_X, B/P_X) \tag{3.31}$$

$$P = \hat{P}(M, B, P_X) = P\big(P_X, P_X \cdot \hat{Q}(M/P_X, B/P_X)\big). \tag{3.32}$$

At an instantaneous equilibrium, the domestic supply of traded goods need not equal the domestic demand for traded goods. The excess of supply over demand is the instantaneous equilibrium value of the trade balance, measured in traded goods;

$$T = \hat{T}(M/P_X, B/P_X) = X^s(\hat{Q}) - X^d(E(Y^s(\hat{Q}), \hat{r}, A/P_X), \hat{Q}),$$
$$\partial\hat{T}/\partial(M/P_X) < 0, \qquad \partial\hat{T}/\partial(B/P_X) < 0, \tag{3.33}$$

where $\hat{Q}$ and $\hat{r}$ are the functions of M/P_X and B/P_X that indicate the instantaneous equilibrium values of Q and r. Using (3.25) and (3.26) and the fact that $N^d = N^s$ at any instantaneous equilibrium, it is easily established that the trade balance at any instantaneous equilibrium is equal to the excess of domestic income over domestic expenditure, as required by the fundamental equation of the absorption approach to the balance of payments:

$$\hat{T}(M/P_X, B/P_X) = Y^s(\hat{Q}) - E(Y^s(\hat{Q}), \hat{r}, A/P_X). \tag{3.34}$$

Since neither monies nor securities are assumed to be internationally traded among private agents, trade imbalances occuring at any instantaneous equilibrium must be financed by a net flow of official foreign exchange reserves. Assuming no sterilization of the effects of such reserve flows on the domestic money supply, the rate of change of the domestic nominal money supply occuring at any instantaneous equilibrium is given by

$$\dot{M} = P_X \cdot \hat{T}(M/P_X, B/P_X). \tag{3.35}$$

The qualitative properties of the relationship between the rate of change of the money supply and the level of the money supply embodied in (3.35) are exactly the same as those embodied in (3.18) and illustrated in figure 3.1. For given values of B and $P_X = S\, P_X^*$, there is a unique long run equilibrium level of domestic nominal money supply, $\bar{M}$, determined by the condition

$$\hat{T}(M/P_X, B/P_X) = 0, \tag{3.36}$$

at which the trade balance and the rate of change of the money supply are both zero.[13] When M is less than $\bar{M}$, there is a trade surplus and $\dot{M}$ is positive. When M is greater than $\bar{M}$, there is a trade deficit and $\dot{M}$ is negative. Thus, there is a natural dynamic process through which monetary changes resulting from reserve flows associated with trade imbalances gradually drive the economy to its long run equilibrium where the trade balance and the rate of change of the domestic money supply are both zero.

The positively sloped $N^d = N^s$ curve in the upper panel of figure 3.3 shows the relationship between $\hat{Q}$ and M/P_X for a given value of B/P_X. This curve may also be interpreted as showing the relationship between $\hat{P}_N$ and M, for given values of B and P_X. Since the market for nontraded goods must clear, the instantaneous equilibrium position of the economy must always be at the point on the $N^d = N^s$ curve, corresponding to the actual value of M/P_X.

The market for traded goods, need not clear domestically. Any excess supply of traded goods can be sold on the world market and any excess demand for traded goods can be purchased from the world market, in exchange for flows

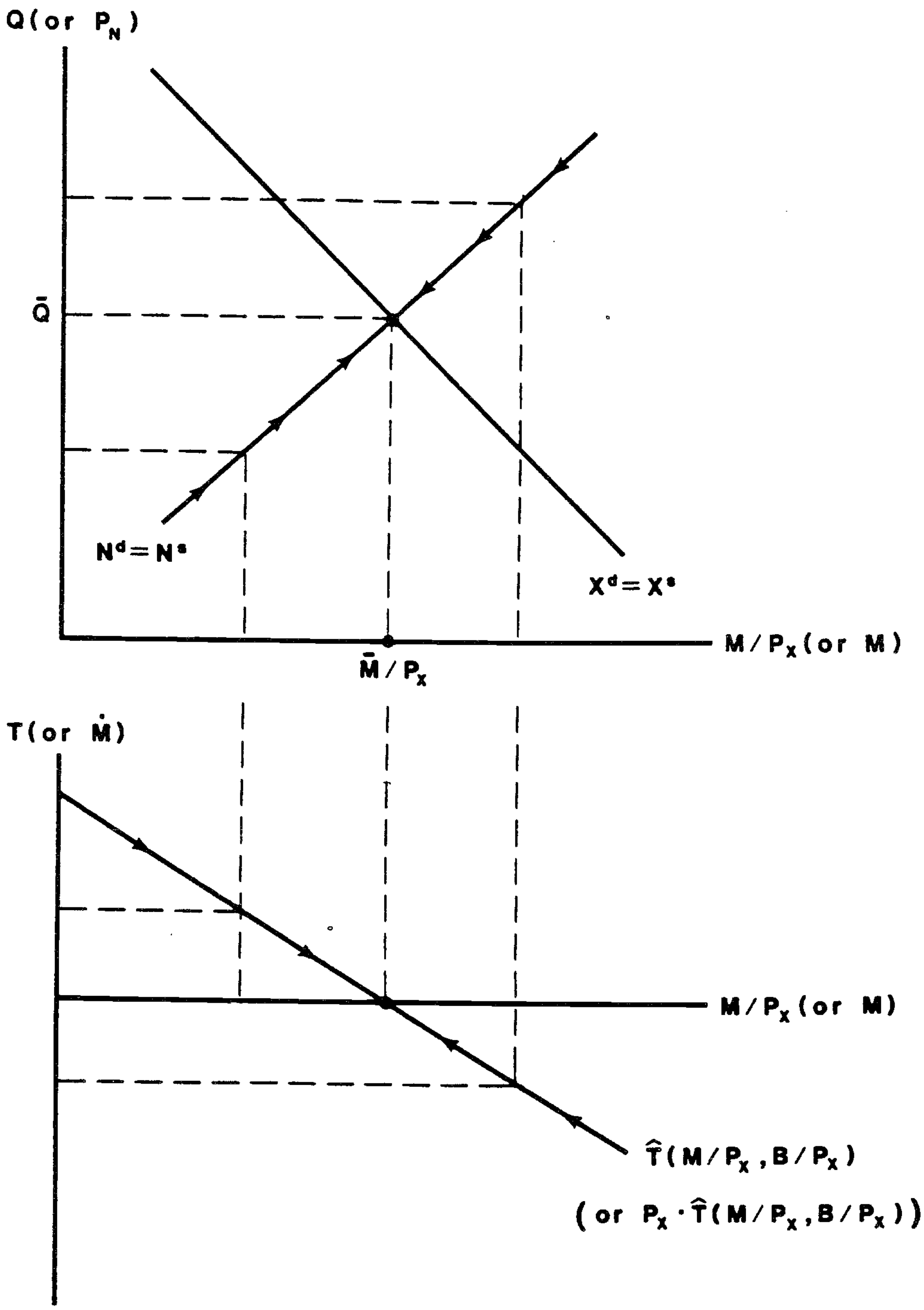

Figure 3.3: Instantaneous Equilibrium and Dynamics with Nontraded Goods

of international reserves. The trade balance surplus measures the domestic excess supply of traded goods:

$$T = X^s\left(\hat{Q}(M/P_X,\ B/P_X\right) - X^d[E(Y^s(\hat{Q}),\ \hat{r},\ A/P_X),\ \hat{Q}]. \quad (3.37)$$

It is noteworthy that the function $\hat{T}(M/P_X,\ B/P_X,\ Y)$ is the same as the function $\hat{T}(M/P,\ B/P,\ Y)$ introduced in section 3.1 and that the trade balance can also be expressed as the difference between domestic income and domestic expenditure; that is,

$$\hat{T}\left(M/P_X,\ B/P_X,\ Y^s(Q)\right) \equiv Y^s(Q) - \hat{E}\left(M/P_X,\ B/P_X,\ Y^s(Q)\right). \quad (3.38)$$

The combinations of Q and M/P_X for which $\hat{T}\left(M/P_X,\ B/P_X,\ Y^s(Q)\right) = 0$, for a given value of B/P_X, are indicated by the negatively sloped $X^d = X^s$ curve in the upper panel of figure 3.3. Alternatively, recognizing that P_X is fixed at $S\cdot P_X^*$, this curve may be regarded as representing the combinations of P_N and M for which $\hat{T}\left(M/P_X,\ B/P_X,\ Y^s(P_N/P_X)\right) = 0$. In either case, above and to the right of this curve there is excess domestic demand for traded goods and a trade deficit; and below and to the left of this curve there is a trade surplus.

The intersection of the $N^d = N^s$ curve and the $X^d = X^s$ curve in the upper panel of figure 3.3 occurs at the point where the relative price of nontraded goods equals its long run equilibrium value $\bar{Q}$ and where the real domestic money supply is at its long run equilibrium value $\overline{M/P_X}$. Alternatively, this intersection point indicates the long run equilibrium nominal price of nontraded goods $P_N = P_X\cdot Q$. and the long run equilibrium level of the nominal money supply $\bar{M}$.

When the domestic money supply differs from its long run equilibrium value, the economy must be at the point in the upper panel of figure 3.3 along the $N^d = N^s$ curve corresponding to the actual size of the domestic money supply. At such a point, the trade balance is given by

$$T = \hat{T}(M/P_X, B/P_X) \equiv \tilde{T}[M/P_X, B/P_X, Y^S(\hat{Q}(M/P_X, B/P_X))]. \quad (3.39)$$

Corresponding to the trade balance there is a net flow of foreign exchange reserves which, holding constant the other assets of the central bank, determines the rate of change of the domestic money supply;

$$\dot{M} = P_X \cdot \hat{T}(M/P_X, B/P_X). \quad (3.40)$$

In the lower panel of figure 3.3, the curve labeled $\hat{T}(M/P_X, B/P_X)$ shows both the trade balance and the rate of change of domestic real money balances as a function of M/P_X, for a given value of B/P_X. Alternativey, if this curve is labeled as the $P_X \cdot \hat{T}(M/P_X, B/P_X)$ curve, it shows the rate of change of the domestic nominal money supply as a function of the level of the domestic nominal money supply, for given values of B and P_X. The intersection of the $\hat{T}(M/P_X, B/P_X)$ curve with the horizontal axis occurs at the long run equilibrium level of real money balances, $\overline{M}/P_X$, where the value of $\overline{M}$ is determined implicitly by the condition

$$\hat{T}(\overline{M}/P_X, B/P_X) = 0. \quad (3.41)$$

Comparison of the lower panel of figure 3.3 with figure 3.1 and comparison of the condition (3.41) with the condition (3.12) reveals the close analogy between the monetary mechanism of balance of payments adjustment that operates with nontraded goods and the mechanism that operates when all goods are traded, and between the condition that determines the long run equilibrium level of money demand with nontraded goods and the condition that is relevant when all goods are traded. Momentary reflection reveals that the four general features of the monetary mechanism of balance of payments adjustment that were discussed in section 3.1, as well as many of the specific conclusions of that earlier analysis, carry over to the case where we have nontraded goods.

The major innovations resulting from the introdution of nontraded goods are that we allow for variations in the relative price of nontradable goods and in the general domestic price level along the path of convergence to long run equilibrium. As is apparent from the upper panel of figure 3.3, if the domestic money supply is initially less than $\bar{M}$, the instantaneous equilibrium relative and nominal prices of nontraded goods determined by the point on the $N^d = N^s$ curve are less than their respective long run equilibrium values, $\bar{Q}$ and $P_X \cdot \bar{Q}$. The general domestic price level, P, which is an index of the nominal prices of traded and nontraded goods will also be less than its long run equilibrium value. As the domestic money supply rises due to reserve inflows resulting from trade surpluses, the instantaneous equilibrium position of the economy moves up along the $N^d = N^s$ curve toward the long run equilibrium point, implying an increase in the relative and nominal price level as the economy converges to long run equilibrium. The opposite process occurs if the initial money supply exceeds $\bar{M}$. It follows immediately that an increase in the fiat issue of the central bank, starting from $M = \bar{M}$, would have the initial effect of raising the relative and nominal price of nontraded goods and the general domestic price level above their long run equilibrium values, and this would be followed by a period of adjustment during which the domestic money supply and these prices all returned to their respective long run equilibrium levels. Starting from an initial position of long run equilibrium, a devaluation would immediately result in an equiproportional increase in the domestic nominal price of traded goods and would increase (not necessarily proportionately) the long run equilibrium value of the domestic nominal money supply. The nominal price of nontraded goods, however, would not rise immediately in proportion with the devaluation nor will it rise to its new long run equilibrium level. The relative and nominal price of nontraded goods and the general domestic price level immediately following devaluation would all be below their new long run equilibrium values and would only gradually rise to these values as the domestic money supply rises to its new long run equilibrium level.[14]

When we consider the effects of growth in an economy with nontraded goods, the modifications of the earlier analysis are more substantial. With only a composite traded good, the long run, cumulative effect of growth in domestic output and income depended only on the effect of an increase in income on the demand for domestic money. With nontraded as well as traded goods, growth can affect the long run equilibrium level of money demand both through the usual effect of an increase in income and through the effect of changes in the long run equilibrium relative price of nontraded goods. For exampe, if the growth of domestic output (at constant relative prices) is biased toward traded goods, relative to the growth of domestic demand, then the long run equilibrium relative price of nontraded goods will have to rise as growth occurs.[15] With the domestic nominal price of traded goods fixed by the exchange rate and by the given world prices of such goods, the increase in the long run equilibrium relative price of nontraded goods requires an increase in the domestic nominal price of such goods and, hence, in the general price index. This increase in the general price index enhances the effect of growth in expanding the long run demand for domestic money and, thereby, increases the cumulative payments surplus resulting from growth. The opposite holds if growth is biased towards the production of nontraded goods. It is still true, however, that the cumulative effect of growth on the balance of payments reflects the effects of growth on the long run equilibrium level of money demand. With nontraded goods, there simply are more channels through which growth can effect the long run equilibrium level of money demand.

3.2.5 Large countries

When the home country is not small relative to the rest of the world, it is necessary to modify the preceding analysis to account for the interaction between the home country and the rest of the world in determining the prices of tradable goods and the distribution of the world stock of foreign exchange reserves. To illustrate these modifications, it is useful to assume that the economic structure of the home country and the foreign country (identified with the rest of the world) is described by the model in the preceding section, with the two countries producing and consuming a common traded good, X, and with each country producing and consuming its own nontraded good, N. Variables for foreign country are indicated by an asterisk (*).

The relative prices of nontraded goods that clear domestic markets in the two countries are given by $\hat{Q}(M/P_X, B/P_X)$ and $\hat{Q}^*(M^*/P_X^*, B^*/P_X^*)$. The trade balance surpluses for the two countries are given by $\hat{T}(M/P_X, B/P_X)$ and $\hat{T}^*(M^*/P_X^*, B^*/P_X^*)$. Nominal prices of traded goods in the two countries are linked by the fixed exchange rate through the relationship $P_X = S \cdot P_X^*$. The condition for equilibrium in the world market for traded goods is expressed by the requirement

$$\hat{T}(M/P_X, B/P_X) + \hat{T}^*(M^*/P_X^*, B^*/P_X^*) = 0. \tag{3.42}$$

Given the domestic and foreign nominal money supplies and the parametrically fixed values of B, B* and S, this equilibrium condition determines the instantaneous equilibrium value of the nominal price of traded goods in the two countries, as is illustrated in figure 3.4. In this figure, P_X^* is plotted on the vertical axis and $P_X = S \cdot P_X^*$ is assumed to vary along with the foreign nominal price. The horizontal axis measures the trade surplus of the home country, T, and the trade deficit of the foreign country, $-T^*$. The positively sloped curves labeled T_i show the trade

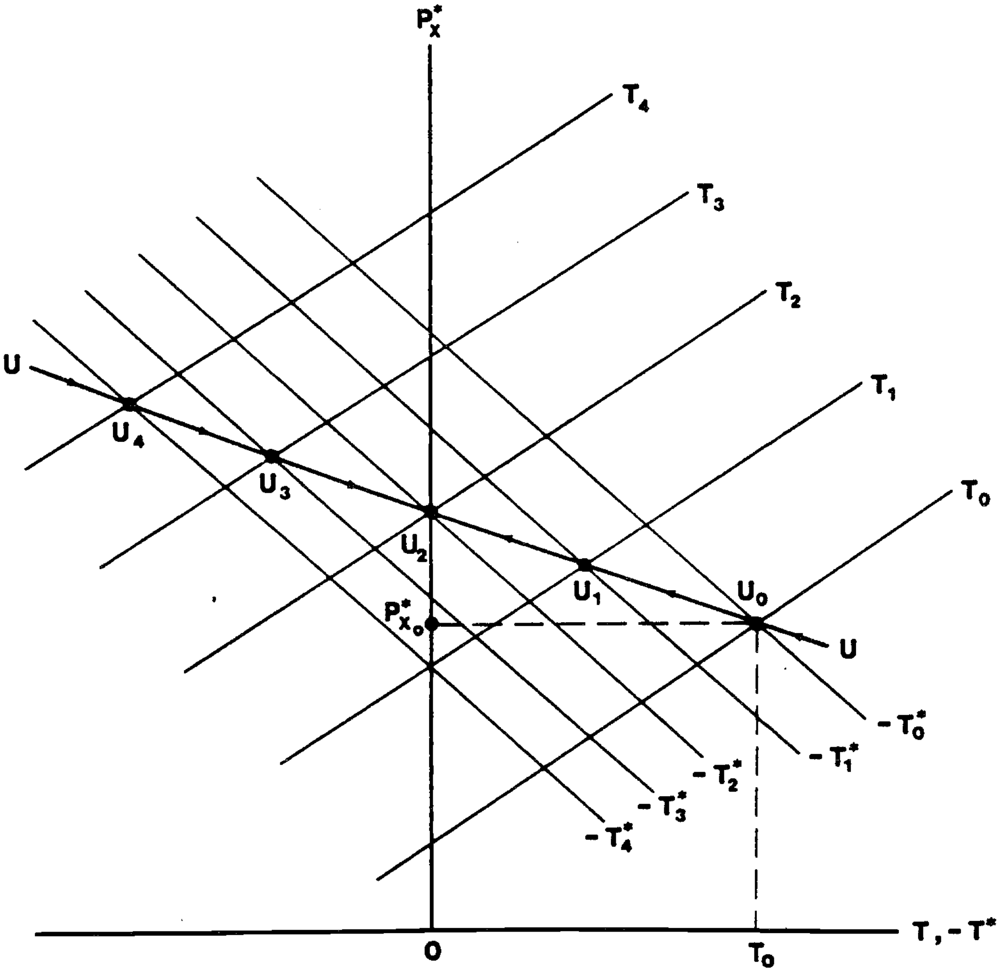

Figure 3.4: Instantaneous Equilibrium and Dynamics in the World Market for Traded Goods

surplus of the home country, $T(M_i/S \cdot P^*_X,\ B/S \cdot P^*_X)$, as a function of P^*_X, for different levels of the domestic money supply. The negatively sloped curves labeled $-T^*_i$ show the trade deficit of the foreign country, $-T^*(M^*_i/P^*_X,\ B^*/P^*_X)$, as a function of P^*_X, for different levels of the foreign money supply. The levels of the domestic and foreign money supplies used in constructing these curves satisfy the condition

$$\frac{M_i}{S} + M^*_i = M_w \qquad (3.43)$$

where M_w is the constant level of the world money supply (measured in units of foreign money). This is consistent with the assumption that the non-reserve assets of both central banks are constant and that money supply changes occur only as a consequence of redistributions of a fixed world stock of international reserves. When the distribution of this stock of reserves is such that money supplies in the two countries are M_0 and M^*_0, instantaneous equilibrium occurs at the point U_0 in figure 4.4, with $P^*_X = P^*_{X_0}$ and $T = -T^* = T_0$. At this instantaneous equilibrium position, foreign exchange reserves are flowing from the foreign country to the home country at a rate consistent with the trade balances of these countries. As the home money supply rises and the foreign money supply declines due to this flow of reserves, the instantaneous equilibrium point gradually moves from U_0 to U_1, which is the instantaneous equilibrium position that is relevant when the domestic money supply is $M_1 > M_0$ and the foreign money supply is $M^*_1 = M^*_0 - \left((M_1 - M_0)/S\right) < M^*_0$. This adjustment process continues until reserve flows have increased the domestic money supply to its long run equilibrium level $M_2 = \bar{M}$ and have decreased the foreign money supply to its long run equilibrium level $M^*_2 = \bar{M}^*$. At this time the instantaneous equilibrium position is at U_2 on the P^*_X-axis, the trade balances of both countries are zero, and the world is in long run equilibrium. Similarly, if the initial distribution of international reserves is such that $M = M_4 > \bar{M}$ and $M^* = M_4^* < \bar{M}^*$, the world starts out at the instantaneous equilibrium point U_4 and gradually moves to the right along the UU locus, with reserves flowing out of the home country and into the foreign country, until long run equilibrium is achieved at U_2.

The behavior of the instantaneous equilibrium nominal price of traded goods (P_X^* and $P_X = S \cdot P_X^*$) reflects a version of the "transfer problem criterion." As we move from the instantaneous equilibrium U_0 along the UU locus toward long run equilibrium, the nominal price of trade goods rises, as illustrated in figure 3.4, if and only if $|\partial \hat{T}/\partial(M/P_X)| > |\partial \hat{T}^*/\partial(M^*/P_X^*)|$; that is, if and only if at constant nominal prices of the traded good, the effect of an increase in the domestic real money supply on excess demand for traded goods in the home country is larger than the effect of an equivalent reduction in the foreign money supply on the excess supply of traded goods in the foreign country. If so, then at the old nominal prices of traded goods and the new distribution of the world money supply, there will be an excess world demand of traded goods, and the nominal prices of traded goods will have to rise in both countries (reducing the real values of money and bond holdings) in order to restore equilibrium to the world market for traded goods.

While the monetary mechanism of balance of payments adjustment is more complicated for the two country world than for the small country, the basic elements of this mechanism are essentially the same. Starting from a situation in which the domestic nominal money suply is below its long run equilibrium level and, correspondingly, the foreign money supply is above its long run equilibrium level, reserve flows associated with trade imbalances gradually move the economic system to long run equilibrium by raising the domestic money supply and reducing the foreign money supply to their respective long run equilibrium levels. As in the case of the small country, the essential ingredient underlying this adjustment process is the relationship through which a deficiency in a country's money supply relative to its long run equilibrium level leads to an excess of domestic income over domestic expenditure which implies a trade surplus which brings an inflow of foreign exchange reseves and a gradual restoration of money balances to their long run equilibrium level.

In the two country world, it remains true that a given initial divergence of a country's money supply (and a corresponding divergence with the opposite sign for the other country) will ultimately lead to a cumulative payments surplus and change in reserves just equal to this initial divergence (assuming there is no change in the non-reserve assets of central banks). The long run cumulative effect of disturbances that affect money supplies and money demands, however, are somewhat different in the two country world than they are for a small country. For example, in the small country case, an increase in the fiat issue of the central bank does not alter the long run equilibrium level of domestic money demand and, hence, ultimately leads to an equal loss of foreign exchange reserves. In the large country case, an increase in the fiat issue of the home country increases the world money supply and thereby increases the long run equilibrium level of the nominal price of traded goods in both countries. This increase in the nominal price of traded goods implies an increase in the long run equilibrium level of nominal money demand in both countries, and hence a loss of foreign exchange reserves by the home country that is smaller than the increase in the fiat issue of its central bank. Similar reasoning leads to the conclusion that a devaluation by the home country raises the long run nominal price of traded goods in that country while reducing the long run nominal price of traded goods in the foreign country. Because part of the effect of devaluation is absorbed by a decline in the foreign price level, the long run nominal demand for domestic money rises less as a consequence of devaluation than it would if the home country were small. Correspondingly, the cumulative gain in foreign exchange reserves for the home country due to devaluation is less than it would be if the country were small [see Dornbusch (1973b)]. Note, however, that these modifications of the small country results do not alter the basic principle that the cumulative effect of any disturbance on a country's balance of payments is equal to the effect of the disturbance on the divergence between the domestic money supply and the long run equilibrium level of domestic money demand.

When two large countries produce and consume only a single traded good, in addition to their own nontraded goods, the stability of the mechanism of balance of payments adjustment is not critically affected by the relative price elasticities of demand or of excess demand for tradable or nontradable goods. These elasticities do influence the extent of variations in the relative price of nontradables as we move along the path of convergence to long run equilibrium, and they do affect the speed of convergence to long run equilibrium. But, low price elasticities of demand do not introduce the possibility of instability in the mechanism of balance of payments adjustment. The reason for this is that the price elasticity that is critical for the stability of this mechanism is the elasticity of demand for imports of tradables into a country with respect to the relative price of tradables between the two countries. The assumption that tradable goods for the two countries are perfect substitutes implies that this elasticity is infinite, and this removes any possibility of instability.

When large countries exchange two or more tradable goods, elasticities of import demands for these countries are important for the stability of the monetary mechanism of balance of payments adjustment. In the standard two-country, two-commodity model of the pure theory of international trade, it is well known that the Marshall-Lerner condition (the requirement that the sum of the absolute values of the import demand elasticities of the two countries be greater than one) is the necessary and sufficient condition for the existence of a unique equilibrium relative price of the two commodities [see Johnson (1956)]. In the monetary extension of this model, in which money supplies, bond supplies and interest rates affect only the level of spending in each country but not its distribution among commodities, the Marshall-Lerner condition becomes the condition for a unique long run equilibrium in which the trade balance of each country is zero and there is no ongoing redistribution of the world money supply. If for each distribution of the world money supply, the instantaneous equilibrium position of the world economy is unique, it may be shown that the monetary mechanism of balance of payments adjustment ultimately drives the world economy to this unique long run equilibrium. Along the path of convergence to this long run equilibrium, spending differs from income by equal and opposite amounts in the two countries, implying equal and opposite trade imbalances and an ongoing redistribution of the world money supply through flows of foreign exchange reserves. The adjustment of the relative commodity price along the path of convergence to long run equilibrium is determined by application of the standard transfer problem analysis to the endogenously determined magnitude of the transfer corresponding to the trade imbalances of the two countries [see Dornbusch (1973a)].

If equilibrium is not unique in the standard two-country, two commodity trade model, long run equilibrium will not be unique in the monetary extension of this model. Corresponding to each real equilibrium, there will be a separate long run monetary equilibrium. If for each distribution of the world money supply, there is a unique instantaneous equilibrium in the monetary model, the monetary mechanism of balance of payments adjustment will still be well-defined: That is, there will be a well-defined differential equation that expresses the rate of change of the distribution of the world money supply as a function of that distribution. Moreover, it may be shown (not without some difficulty) that the stable nodes of this differential equation describing the monetary mechanism of balance of payments adjustment will correspond to the real trade equilibria at which the Marshall-Lerner condition is satisfied, and that the unstable nodes of this differential equation will correspond to the real trade equilibria where the Marshall-Lerner condition is not satisfied. Thus, as suggested by many earlier writers, sufficiently large elasticities of import demand are essential for stability of the mechanism of balance of payments adjustment. While this interpretation reflects different considerations, it rationalizes some of the statements made by proponents of the elasticity approach to the balance of payments" [see Machlup (1939)].

3.2.6 Capital mobility

Two important modifications of the preceding analysis of the monetary mechanism of balance of payments adjustment are required when we allow for international mobility of privately held financial assets. First, the official settlements balance is no longer equal to trade balance but to the sum of the current account balance (which is the trade balance plus the flow of interest income that domestic residents earn on their net foreign securities holdings) and the capital account balance (which measures net sales of privately held financial assets by domestic residents to foreign residents). Second, we must allow for the possibility of swaps of stocks of privately held assets between domestic and foreign residents that occur at an instant of time. The possibility of asset swaps does not alter the principle that the current account balance is a flow magnitude, but, it does introduce the possibility of stock unit changes in a country's international reserves resulting from private attempts to swap domestic money for financial securities.[16]

The implications of capital mobility for the monetary mechanism of balance of payments adjustment are most easily illustrated by returning to the case of a small open economy that produces and consumes only traded goods. The model presented in section 3.1 is modified by assuming that securities held by domestic residents, B, are perfect substitutes for securities issued in the rest of the world, and that the domestic interest rate, r, is equal to the (fixed) interest rate prevailing in the world capital market, r^*. Net foreign security holdings of domestic residents, V are the excess of domestic private security holdings over the stock of government debt that is outside of the domestic central bank,

$$V = B - (\bar{B} - B_g). \tag{3.44}$$

Domestic real income, Y, is equal to the full employment level of domestic output, Y, plus interest income from net foreign security holdings, $r^* \cdot V/P$;

$$Y = \bar{Y} + r^* \cdot V/P. \tag{3.45}$$

The condition for asset market equilibrium, $L(Y, r^*, A/P) = M/P$, no longer determines the domestic interest rate, but rather, the instantaneous equilibrium size of the domestic real money supply,

$$M/P = \tilde{m}(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*) \tag{3.46}$$

The effect of an increase in real private domestic assets on M/P, $\partial\tilde{m}/\partial(A/P) = \partial L/\partial(A/P) + r^* \cdot (\partial L/\partial Y)\left[1 - \left(\partial L/\partial(A/P)\right)\right]$ is assumed to be less than one.

The excess of domestic income over domestic expenditure determines the current account balance, $\Psi = Y - E$, where $E = E(Y, r, A/P)$. Setting $r = r^*$ and taking account of (3.44), (3.45) and (3.46), we arrive at a reduced form expression for the current account balance,

$$\Psi = \hat{\Psi}(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*). \tag{3.47}$$

It is assumed that an increase in real private domestic assets worsens the current account balance; that is, we assume that

$$\partial\hat{\Psi}/\partial(A/P) = -\left(\partial E/\partial(A/P)\right) + r^* \cdot [1 - \partial\hat{L}/\partial(A/P)] \cdot [1 - \partial E/\partial Y] < 0.$$

Given the domestic price level $P = S \cdot P^*$, and holding constant the non reserve assets of the central bank, the current account balance determines the rate of change of real private asset holdings;

$$\dot{A}/P = \hat{\Psi}\left(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*\right). \tag{3.48}$$

This differential equation characterizes the dynamic process through which the real stock of privately held assets is adjusted to its long run equilibrium value, $\bar{A}/P$, which is determined implicitly by the condition

$$\hat{\Psi}\left(\bar{A}/P, \bar{Y}, (\bar{B} - B_g)/P, r^*\right) = 0. \tag{3.49}$$

This adjustment process for private assets is illustrated in the middle panel of figure 3.5, where the curve labeled $\hat{\Psi}\left(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*\right)$ shows the relationship between $\dot{A}/P$ and A/P. In the top panel the curve labeled $\tilde{m}(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*)$ shows the reduced form relationship between the level of real private assets and the instantaneous equilibrium level of real money balances. Finally, in the bottom panel of figure 3.5, the curve labeled $\hat{\Psi} \cdot \left(\partial\tilde{m}/\partial(A/P)\right)$ shows the relationship between the level of real private assets and the rate of change of domestic real money balances, $\dot{M}/P$, determined by

$$\dot{M}/P = \left(\partial\tilde{m}/\partial(A/P)\right) \cdot (\dot{A}/P) = \left(\partial\tilde{m}/\partial(A/P)\right) \cdot \hat{\Psi}\left(A/P, \bar{Y}, (\bar{B} - B_g)/P, r^*\right). \tag{3.50}$$

Three important principles concerning the mechanism of balance of payments adjustment when we allow for international capital mobility are

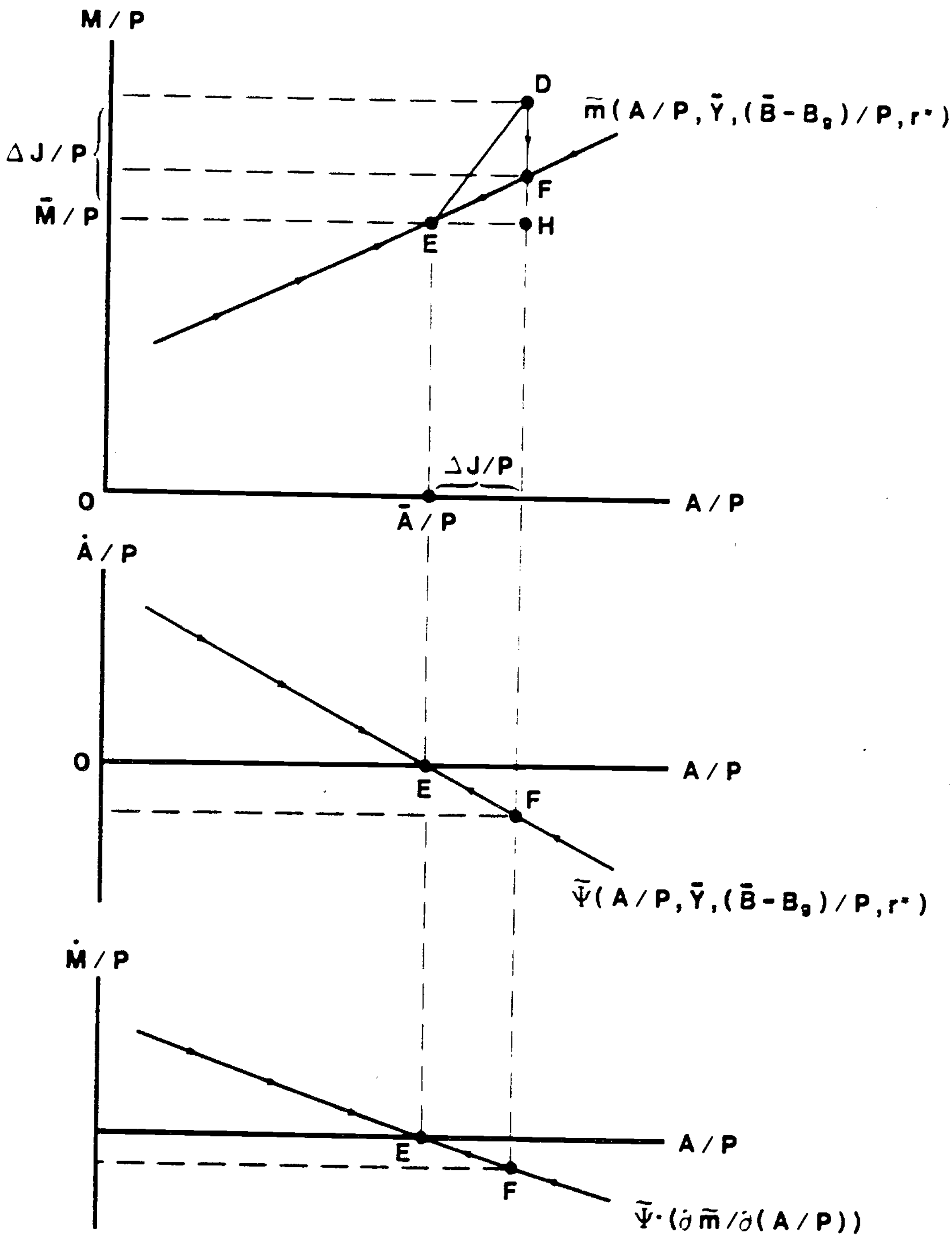

Figure 3.5: Portfolio Balance, Assets, and Balance of Payment Adjustment with Capital Mobility

reflected in figure 3.5. First, the level of money balances in the economy adjusts immediately to the instantaneous equilibrium level associated with the actual level of privately held assets: that is, the economy always operates at the point on the $\tilde{m}$ curve in the top panel of figure 3.5 corresponding to the actual level of A/P. Achievement of such an instantaneous equilibrium position subsequent to a disturbance that creates a stock unit divergence between the demand for domestic money and the existing supply requires a stock unit change in the central bank's holdings of international reserves as private asset holders buy or sell securities in order to achieve the desired composition of their assets between money and securities. Second, the process of adjustment of the stock of privately held assets that occurs as a counterpart of current account imbalances, as illustrated in the middle panel of figure 3.5, is necessarily a gradual adjustment process in which the flow of net saving determined by the excess of domestic income over domestic expenditure accumulates over time into changes in the stock of privately held assets. Third, as illustrated in the bottom panel of figure 3.5, changes in the stock of privately held assets resulting from current account imbalances cause gradual changes in the instantaneous equilibrium level of money balances and corresponding flows of foreign exchange reserves which are registered as official settlements surpluses or deficits. This mechanism of monetary adjustment is similar to the monetary mechanism of balance of payments adjustment that operates in the absence of international capital mobility. In the present case however, reserve changes also occur in response to asset swaps motivated by the desire of domestic residents to adjust the actual level of money balances within their portfolio of assets to its desired level. Through reserve changes brought about by the operation of these two mechanisms, the level of the domestic money supply is ultimately adjusted to the long run equilibrium level of domestic money demand that is associated with the long run equilibrium level of privately held domestic assets and with long run equilibrium of the current account balance.

These three principles all come into operation when we consider an increase ΔJ in the fiat issue of the domestic central bank. Starting from an initial situation of long run equilibrium, domestic real assets exceed their long run equilibrium value by the amount $\Delta J/P$. Since the entire increase $\Delta J/P$ in real privately held assets comes in the form of domestic money, the economy is tentatively at the point D in the top panel of figure 3.5 which lies above the $\tilde{m}$ curve as well as to the right of the long run equilibrium level of A/P. To restore the desired composition of assets individuals sell money balances and purchase securities sufficient to move the economy downward from the point D in the top panel of figure 3.5 to the point F that lies along the $\tilde{m}$ curve. The additional securities are purchased from foreign residents who convert the domestic money they receive from their sales of securities into foreign money, with a consequent loss of foreign exchange reserves by the domestic central bank. This immediate, stock unit loss of foreign exchange reserves accounts for the reduction in the domestic money supply implied by the jump from the point D to the point F. At the point F, the real value of private domestic assets exceeds its long run equilibrium value $\bar{A}/P$, resulting in an excess of domestic real expenditure over domestic real income and in a current account deficit, as indicated by the point F along the $\tilde{\Psi}$ curve in the middle panel of figure 3.5. Over time, downward adjustments in the real stock of privately held assets gradually reduce A/P to its long run equilibrium level. The gradual reductions in A/P gradually reduce the instantaneous equilibrium level of real money balances, implying, as illustrated in the bottom panel of figure

3.5, corresponding losses of foreign exchange reserves by the central bank. The total loss of reserves that results from this adjustment process, together with the initial swap of domestic money for foreign securities, exactly offsets the increase in the fiat issue of the central bank and restores domestic money balances to their long run equilibrium level [see Frenkel and Rodriguez (1975)].

The general features of this analysis extend to the effects of other types of disturbances. If the disturbance creates an incipient divergence between the actual level of money balances and their new instantaneous equilibrium level, there will be a swap of domestic money for foreign securities and a corresponding stock unit change in the central bank's holdings of international reserves. If after this asset swap the actual level of domestic privately held assets differs from the long run equilibrium level, there will be a gradual process of adjustment of asset holdings through current account imbalances toward their long run equilibrium level. Associated with these changes in the level of assets, there will be changes in the instantaneous equilibrium level of money balances which will induce changes in the central bank's holdings of foreign exchange reserves. The total change in reseves will equal the divergence that the initiating disturbance creates between the long run equilibrium level of domestic money balances and the actual level of such balances.

The introduction of nontraded goods modifies the analysis of mechanism of balance of payments adjustment with international capital mobility in essentially the same way as it modifies the analysis of this mechanism for the case in which capital is immobile. Starting from a level of A/P that is below $\bar{A}/P$, the domestic relative and nominal prices of nontradables and the general domestic price level are all below their respective long run equilibrium levels. As A/P rises due to current account surpluses, all of these prices rise toward their respective long run equilibrium levels.

A modification that is in the same spirit as the introduction of nontraded goods is the introduction of a nontradable asset that domestic residents hold in addition to domestic money and internationally tradable securities. The rate of return and the price of this nontradable asset is determined by the requirement for equilibrium in the domestic market for this asset, in much the same way that the relative price of a nontradable good is determined by the requirement for equilibrium in the domestic market for such a good. Starting from an initial value of A/P that is less than its long run equilibrium value and assuming that asset demands are normal (in the sense that an increase in A/P increases the real demands for all assets), the instantaneous equilibrium price of the nontraded asset will be lower and the instantaneous equilibrium rate of return on this asset will be higher than their respective long run equilibrium values. As A/P rises due to current account surpluses, the price of the nontraded asset will rise, and the rate of return on the nontraded asset will fall toward their respective long run equilibrium values [see Dornbusch (1975) and Branson (1976); on the policy implications see Frenkel and Mussa (1981)].

This analysis can be extended to the case of two large countries that trade a single good and exchange a single internationally mobile security. The results of this analysis are similar to those in section 3.2.5, modified to reflect the implications of capital mobility. Prices of nontraded goods and yields on nontraded assets adjust to clear domestic markets for these goods and assets in each country, conditional on the world price of the tradable good, the world yield on the mobile security, and the prevailing distribution of world wealth. Instantaneous equilibrium requires that the world price of tradable goods and the world yield on the mobile security clear the world markets for these goods and securities, conditional on the distribution of world wealth. At such an instantaneous equilibrium, one country will generally spend more than its income and the other country will spend an equal amount less than its income, implying a corresponding current account deficit and current account surplus. The country with the surplus will be increasing its share of world wealth at the expense of the country with the deficit. The redistribution of world wealth that finances the trade imbalances will be accomplished partly by a flow of privately held securities and partly by a flow of official reserves (with effects on the money supplies of the two countries). If the balance of payments adjustment process is stable, as it should be in such a world, current account imbalances between the two countries will gradually decline as the wealth of the surplus country rises and the wealth of the deficit country declines, and the world will converge to a long run equilibrium in which current account balances are zero and there is no further redistribution of world wealth [see Frenkel (1976b)].

In this type of model of the world economy, an increase in the fiat issue of the central bank of the home country results in an immediate loss of foreign exchange reserves as domestic asset owners rebalance their portfolios between money and securities. Foreign residents will accommodate this portfolio shift because the increase in the world price of traded goods and the adjustment of the world yield on internationally mobile securities induces them to swap securities for money. At the instantaneous equilibrium established immediately after the increase in the fiat issue of the home country's central bank, the wealth of home residents has risen and that of foreign residents has declined because the entire increase in the world money supply went initially to home residents while the increase in the world price level reduced the real value of the nominal assets of residents of both countries. During the process of adjustment subsequent to the establishment of this instantaneous equilibrium, the wealth of home residents will decline as they spend in excess of their income, and the wealth of foreign residents will rise as they spend less than their income. The central bank of the home country will suffer a further loss of foreign exchange reserves because the demand for money by home residents will decline along with their wealth. In the end, however, the total loss of foreign exchange reserve by the home central bank (both from the initial asset swap and from subsequent reserve flows) will be smaller than the increase in the fiat issue of this central bank. As in the case of no private capital mobility (section 3.2.5), this is because the increase in the fiat issue of the home central bank has increased the world money supply, the long run equilibrium level of all nominal prices and, hence, the long run equilibrium level of the demand for domestic money.

An increase in the money supply of the home country brought about by an open market operation has somewhat different effects than an increase in the fiat issue of the home central bank because the open market operation affects the supplies of securities available to private asset holders. Moreover, the effects of such an open market operation depend on whether the securities purchased by the central bank are domestic nontradable securities or internationally tradable securities. Under standard assumptions about substitutability among assets in private portfolio demands, a purchase of domestic nontradable securities will decrease the long run equilibrium yield on such securities both absolutely and relative to the yield on internationally mobile securities; whereas an open market purchase of the internationally mobile security will have a smaller effect in reducing the long run equilibrium yield on this security and will reduce this yield relative to the yield on the domestic nontradable security. The differential effect of these two policies on the long run equilibrium world price level and on the distribution of international reserves depends on the degrees of substitution between national monies and different classes of securities [see Dornbusch (1975, 1977)].

Substitution relations among assets in portfolio demands are crucial in large countries models with two or more internationally tradable securities. Since the analysis of such models is provided by Branson and Henderson in Chapter 15 of this volume along with an extended list of references, we conclude the present section by only highlighting one critical feature of these models--the effects of sterilized intervention in the foreign exchange market. If the central bank of the home country intervenes in the foreign exchange market by selling foreign securities in order to prevent depreciation of the foreign exchange value of domestic money and sterilizes the monetary effect of this intervention by buying domestic securities, the overall effect of the operation will be to increase the outstanding supply of foreign securities and decrease the outstanding supply of domestic securities while holding the money supply constant. Given standard assumptions about portfolio demands for different securities, this alteration of security supplies will increase the equilibrium yield on foreign securities and decrease the equilibrium yield on domestic securities. If each country's security is a closer substitute for its money than the security of the other country, then this alternation in yields will decrease the demand for home money and increase the demand for foreign money and, thereby, tends to alleviate the monetary disequilibrium that was the cause of the drain of foreign exchange reserves.

4. Flexible exchange rates

4.1 The monetary model of exchange rate determination

The monetary model of exchange rate determination emphasizes the role of money market equilibrium as well as the interaction between domestic and foreign commodity markets.[17] An essential element of any montary model is the assumption of money market equilibrium:

$$(p-p^*) = (m-m^*) + (\ell^* - \ell). \tag{4.1}$$

where ℓ denotes the logarithum of the demand for domestic real balances, m denoted tne logarithm of the nominal money supply, p the logarithm of the price level and where an asterisk indicates a variable pertaining to the foreign country. A second essential element in a monetary model of exchange rate determination is a link between domestic and foreign prices through some form of the purchasing power parity, the simplest form of which is expressed by

$$p = e + p^* \tag{4.2}$$

where e denotes the logarithm of the exchange rate, i.e., the price of foreign money in terms of domestic money. Using equation (4.2) in (4.1) yields

$$e = (m-m^*) + [\ell^* - \ell] \tag{4.3}$$

which expresses the exchange rate in terms of supplies of domestic and foreign monies and demands to hold these monies. Anything that increases the supply of domestic relative to foreign money or increases the demand for foreign relative to domestic money, raises the exchange rate (i.e., depreciates the domestic currency).

The assumption that the prices relevant for money market equilibrium are the same as those relevant for the purchasing power parities [equation (4.2)] is easily relaxed by allowing the price level to be a weighted average of the prices of non-tradeable goods and internationally traded goods:

$$p = \sigma p_N + (1-\sigma)p_T \tag{4.4}$$

$$p^* = \sigma^* p_N + (1-\sigma^*)p_T^* \tag{4.5}$$

where p_N and p_T denotes, respectively, the logarithm of the prices of non-tradeable and tradeable goods, and σ denotes the weight of nontradable goods in the price index. If purchasing power parity holds only for tradeable goods, we replace equation (4.2) by (4.6):

$$p_T = e + p_T^* . \tag{4.6}$$

Using (4.4)-(4.6) in (4.1) yields

$$e = (m-m^*) + [\ell^* - \ell] + [\sigma(p_T - p_N) - \sigma^*(p_T^* - p_N^*)] . \tag{4.7}$$

This equation reveals a third important factor determining the exchange rate: relative price structures in the two economies. A rise in the domestic relative price of tradeable goods (a loss of competitiveness), raises the exchange rate (i.e., depreciates the domestic currency).

Specification of the determinants of real money demand adds further content to the general monetary model of exchange rate determination. One such specification is given by

$$\ell = k+\eta y - \alpha i \tag{4.8}$$

$$\ell^* = k^* + \eta^* y^* - \alpha^* i^* \tag{4.9}$$

where y and i denote the logarithm of income and the rate of interest and where η and α denote the income elasticity and the interest (semi) elasticity of the demand for money. Substituting this specification into (4.7) and assuming for simplicity of exposition that $\eta = \eta^*, \alpha=\alpha^*$, and $\sigma=\sigma^*$, we obtain

$$e = (k^*-k) + (m-m^*)+ \eta(y^*-y) + \alpha(i-i^*) + \sigma[(p_T-p_N) - (p_T^*-p_N^*)] \tag{4.10}$$

Other things constant, a rise in the level of domestic relative to foreign income, appreciates the value of domestic currency (reduces e) and an increase in the domestic nominal interest relative to the foreign nominal interest rate depreciates the value of domestic currency (increases e).

The result (4.10) is further refined by incorporating the interest parity condition,

$$i - i^* = \pi \tag{4.11}$$

where π denotes the forward premium a foreign exchange (i.e., the difference between the logarithms of the forward and the spot exchange rates). Substituting π for $(i-i^*)$ in equation (4.10) yields the prediction that a rise in the forward premium on foreign exchange depreciates the currency (raises e).[18] This dependence of the current exchange rate on expectations concerning the future (as summarized by the forward premium) is a typical characteristic of price determination in asset markets. Thus, an expected future depreciation of the currency is reflected immediately in the current value of the currency.

In the above model we have not drawn the distinction between "the demand for domestic money" and "the domestic demand for money." Implicitly it has been assumed that domestic money is demanded only by domestic residents while foreign money is demanded only by foreign residents. Furthermore, the formulation of the demands for real cash balances [in equations (4.8)-(4.9)] included the domestic interest rate in the domestic demand, and the foreign interest rate in the foreign demand; it has been implicitly assumed that the only relevant alternative for holding domestic money is domestic securities while the only relevant alternative for holding foreign money is foreign securities. In principle, however, the alternatives to holding domestic money include domestic securities, foreign securities, inventories of domestic and foreign goods as well as foreign exchange. It follows that a richer formulation of the demand for money would recognize that, as an analytical matter, the spectrum of alternative assets and rates of return that are relevant for the specification of the demand for money is rather broad, including both rates of interest, i and i^* expected domestic and foreign inflation as well as the forward premium on foreign exchange π. Furthermore, to the extent that under flexible exchange rate system individuals might wish to diversify their currency holdings, the demand for domestic money would include a foreign component which depends on foreign income, while the demand for foreign money would include a domestic component which depends on domestic income.[19] These characteristics reflect the phenomenon of currency substitution which is likely to arise when the exchange rate is not pegged.[20] Under these circumstances the demand function ℓ and ℓ^* will be richer and, when substituted into equation (4.7), the predictions of the effects of parametric changes in incomes or rates of interest will depend on the relative sensitivity of the demands for domestic and foreign monies to these parametric changes, which in turn may depend on the relative degrees of substitutions among assets in portfolios. The general principles which govern the effects of parametric changes on the relative demands for money are similar to those that govern the effects of international transfers on relative demands and resemble the "transfer problem criteria".

The monetary approach that was summarized in the preceeding discussion differs from the elasticities approach to exchange rate determination in that concepts like exports, imports, and the like, do not appear explicitely as being fundamentally relevant for the understanding of the evolution of the exchange rate. Rather, the relevant concepts relate to three groups of variables: first are those which are determined by the monetary authorities, second are those which affect the demands for domestic and foreign monies, and third are those which affect the relative price structures.[21]

The formulation of the link between domestic and foreign prices in equation (4.6) assumed that purchasing power parities holds with respect to internationally traded goods. Implicitly it was assumed that there are no barriers to trade. This formulation can be easily extended so as to incorporate price differential which stem from commercial policies. For example, when the domestic economy has tariffs on imports, equation (4.6) becomes

$$p_T = \kappa + e + p_T^* \tag{4.12}$$

where κ denotes the logarithm of one plus the proportional tariff rate. Using equation (4.12) instead of (4.6) in the derivation of the exchange rate equation shows the negative dependence of e on κ. Accordingly, the imposition of a tariff results in an appreciation of the currency. In explaining this result the monetary approach does not emphasize the effect of the tariff on the relative price of imports along the lines of the "elasticity approach" but rather,it is argued that the currency appreciates because, ceteris paribus, a rise in the tariff rate raises the price level, induces a rise in the demand for nominal balances and results in a rise in the relative price of nominal balances. The monetary approach also provides for a mechanism by which a tariff may result in a depreciation of the currency. If subsequent increases in tariffs result in distortions which lower real income,the reduced real income reduces the demand for money and may outweigh the effect of the rise in the price level. In that case a rise in the tariff rate may weaken the currency [for further discussion see Kimbrough (1980)].

We turn now to a brief illustration of the working of the model under the assumption that capital is immobile internationally. As shown in equation

(4.10), the equilibrium exchange rate can be expressed in terms of variables pertaining to the demand and the supply of monies as well as to those which underlie the relative price structure. The equilibrium relative price structure is determined by the condition that the demands for traded and non-traded goods equal the corresponding supplies. Panel II of figure 4.1 describes the determination of the equilibrium relative price $(p_T - p) = \sigma(p_T - p_N)$ for the domestic economy that is assumed to face a given foreign price of traded goods.[22] The NN and the TT schedules describe combinations of relative prices and interest rates that maintain equilibrium in the markets for non-traded and traded goods, respectively. The NN schedule is positively sloped since a rise in $(p_T - p)$ creates an excess supply for non-traded goods which can be eliminated by a higher interest rate. The higher interest rate restores the equilibrium since it lowers demand. The reduction in the demand in turn is based on the assumption that aggregate spending depends negatively on the rate of interest. The TT schedule is negatively sloped since a rise in the relative price $(p_T - p)$ creates an excess supply of traded goods which can be eliminated by a fall in the rate of interest which induces a rise in spending. The equilibrium rate of interest and relative prices is designated by point Q. Panel I of figure 4.1 describes the condition for money market equilibrium. The horizontal axis represents the real value of cash balances as a function of the rate of interest. For subsequent use it is noted that, from equations (4.4)-(4.6), the price level that is used in the computation of real balances can be written as

$$p = e + p^* + (p_T^* - p^*) - (p_T - p) \quad . \qquad (4.13)$$

Consider a rise in spending that falls entirely on traded goods. As shown in panel II of figure 4.1, this induces a rightward shift of the TT schedule to T' T' and results in a new equilibrium at point Q' with a higher

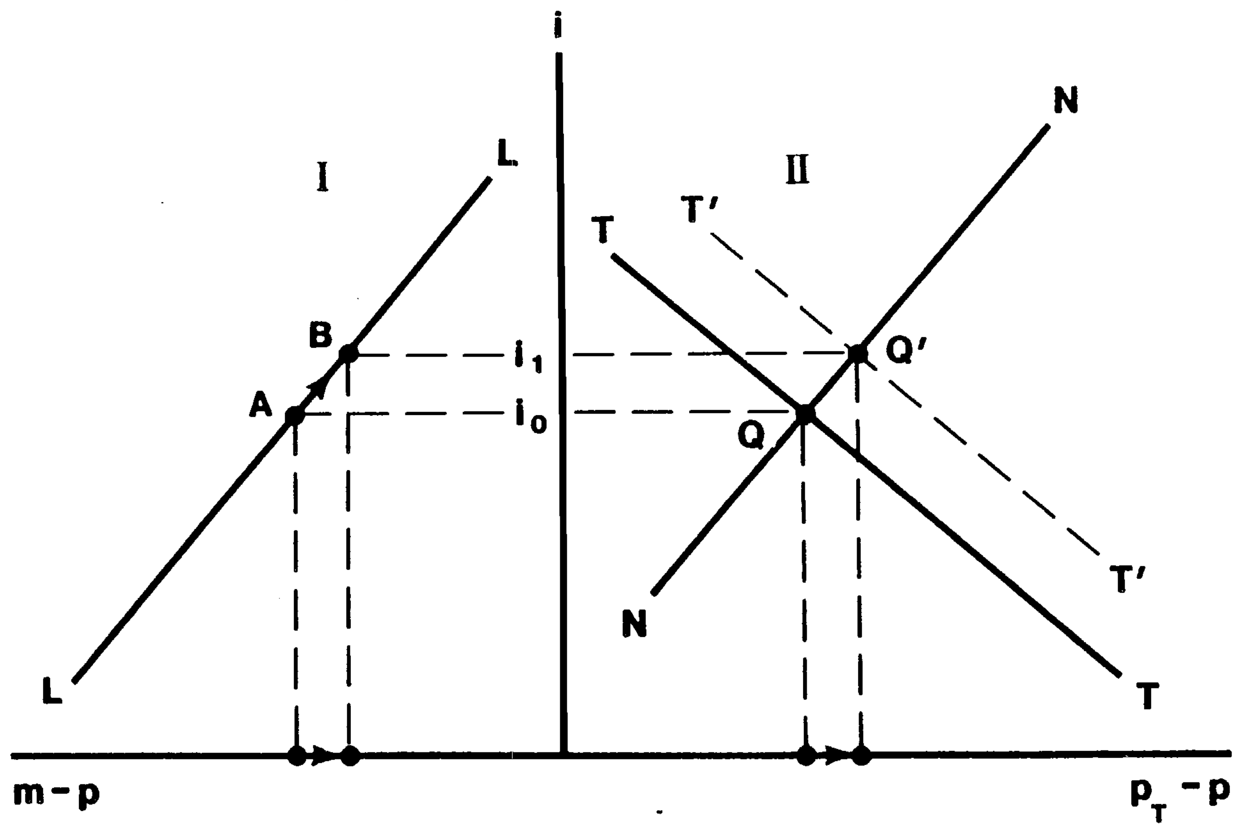

Figure 4.1: Stock and Flow Equilibruim Under Flexible Exchange Rates: The Effect of a Rise in Spending on Traded Goods

relative price of traded goods and a higher rate of interest. The higher rate of interest in turn lowers the demand for real balances and, as shown in panel I of figure 4.1, results in a new equilibrium at point B. Inspection of equation (4.13) helps to ascertain the effects of the change in spending on the exchange rate. Since, given the higher interest rate, the price level must rise (so as to reduce real balances) and since the rise in (p_T-p)--which is induced by the decline in the nominal price of non-traded goods--contributes to a fall in the price level, it follows that the exchange rate, e, must rise so as to more than offset the price level effect of the relative price change.

Consider now the case where the rise in spending falls entirely on non-traded goods. In this case the NN schedule shifts to the left as in figure 4.2 and the new equilibrium (point Q'') is characterized by a lower relative price of traded goods and a higher rate of interest. As before, the higher rate of interest induces a decline in the desired quantity of real balances (point C) and therefore, given the nominal quantity of money, necessitates a higher price level. In this case, however, the change in the exchange rate is ambiguous. The fall of the relative price (p_T-p) lowers the price level and therefore, depending on whether this reduction in the price level exceeds or falls short of the reduction that is necessary for money market equilibrium, the exchange rate will fall or rise. We conclude by noting, that in contrast with the predictions of the "simple absorption" approach one may not conclude unambiguously that a rise in aggregate spending weakens the currency. Rather, the exchange rate effect may depend on whether the rise in spending falls on traded or non-traded goods.

The same model can be used to examine the effects of other changes like expenditure switching for which the rise in spending on one group of goods

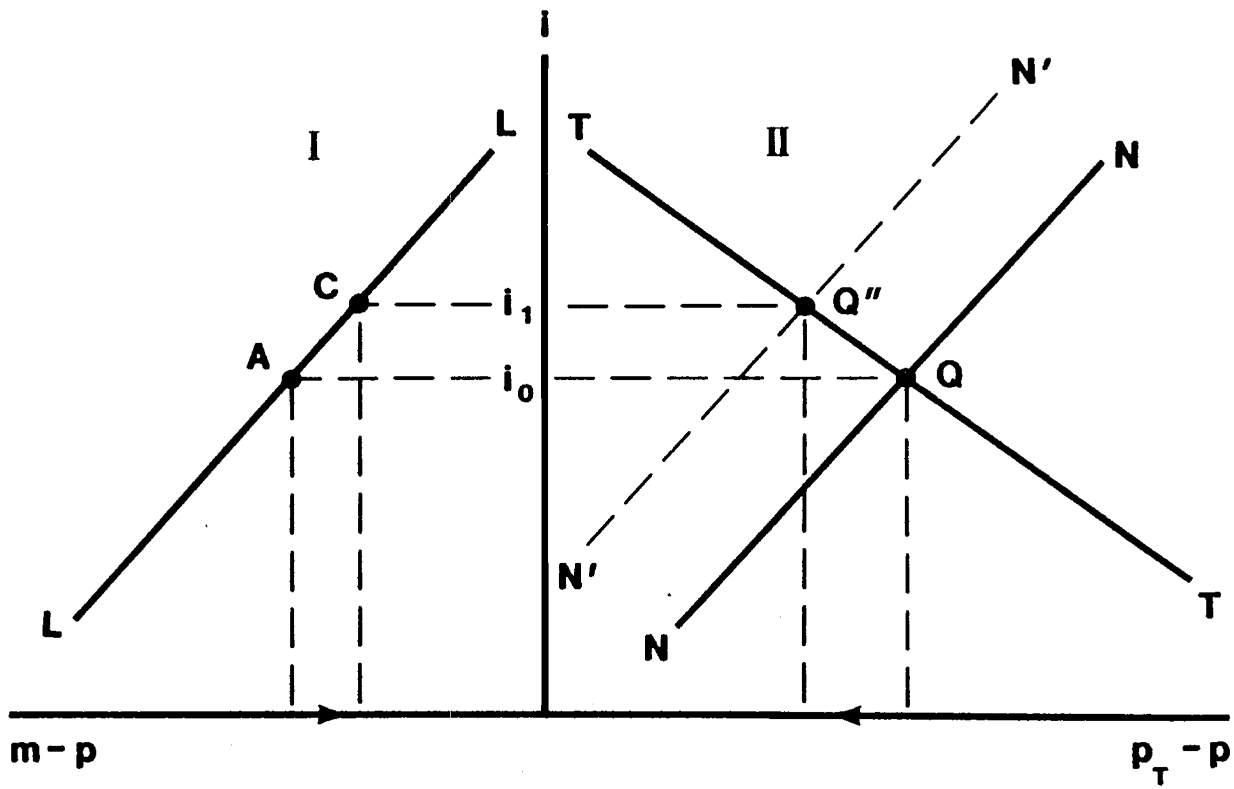

Figure 4.2: Stock and Flow Equilibrium Under Flexible Exchange Rates: The Effect of a Rise in Spending on Nontraded Goods

does not come at the expense of savings but rather corresponds to a decline in spending on the other group of goods. Likewise one could analyse the effects of economic expansion which originates in one of the sectors. In that case it can be shown that a rise in output originating in the traded goods sector, results in a fall in e (i.e. in an appreciation of the currency). On the other hand the exchange rate effects of a rise in output originating in the non-traded sector are ambiguous. As before, this ambiguity stems from the fact that the change in the equilibrium relative prices induces a change in the price level which may exceed or fall short of the change required by money market equilibrium.[23]

The above analysis which was intended to illustrate the working of the model was conducted under the assumption that capital was immobile internationally. Under these circumstances the balance of trade had to be balanced. The model can be extended to allow for capital mobility. In that case, flow equilibrium would require that in addition to a zero excess demand for non-traded goods, the trade balance surplus must equal the deficit on the capital account. The qualitative conclusions of the analysis remain unchanged except for the fact that the induced change in the rate of interest (and thereby the required change in the price level) would be smaller the higher the degree of capital mobility. In the extreme case, when capital is perfectly mobile, the interest rate and thus the desired level of real balances would not change. As can be seen from equation (4.13), in this case to maintain a constant price level, the exchange rate would have to change by the same amount as the relative price (when both are measured logarithmically).

Finally, it is noteworthy that the model satisfies the homogeneity postulate. A once and for all rise in the domestic money supply results in a once and for all rise in the exchange rate and in the nominal price of non-traded goods while leaving all real variables (like real balances, relative prices, and the rate of interest) unchanged. Likewise, a once and for all equal rise in the domestic and the foreign money raises all nominal prices while leaving all real variables and the exchange rate unchanged.

The formulation in equation (4.9)-(4.10) presumed that money market equilibrium obtains continuously. The analytical framework could be modified easily to allow for a distinction between short-run and long-run demands for money. This formulation would imply the dynamics of adjustment. Likewise, the formulation in equation (4.16) could be modified to allow for a gradual adjustment to purchasing power parities [see Bilson (1978a). While such modifications of the theoretical model do not introduce severe complexities, the implications for empirical estimates are much more involved and great care is required in the specification of the corresponding econometric model.

Further modifications of the model allow for legal restrictions on transactions in foreign currency which results in black markets, [Blejer (1978)], as well as for government intervention in the determination of exchange rates which results in a crawling peg [Blejer and Leiderman (1981)]. An additional modification concerns the choice of the rate of interest that is included in the demand for money. The formulation that we have used included the nominal rate of interest as an argument without drawing a distinction between the real interest rate and inflationary expectations. Likewise, the specification assumed some form of purchasing power parities. This specification can be modified so as to allow for short term price stickiness.[24] In that case a rise in the quantity of money lowers the real rate of interest for the short-run and induces a depreciation of the currency.

The discussion of currency substitution suggested the possibility that the function characterizing the demand for money includes many alternative rates of return corresponding to the many alternative assets. Again, as a theoretical matter this modification does not introduce severe complexities but the implications for empirical research may be severe since the various rates of return may be highly collinear. The degree of collinearity maybe very high if the alternative rates of return are linked to each other by various parity conditions. Among such parity conditions are the interest parity--linking the forward premium on foreign exchange to the difference between domestic and foreign rates of interest, the purchasing power parity--linking domestic and foreign prices, and the Fisher relations--linking the nominal rates of interest to the real rates of interest and to inflationary expectations.

The analysis of exchange rate determination within the monetary framework did not put much explicit emphasis on the stocks of other assets. According to the monetary model changes in the stocks of alternative assets results in exchange rate changes only to the extent that they alter the various rates of return which affect the demand for money. In contrast, the portfolio-balance model emphasizes the limited degree substitutability among alternative assets. According to the portfolio-balance model the relative quantities of the various assets and of the rate of accumulation of these assets excert profound first order effects on the exchange rate.[25] As an empirical matter, however, the implementation of this approach is made difficult due to limited availability of data on the various quantities of the assets that would be relevant for inclusion in the world portfolio model.

Since the rate of accumulation of assets equals the current account of the balance of payments, it provides for a dynamic linkage between the current account and the exchange rate. As a result, analyses of the portfolio-balance model have typically linked the exchange rate to the current account.[26] It is relevant to note, however, that such a linkage is not specific to the portfolio-balance model. Rather, it reflects the implications of the budget constraint by which the current account of the balance of payments equals the discrepancy between income and spending, and this constraint holds of course independent of the determinants of portfolio composition. Consequently, any model which allows for net savings, must imply a relationship between the exchange rate and the current account.[27]

Prior to concluding this section it might be useful to note that the monetary approach to the exchange rate does not claim that the exchange rate is "determined" only in the money or in the asset-markets and that only stock rather than flow considerations are relevant for determining the equilibrium exchange rate. Obviously, general equilibrium relationships which are relevant for the determination of exchange rates include both stock and flow variables.[28] In this respect, the money market equilibrium relationship that has been used, may be viewed as a reduced form relationship. Furthermore, the fact that the analysis of the exchange rate has been carried out in terms of the supplies and the demands for monies, does not imply that "only money matters" or that the exchange rate is determined only by the supply of domestic and foreign monies: on the contrary, in addition to the key role played by the intersectoral relative price structure, the demand for money plays a critical role and it depends on real variables like real income as well as on other real variables which underlie expectations. The rationale for concentrating on the relative supplies and demands for money is that they provide a convenient and a natural framework for organizing thoughts concerning the determinants of the relative price of monies. It is the same principle which has been used by proponents of the monetary approach to the balance of payments in justifying the use of the money demand-money supply framework for the analysis of the money account of the balance of payments under a pegged exchange rate system.[29]

The model that was discussed in this section included anticipatory variables, like the forward premium on foreign exchange, as one of the determinants of the current exchange rate. However, this formulation has not emphasized sufficiently the critical role that expectations play in affecting the exchange rate. This unique role is best exemplified within a more general framework that views the question of exchange rate determination as part of the more general theory of the determination of asset prices.

4.2. Exchange rates as asset prices

In the models of exchange rate determination examined in the preceding section, the dynamic behavior of the exchange rate is usually analyzed in terms of the response of the exchange rate to an exogenous disturbance (such as a permanent increase in the domestic money supply) and its subsequent path of convergence to its new long-run equilibrium. This general view of exchange rate determination, however, does not fully explain key empirical regularities that have been characteristic of the behavior of exchange rates during the 1970's and during earlier periods of generalized floating. As a statistical matter, the logarithm of spot exchange rates between the U.S. dollar and other major currencies (the British pound, the Deutsche mark, the French franc, the Japanese yen and the Swiss franc) is generally well described as random walks in which month-to-month and quarter-to-quarter changes are almost entirely unpredictable. Changes in spot exchange rates are generally closely correlated with contemporaneous changes in forward exchange rates (especially for large changes), indicating that movements in spot rates are closely related to movements in the market's expectation of future spot rates.

Monthly and quarterly changes in exchange rates are not, however, closely related to differentials in national inflation rates, implying that most short-run changes in nominal exchange rates correspond changes in real exchange rates (i.e., to deviations from purchasing power parities). Moreover, monthly and quarterly changes in exchange rates are not closely related to differentials in rates of monetary expansion or to current account imbalances.[30]

These facts suggest that exchange rates should be viewed as prices of durable assets determined in organized markets (like stock and commodity exchanges) in which current prices reflect the market's expectation concerning present and future economic conditions relevant for determining the appropriate values of these durable assets, and in which price changes are largely unpredictable and reflect primarily new information that alters expectations concerning these present and future economic conditions. This general notion of exchange rates as "asset prices" can be represented in skeletal model in which the logarithm of the equilibrium exchange rate in period t, denoted by e(t), is determined by[31]

$$e(t) = X(t) + a \cdot E[(e(t+1) - e(t));t)]; \qquad (4.14)$$

where X(t) represents the basic economic conditions that affect the foreign exchange market in period t, $E[(e(t+1) - e(t));t]$ denotes the expected percentage rate of change of the exchange rate between t and t+1 conditional on information available at t, and the parameter <u>a</u> measures the sensitivity of the current exchange rate to its expected rate of change. To close the model, it is assumed that expectations are "rational" in the sense that they are consistent with the application of (4.14) in all future periods (and with a suitable boundary condition). By forward iteration, it follows that the exchange rate that is expected at any t+j, for $j > o$, conditional on information available at t, depends on a discounted sum of expected future X's, starting at t+j; specifically,

$$E[e(t+j);t] = (1/(1+a))\cdot\sum_{i=0}^{\infty} (a/(1+a))^{i}\cdot E[X(t+j+i);t]. \qquad (4.15)$$

Setting j = 0, we obtain the "asset price" expression for the current exchange rate as a discounted sum of present and expected future X's.

Using (4.15), we also obtain a convenient decomposition of the change in the exchange rate, $D(e(t)) \equiv e(t+1) - e(t)$, into its expected change component, $D^{e}(e(t)) = E[D(e(t)); t] = E[(e(t+1) - e(t)); t]$ and its unexpected change component, $D^{u}(e(t)) = e(t+1) - E[e(t+1);t]$. The expected change in the exchange rate is a discounted sum of expected future changes in the X's;

$$D^{e}(e(t)) = (1/(1+a))\cdot\sum_{i=0}^{\infty}(a/(1+a))^{i}\cdot E[D(X(t+i));t]. \qquad (4.16)$$

Alternatively, the expected change in the exchange rate can be expressed as proportional to the difference between the discounted sum of all expected future X's that determines E[e(t+1);t] and the current X;

$$D^{e}(e(t)) = (1/(1+a))\cdot[E([e(t+1);t) - X(t)]. \qquad (4.17)$$

The unexpected change in the exchange rate is a discounted sum of changes in expectations about future X's based on new information received between t and t+1;

$$D^{u}(e(t))=(1/(1+a))\cdot\sum_{i=0}^{\infty}(a/(1+a))\cdot[E(X(t+j+1);t+1)-E(X(t+j+1);t)]. \qquad (4.18)$$

These results provide a general rationale for many of the observed regularities in the dynamic behavior of exchange rates. The expected component of monthly changes in exchange rates between major industrial countries should usually be quite small because the factor of proportionality 1/(1+a) that appears in (4.17) is probably of the order of magnitude of 1/100, implying that only very large differences between the current X and the discounted sum of all future X's could justify a substantial expected change in the exchange rate over a period of a month.[32] In contrast, the unexpected component of the monthly change in the exchange rate, which is necessarily unpredictable on the basis of information available at t, could be quite large. If new information received between t and t+1 leads to a substantial revision, in the same direction, of expectations, we should observe changes in expectations concerning future exchange rates that are in the same direction and are of similar magnitude as the unexpected change in the spot exchange rate.[33] This suggests a rationale for the observed relation between unexpected movements in spot and forward exchange rates, especially for large movements.

4.3 Balance of payments equilibrium and the real exchange rate

One procedure for introducing specific economic content into the general asset price model of exchange rates is to focus on the condition of balance of payments equilibrium as the fundamental determinant of the equilibrium exchange rate, and allowing for a suitable channel through which expected changes in the exchange rate influence the balance of payments. This procedure is reminiscent of traditional flow market models of the determination of exchange rates, and is also similar to a number of more recent analyses of the interaction between the exchange rate and the current account balance.[34] In implementing this procedure, it is convenient initially to deal with a real model of the determination of the real exchange rate, and only subsequently (in the next section) to introduce the monetary considerations centrally important in determining nominal exchange rates.[35]

For a moderate size country, the real exchange rate, q, is identified with the logarithm of the relative price of domestic goods in terms of foreign goods. Domestic goods may either be exclusively nontraded goods or may be goods for which there is a less than infinitely elastic foreign demand. Consistent with either of these interpretations, it is plausible to assume that the current account surplus b, (measured in terms of imported good), is determined by[36]

$$b = \beta \cdot (z - q) + r^{*} \cdot A, \quad \beta > 0, \tag{4.19}$$

where z summarizes the exogenous real factors that affect domestic excess demand and foreign excess demand for domestic goods, β is a parameter that reflects the relative price elasticities of domestic and foreign excess demands for domestic goods, r^{*} is the (fixed) foreign real interest rate, and A is the net stock of foreign assets (denominated in foreign goods) held by domestic residents. Absent changes in official holdings of foreign assets, the current account surplus necessarily determines the rate of change of net private holdings of foreign assets;

$$D(A) = b = \beta \cdot (z - q) + r^{*} \cdot A. \tag{4.20}$$

The rest of the world, which is large relative to the home country, willingly absorbs changes in assets A, in exchange for foreign goods, at the fixed foreign real interest rate, r^{*}. Hence, the capital account deficit of the home country (measured in terms of foreign goods), denoted by c, reflects the desired rate of accumulation of net foreign assets by domestic residents. Two factors are assumed to influence the desired rate accumulation of net foreign assets: the divergence between the current "target level" of net foreign assets, $\hat{A}$ and their current actual level, A; and the expected rate of change of the real exchange rate; formally,

$$c = \mu \cdot (\hat{A} - A) - \alpha \cdot D^{e}(q), \quad \mu, \alpha > 0. \tag{4.21}$$

The effect of $D^{e}(q)$ on c may be thought of either as the influence of expected changes in the value of foreign assets (measured in terms of domestic goods) on desired accumulation of such assets, or as the influence of the domestic real interest rate (defined relative to a basket of both domestic and foreign goods) on desired saving.

Balance of payments equilibrium requires that the current account surplus, b, is matched by the capital account deficit, c; that is,

$$\beta\cdot(z - q) + r^{*}\cdot A = \mu\cdot(\hat{A} - A) - \alpha\cdot D^{e}(q). \qquad (4.22)$$

This condition, together with (4.20), constitute a simultaneous sytems of forward looking difference equations that may be solved for the expected future time paths of the endogenous variables, q and A, conditional on the current inherited stock of net foreign assets and on the expected future time paths (based on current information) of the exogenous forcing variables, z and $\hat{A}$. In particular, the solution for the current equilibrium real exchange rate is given by

$$q(t) = \bar{q}(t) + \gamma\cdot(A(t) - \bar{A}(t)) \qquad (4.23)$$

where

$$\bar{q}(t) = \bar{z}(t) + (r^{*}/\beta)\cdot\bar{A}(t)$$

$$\bar{z}(t) = (1-\Theta)\cdot\sum_{j=0}^{\infty}\Theta^{j}\cdot E[z(t+j);t]$$

$$\bar{A}(t) = (1-\Theta)\cdot\sum_{j=0}^{\infty}\Theta^{j}\cdot E[A(t+j);t]$$

$$\Theta = (1/(1+\lambda)) \quad \text{and} \quad \gamma = (\lambda/\beta) - (1/\alpha) > 0$$

$$\lambda=(1/2)\cdot[(r^{*} + (\beta/\alpha))+\sqrt{(r^{*}+(\beta/\alpha))^{2}+4\cdot(\mu\beta/\alpha)}]>(r^{*}+(\beta/\alpha)).$$

The result in (4.23) indicates that the current real exchange rate depends on (i) the current estimate of the long-run equilibrium real exchange rate, $\bar{q}(t)$, that is expected to be consistent with the requirement that on average (in present and future periods), the current account is balanced $(b = 0)$, and (ii) on the divergence between current net foreign asset holdings and the current estimate of the long-run desired level of such holdings, $\bar{A}(t)$. The asset price property of the real exchange rate is reflected in the dependence of $\bar{q}(t)$ on a discounted sum of present and expected future z's and in the dependence of $\bar{A}(t)$ on a discounted sum of present and expected future $\hat{A}$'s. The discount rate, λ, that is applied in determining both $\bar{q}(t)$ and $\bar{A}(t)$, reflects the sensitivity of the current account surplus to the level of q and the sensitivity of the capital account deficit both to expected rate of change of q and to the divergence of net foreign assets from their target level.

It is noteworthy that the asset price expression for the real exchange rate that is embodied in (4.23) is consistent with a sophisticated version of the traditional flow market model of exchange rate determination. As illustrated in figure 4.3, the current real exchange rate may be thought of as being determined by the intersection of the b schedule, characterizing the flow of foreign exchange arising from current account transactions, $b = \beta\cdot(z - q) + r^{*}\cdot A$, and the c schedule, characterizing the flow of foreign exchange arising from capital account transactions, $c = \mu\cdot(\hat{A} - A) - \alpha\cdot(E[q(t+1);\ t] - q)$, where the expected future real exchange rate, $E[q(t+1);t]$, is treated as a parameter affecting the position of the c schedule.[37] The element of sophistication that transforms this traditional model into the asset pricing results expressed by (4.23) is the assumption that expectations concerning the future real exchange rate are consistent with the economic forces that will actually determine the future real exchange rate.

The present results are also consistent with recent models of the dynamic interaction between the exchange rate and the current account which view the current exchange rate as determined by the willingness of asset holders to hold existing stocks of foreign assets, and which view the rate of change of the exchange rate as determined by rate of change of foreign assets which is equal to the current account balance.[38] In particular, if we assume that the

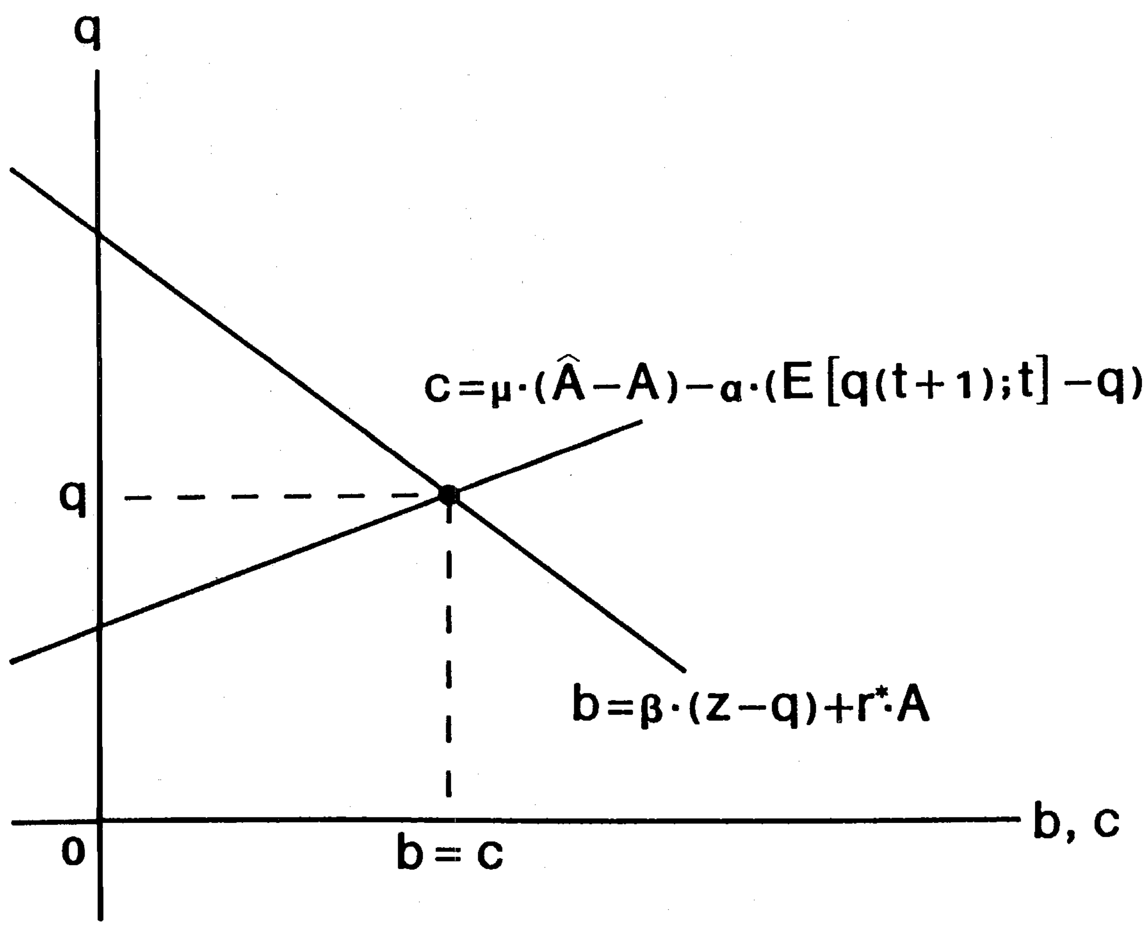

Figure 4.3: Balance of Payments Equilibrium and the Real Exchange Rate

exogenous factors affecting the current account (the z's) and the target levels of net foreign assets (the $\hat{A}$'s) are constant, then the current real exchange rate, $q(t)$, determined by (4.23) becomes a function of the inherited stock of net foreign assets, as illustrated in left hand panel of figure 4.4. Also, as illustrated in the right hand panel of figure 4.4, the current account surplus, b, is determined by this value of $q(t)$ and by the interest received on the inherited stock of net foreign assets. When $A(t) = A_0$ is less than $\bar{A} = \hat{A}$, $q(t) = q_0 = \bar{q} + \gamma\cdot(A_0 - \bar{A})$ is less than $\bar{q} = z + (r^*/\beta)\cdot\bar{A}$, and the current account surplus is
$b_0 = \beta\cdot(z - q_0) + (r^*/\beta)\cdot A_0 = (\beta\gamma - r^*)\cdot(\bar{A} - A_0) = (\beta - (r^*/\gamma))\cdot(\bar{q} - q_0) > 0.$
This surplus adds to the stock of net foreign assets, and the new stock, $A_1 = A_0 + b_0$, determines a new real exchange rate, q_1, where
$q_1 = \bar{q} + \gamma\cdot(A_1 - \bar{A}) = q_0 + \gamma\cdot b_0 > q_0.$ The new real exchange rate, together with the new stock of net foreign assets, determine a new current account surplus, b_1, where
$b_1 = \beta\cdot(z - q_1) + (r^*/\beta)\cdot A_1 = (\beta\gamma - r^*)\cdot(\bar{A} - A_1) = (\beta - (r^*/\gamma))\cdot(\bar{q} - q_1)$,
which is still positive but is smaller than b_0. This dynamic process continues, with ever smaller current account surpluses and ever smaller increases in q, until the current account is in balance and $q = \bar{q}$.

New elements enter into the analysis of exchange rate dynamics when we consider either expected changes in the z's and the $\hat{A}$'s or changes in expectations about the future paths of these exogenous forcing variables due to new information.[39] The general expression for the expected change in the exchange rate implied by (4.23) is given by

$$D^e(q(t)) = (\beta\gamma - r^*)\cdot(\bar{A}(t) - A(t)) + (1 - \Theta - \beta\Theta)\cdot E[(\bar{z}(t+1) - z(t));t] \quad (4.24)$$
$$- (\gamma - (r^*/\beta))\cdot(1 - \Theta)\cdot E[(\bar{A}(t+1) - \hat{A}(t));t].$$

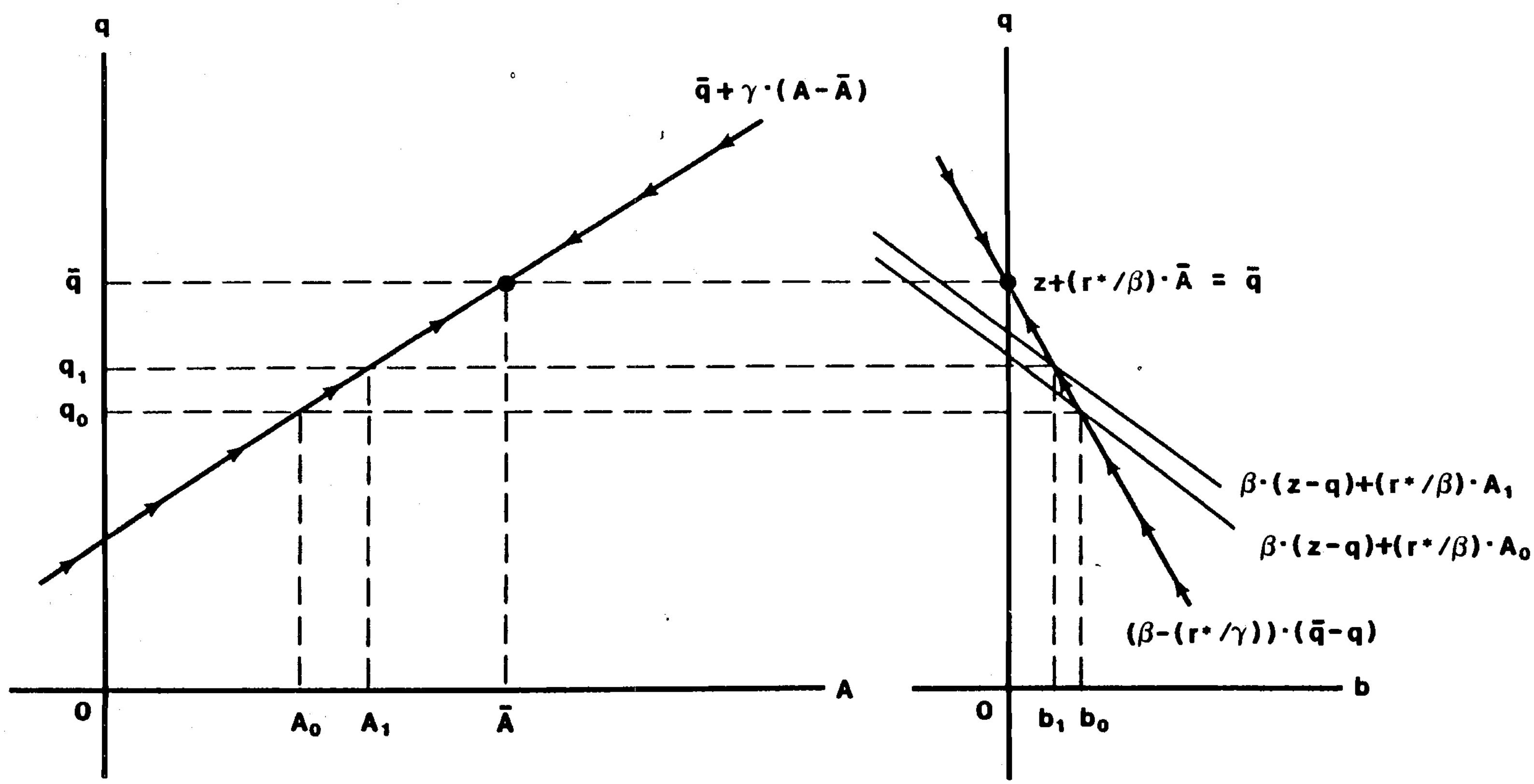

Figure 4.4: The Dynamic Interaction Between the Exchange Rate, Asset Stocks and the Current Account.

The first term on the right hand side of (4.24) captures the essential element of figure 4.4, namely, the effect of divergences between current long-run desired level of net foreign assets and the current actual level of net foreign assets on the expected change in the real exchange rate. The second term on the right hand side of (4.24) represents the effect on $D^e(q(t))$ of "temporary expected disturbances to the current account" associated with differences between the expected discounted sum of all future z's, $E[\overline{z}(t+1);t]$, and the current expected value of z. The third term on the right hand side of (4.24) reflects the effect of expected changes in the target level of net foreign assets, measured by $E[\bar{A}(t+1) - \hat{A}(t)); t]$, on the expected change in q. The general expression for the unexpected change in the real exchange rate implied by (4.23) is given by

$$D^u(q(t)) = \gamma \cdot D^u(A(t)) + D^u(\overline{z}(t)) - (\gamma - (r^*/\beta)) \cdot D^u(\overline{A}(t)) \qquad (4.25)$$

where $D^u(A(t))$ is the unexpected change in net foreign assets associated with "innovations" in the current account, $D^u(\overline{z}(t))$ measures the effect of new information in revising expectations about future z's, and $D^u(\overline{A}(t))$ indicates the effect of new information in revising expectations about future target levels of A. The new information that leads to revisions of expectations about future z's and about future target levels of wealth may come from a variety of sources, including particularly the possible effect of innovations in the current account on expectations concerning the future behavior of the exogenous factors affecting the current account.

4.4 Exchange rates and money in the general model of exchange rate determination

Models of the type examined in the preceding section are easily extended to incorporate monetary phenomena and to deal with the nominal exchange rate.[40] Let p denote the logarithm of the domestic money price of domestic goods, p^* denote the logarithm of the foreign money price of foreign goods, and e the logarithm of the domestic money price of foreign exchange. The logarithm of the relative price of domestic goods in terms of imported goods is given by

$$q = p - (e + p^*). \tag{4.26}$$

The logarithm of the general price level in the home country is given by

$$P = \sigma \cdot p + (1 - \sigma) \cdot (e + p^*) = e + p^* + \sigma \cdot q \tag{4.27}$$

where σ is the weight of domestic goods in the domestic price index, and where P denotes the price level. The logarithm of the demand for domestic money is given by

$$m^d = K + L \cdot P + J \cdot e + V \cdot q - N \cdot i - U \cdot D^e(e) + W \cdot A \tag{4.28}$$

where K represents all exogenous factors (such as real income) affecting the demand for domestic money, $L > 0$, $J > 0$ and $V \gtrless 0$ are the elasticities of money demand with respect to the general price level, the nominal exchange rate and the relative price of domestic goods, and $N > 0$, $U > 0$ and $W > 0$ are the semi-elasticities of money demand with respect to the domestic nominal interest rate, i, the expected rate of change of the nominal exchange rate, $D^e(e)$, and the stock of net foreign assets. The domestic nominal interest rate is determined by the interest parity condition,

$$i = i^* + D^e(e) + \rho \tag{4.29}$$

where i^* is the exogenous foreign nominal interest rate and ρ is an exogenous risk premium that accounts for differences between the forward premium on foreign exchange and the expected rate of change of the nominal exchange rate.[41]

The critical equilibrium condition for nominal variables is the requirement that the logarithm of demand for domestic money, m^d, must equal the logarithm of the supply of domestic money, m. Using equations (4.26)-

(4.29), this equilibrium condition may be expressed in terms of the following "reduced form" condition for monetary equilibrium:

$$m = k + \zeta \cdot e - \eta \cdot D^{e}(e) \qquad (4.30)$$

where $\zeta = L + J > 0$ and $\eta = N + U > 0$, and where k summarizes all of the factors other than e and $D^{e}(e)$ that influence the logarithm of demand for domestic money, i.e.,

$$k = K + L \cdot p^* - N \cdot (i^* + \rho) + (V + \sigma L) \cdot q + W \cdot A. \qquad (4.31)$$

If it is assumed that paths of the real variables q and A are determined independently of the behavior of the domestic money supply, as indicated by the analysis in the preceding section, then the expected path of the nominal exchange rate may be determined from the solution of the forward looking difference equation (4.30). As is seen from (4.32), the expected nominal exchange rate depends on a discounted sum of expected future differences between m and k;[42]

$$E[e(s);t] = (1/(\zeta+\eta)) \cdot \sum_{j=0}^{\infty} (\eta/(\zeta+\eta))^{j} \cdot E[(m(s+j) - k(s+j));t]. \qquad (4.32)$$

Setting $s = t$, we find that (the logarithm of) the current nominal exchange rate, $e(t) = E[e(t);t]$, depends on a discounted sum of present and expected future differences between m and k.

This result represents the "asset price version" of the simple monetary model of exchange rate determination discussed in section 4.1. Its advantage over this simpler model is that it indcates clearly dependence of the current exchange rate not only on current money supplies and money demands, but also on the entire expected future time paths of money supplies and money demands.[43] In accord with the general principles of the asset price view of exchange rates, the expected rate of change of the exchange rate is a discounted sum of expected future changes in m-k's; and the unexpected change in the exchange rate is a discounted sum of revisions in expectations about future $m-k$'s brought about by new information received between t and $t+1$. In general, these two components of the change in the exchange rate should reflect the stochastic process generating $m-k$ and the information about this process that is available to economic agents. For example, if $m-k$ is directly observable and is known to follow a random walk, then the exchange rate, e, should also follow a random walk in which all changes in e are unexpected and are proportional to the observed unexpected changes in $m-k$. Alternatively, if k is unobservable (to private agents) and is known to follow a random walk, and if the monetary authority allows m to change to offset changes in k and adds an uncorrelated error to changes in m, then e should still follow a random walk but, following the rules of optimal forecast, the response of e to observed changes in m should depend on the ratio of the variance of the pure error component of changes in m to the variance of changes in k.

In (4.32), the influence of real factors on the expected path of the nominal exchange rate comes through their effect on the expected paths of m--the money supply variable, and k--the money demand variable. An alternative, analytically equivalent expression for $E[e(s);t]$ brings the influence of these real factors into sharper focus;

$$E[e(s);t] = E[P(s);t] - E[p^*(s);t] - \sigma \cdot E[q(s);t] \tag{4.33}$$

where $E[P(s);t]$ is the expectation of (the logarithm of) the general level of domestic prices, as determined by

$$E[P(s);t] = (1/(\zeta+\eta)) \cdot \sum_{j=0}^{\infty} (\eta/(\zeta+\eta))^j \cdot E[(m(s+j) - \ell(s+j));t] \tag{4.34}$$

where ℓ is a measure of factors affecting (the logarithm of) the demand for domestic money that is defined by

$$\ell = K - J \cdot p^* - N \cdot (i^* + \rho) + (V - \sigma J) \cdot q + \eta \cdot D^e(p^*) + \eta\sigma \cdot D^e(q) + W \cdot A. \tag{4.35}$$

The results (4.33) to (4.35) represent the asset price version of the extended monetary model of exchange rate determination considered before. From these results, we find that a discounted sum of present and expected future money supplies affects the nominal exchange rate by affecting the general level of all domestic prices. Movements in the nominal exchange rate that are associated with expected or unexpected changes in this discounted sum of present and future m's are consistent with the maintenance of purchasing power parity. By the same token, changes in the foreign price level, which are not associated with changes in domestic money demand or supply or in the relative price of domestic goods in terms of foreign goods, induce movements in the nominal exchange rate that are consistent with purchasing power parity. Real economic factors influence the exchange rate through two channels: to the extent that such factors affect the discounted sum of present and future levels of demand for domestic money (measured by the ℓ's), they induce movements in the nominal exchange rate that are consistent with purchasing power parity; however, to the extent that such real factors induce movements in the relative price of domestic goods in terms of foreign goods, they require movements in the nominal exchange rate and in prices that constitute divergences from purchasing power parity.

When we combine the model of the nominal exchange rate embodied in (4.33)- (4.35) with the model of the real exchange rate discussed in the preceding section, we arrive at a general model in which the exchange rate exhibits the essential properties of an "asset price," while, at the same time, the general model also incorporates the key ingredients of both monetary models that focus on conditions of flow market equilibrium, as the critical determinants of exchange rates. This already general model of exchange rate determination can be further extended by introducing phenomena associated with macroeconomic disequilibria. The two modern approaches to the modelling of such phenomena are (i) the contracting models and (ii) the incomplete information models. Both share the common feature that stabilization policy (especially monetary policy) has no capacity to affect the long-run equilibrium behavior of national output, but they differ critically in their implications for the successful short-run use of stabilization policy. In the contracting models, changes in the money supply that were unanticipated at the time when existing nominal contracts were established can temporarily affect the level of national output, and the government can use its freedom to act with respect to monetary policy (while private agents are locked into existing nominal contracts) to improve the performance of national output [see Fischer (1977), Phelps and Taylor (1977), Taylor (1980)]. In contrast, in the incomplete information models, unanticipated changes in the money supply can temporarily affect national output, but stabilization policies linked to past values of variables observed by private agents have no capacity to improve the performance of national output, [see Lucas (1972, 1975), Barro (1976)].

The key implications of these two approaches to modelling macroeconomic disequilibrium for the behavior of national output carry over from the closed economy setting in which they were originally developed to an open economy setting. In either approach, unanticipated money supply changes temporarily affect domestic output and, in general, have some effect on foreign output; but only in the contracting approach can stabilization policy be used successfully to improve the performance on national output.[44] In addition to these implications with respect to national outputs, models that incorporate macroeconomic disequilibrium introduce the possibility that monetary disturbances may induce short-run price and exchange rate movements that diverge from purchasing power parity. In the incomplete information approach, such divergences are simply one of the manifestations of the real effects of unanticipated monetary changes, without any policy significance. In the contracting approach, stickiness of nominal prices resulting from existing nominal contracts may necessitate "overshooting" of the nominal exchange rate in response unanticipated monetary changes and an associated temporary but persistent change in the real exchange rate.[45] This "overshooting" response to the nominal exchange rate may provide additional leverage for monetary policy to affect the short-run behavior of national output, and may increase the usefulness of exchange rates as indcators for the conduct of stabilization policy.

4.5 Empirical issues in exchange rate analysis

One of the significant developments characterizing research in international economics during the last decade has been the prolification of empirical work.[46] In this section we will only highlight some aspects of this research.

The empirical methodology followed three general lines. The first examined the characteristics of the foreign exchange market, the second examined the validity of basic parity conditions and the third examined the performance of speicifc models.

An example of the first line of research has been an examination of market efficiency. For an asset market to be "efficient" prices must appropriately reflect all available information and thus it should be impossible to make extra-ordinary profits by exploiting generally available information. Tests of foreign exchange market efficiency have focused on (i) the statistical properties of forward rates as predictors of future spot rates, (ii) the time-series properties of exchange rates and of deviations from forward rates (iii) the relative degree of volatility of spot and forward rates, (iv) the ability to improve on market forecasts of future exchange rates by using past spot and forward exchange rates and other publicly available information, and (v) the capacity to make extra-ordinary profits by employing various trading rules. Different tests applied to differrent exchange rates in different time periods have not reached a unanimous consensus concerning the hypothesis of market efficiency.[47]

Tests of the various parity conditions examined the performance of the interest parity theory and the purchasing power parity doctrine. Tests of the interest parity have generally been favorable to the predictions of the theory at least when account is taken of the costs and timing of transactions in various markets [see, for example, Frenkel and Levich (1975, 1977)]. In contrast, tests of the purchasing power parity doctrine have not figured as well. The data specifically during the 1970's, suggest that short-run changes in exchange rates bear little relationship to short-run differentials in national inflation rates, particularly as measured by consumer price indices. Further, changes in exchange rates over longer periods of time have frequently been associated with large cumulative divergences from relative purchasing power parities.[48] As an analytical matter, purchasing power parities can be expected to hold in the long run if most of the shocks to the system are of a monetary origin which do not require changes in relative prices. The evidence on the large cumulative deviations from purchasing power parities are consistent with prominance of "real" shocks. It is relevant to note that the short-run deviations from purchasing power parities reflect, in addition to the effects of real shocks, the intrinsic differences between the properties of exchange rates and those of national price levels. Exchange rates, like other asset prices, are likely to respond promptly to new information which alters expectations, while national price level exhibits some "stickiness" reflecting the cost of price adjustment which result in nominal contracts of finite length. The resulting difference between the time-series properties of exchange rates and prices is reflected in the low correlation between the practically random month-to-month exchange-rate changes and the serially correlated differences between national rates of inflation.

The third line of research has tested directly the performance of specific models. The monetary model was reasonable successful when applied to extreme episodes like the German hyperinflation of the 1920's where monetary shocks dominated the scene. However, when applied to more regular periods it yielded mixed results [see, for example, Frenkel (1976), Frenkel and Clements (1982), Bilson (1978a, 1978b) and Hodrick (1978)]. Modifications of the simple monetary model which included elements of the term structure of the interest rate and which allowed for a trend in the income velocity have enjoyed limited success but have faced the difficulties arising from parameter instability [see, for example, Frankel (1979, 1984), Dornbusch (1978)]. Likewise, tests of the portfolio-balance model yielded occasionally mixed success but further examination yielded poor results [see, for example, Branson, Halttunen and Masson (1977) and Frankel (1984)]. While the various models might have enjoyed some success in accounting for the variability of exchange rates during a specific sample period, all have performed poorly when applied to out-of- sample data [see, for example, Meese and Rogoff (1983)]. It seems that at the present stage the empirical evidence taken as a whole, suggest the lack of a satisfactory structural model accounting for exchange rate behavior.

The analytical framework that was developed in section 4.2 views the exchange rate as an asset price which is highly sensitive to new information that alters expecatations. This general view implies that empirical research on the determinats of exchange rate changes should relate these changes to the "innovations" in the relevant variables.[49] The econometric modelling of these issues are, however, complex since they involve measurements of unanticipated events. Therefore, tests of these models are always joint tests of the specification of the model and of the decomposition of events into their anticipated and unanticipated components. Recent work on the relation between exchange rate and "news" measured "news" in a variety of ways and have produced evidence consistent with this general analytical view.[50] While this line of research is relatively new in exchange rate analysis, applications in other areas on economics suggest the potential for considerable promise.

FOOTNOTES

*We are grateful to Stanley Black, William Branson and Peter Kenen for helpful comments on an earlier draft of this paper. The research reported here is part of the NBER's research program in International Studies and Economic Fluctuations. Any opinions expressed are those of the authors and not necessarily those of the NBER.

[1]In figure 1 the FF curve is drawn steeper than the LM curve in order to emphasize that at this stage of the analysis we rule out private capital flows. This assumption is modified below.

[2]This result follows from the fact that the horizontal shift of the FF curve is larger than the corresending shift of the IS curve since $DE/Dy < 1$. Both curves shift to the right since income must rise to offset the impact of the fall in τ on demand.

[3]Interest payments on government bonds outside of the central bank are assumed to be financed by lump sum taxes so as to avoid issues associated with changes in the government budget and disposable income.

[4]The concept of the "natural distribution" is one of the central propositions of the classical doctrine. Accordingly, "A Nation cannot retain more than its natural proportion of what is in the world, and the balance of trade must run against it" [Gervaise (1720, p. 12)]. Similar statements were made by Hume (1752, pp. 62-64), Ricardo (1821, p. 123) and Mill (1893, book III, p. 194-95). For further references see Frenkel (1976b) and Frenkel and Johnson (1976a).

[5]The loss of control over the money supply is central to the predictions of the monetary approach to the balance of payments. For examples see Johnson (1958), Mundell (1968c, 1971), Mussa (1979). This loss of control is, of course, the key message of Hume's (1752) famous experiments of sudden annihilation of four-fifths of the money supply. For expositions of analyses of the monetary mechanism of balance of payments adjustment see Collery (1971), Frenkel (1976b), Hahn (1959), Johnson (1976a), Mundell (1968a), Mussa (1974), Swoboda (1972, 1973), Swoboda and Dornbusch (1973), Frenkel and Johnson (1976a), International Monetary Fund (1977), Allen and Kenen (1980).

[6]For analyses of growth and the balance of payments see Mundell (1968b), Komiya (1969), Dornbusch (1971), Frenkel (1971, 1976b), Flood (1977), and Purvis (1972).

[7]For analyses of devaluations see Dornbusch (1973a, 1973b), Berglas (1974), Boyer (1975), Blejer (1977), Frenkel and Rodriguez (1975), Johnson (1976a, 1976b). For empirical evidence see Connolly and Taylor (1976), Miles (1979) and Craig (1981). On the role of government debt, future tax liabilities, and the capital market see Metzler (1951), Mundell (1971) and Barro (1974).

[8]On the balance of payments effects of tariffs and other commercial policies see Mussa (1976a), Johnson (1976b) and Hawtrey (1922).

[9]For criticism of the restrictive assumptions see Chipman (1978), Hahn (1977), Kreinin and Officer (1978), Tsiang (1977). For a survey of the issues see Whitman (1975).

[10]This analysis of non-clearing of the labor market and gradual adjustment of the domestic nominal wage rate can be extended to other markets

and other prices. Provided that the adjustment mechanisms that are assumed to operate in these other markets are specified in a consistent manner, the essential features of the monetary mechanism of balance of payments adjustment are preserved. The exact details of path of convergence of other variables, however, are likely to be critically affected by the precise forms of these adjustment mechanisms.

[11]On the non-viability of long-run sterilization policies see Mundell (1968), Swododa (1972). On empirical aspects see Kouri and Porter (1974), Magee (1976), and Obstfeld (1982).

[12]For analysis of the role of non-traded goods see Dornbusch (1973b, 1974), Mundell (1971), Berglas (1974).

[13]The level of income does not appear as a determinant of $\bar{M}$ in (3.36), while it does in (3.12), only because the transformation curve determining the economy's production possibilities for traded and nontraded goods has been assumed fixed.

[14]For analyses of the price dynamics see Dornbusch (1973b), Berglas (1974), Blejer (1977).

[15]On the effect of the patterns of growth on relative prices see Balassa (1958).

[16]For analyses of portfolio equilibrium and the role of capital mobility see Branson (1970, 1976), Dornbusch (1975), Frenkel and Rodriguez (1975), McKinnon (1969), Henderson (1977), Allen and Kenen (1980), and Obstfeld (1980).

[17]For theoretical developments and applications of the approach see, for example, Dornbusch (1976a, 1976b), Kouri (1976), Mussa (1976b), Frenkel

(1976a), Frenkel and Johnson (1978), Bilson (1978a, 1978b), Hodrick (1978), Frankel (1979), and Frenkel and Clements (1982).

[18]See Frenkel (1976a), and Frenkel and Clements (1982).

[19]For a discussion of the specifications of the demand for money under a flexible exchange rate regime see Frenkel (1977), (1979) and Abel, Dornbusch, Huizinga and Marcus (1979).

[20]For an analysis of the phenomenon of currency substitutions see Boyer (1973), Chen (1973), Chrystal (1977), Girton and Roper (1981), Stockman (1976), Calvo and Rodriguez (1977), Miles (1978) and Frenkel and Clements (1982).

[21]It should be noted that when properly specified other approaches to exchange rate determination would also yield reduced form equation like (4.10) with money supplies, incomes, interest rates and relative prices appearing on the right-hand side. The virtue of the monetary approach in comparison with the elasticities approach is in bringing these variables to the foreground rather than leaving them in the "background".

[22]This panel of Figure 4.1 is due to Dornbusch (1976b).

[23]See Dornbusch (1976b) and Kimbrough (1980).

[24]See for example Frankel (1979) and Dornbusch (1978).

[25]See for example Allen and Kenen (1980), Branson, Halttunen and Masson (1977), Branson (1977), Kouri (1976), Dooley and Isard (1978), de Macedo and Barga (1982), Frankel (1984). For details see the analysis in Chapter 15 by Branson and Henderson.

[26]See for example Branson (1977) and Kouri (1976).

[27]For variety of additional models linking the exchange rate to the current account see Niehans (1977), Rodriguez (1980), Dornbusch and Fischer (1980), Mussa (1980, 1982), Kimbrough (1980), Shafer (1980) and Frenkel and Rodriguez (1982).

[28]It is noteworthy that the shift of emphasis from flow consideration to the requirement of stock equilibrium revived issues from the Bullionist controversy of the early 1800's which led to the competing "Balance of Payments Theory" and "Inflation Theory" of exchange rate determination; see Ricardo (1811) and Viner (1937). For an early modern formulation emphasizing stock equilibrium see Black (1973).

[29]See for example Mussa (1974) and Frenkel and Johnson (1976a); in the context of flexible exchange rates the same argument is made by Dornbusch (1976b) and Mussa (1976b). It should be noted that the money demand-money supply framework is not employed only for convenience; it reflects the hypotheses that money markets clear fast relative to goods markets, that the demands for real balance are relatively stable and that the supply of nominal balances is a policy instrument that is controlled by the monetary authorities.

[30]A number of empirical studies have reported results that are consistent with the empirical regularities discussed in this paragraph; see, for example Mussa (1979b), Frenkel (1981a, 1981b) and, in particular, Chapter 19 by Levich in this volume. The implications of these regularities for the general approach to the theory of exchange rate determination are considered in Mussa (1979b, 1984), Frenkel and Mussa (1980), Frenkel (1981b) and Mussa (1982).

[31]The present exposition of the "asset price" view of exchange rates draws on that given in Frenkel and Mussa (1980), Frenkel (1981b) and Mussa (1982, 1984). Key elements of this view are also contained in Mussa (1976b). It is also relevant to note that while our exposition presents a specific version of the "asset price" view of exchange rates, there are also other versions that may be termed as "asset views"; see for example the version of the portfolio balance model presented by Branson and Henderson in Chapter 15 of this volume.

[32]A value of 1/(1+a) equal to 1/100 means that an adjustment of about one percent in the annual expected rate of change of the exchange rate will offset a ten percent divergence between the current month's expected X and the discounted sum of X's in all future months.

[33]The role of new information in inducing unexpected movements in exchange rates is emphasized by Dornbusch (1978), Frenkel (1981b), Frenkel and Mussa (1980), and Mussa (1976c, 1977, 1979b, 1980, and 1982).

[34]The "traditional approach" is the textbook approach in which the equilibrium exchange rate is determined by the intersection of the flow demand for foreign exchange arising from trade transactions with the speculative supply of foreign exchange provided by capital holders who are prepared to undertake risks in exchange for expected gains. More sophisticated versions of this approach are presented in the work of Black (1973), Stein (1980). On the interaction between the exchange rate and the current account see Dornbusch and Fischer (1980), Rodriguez (1980), Mussa (1980, 1982), Sachs (1981) and Frenkel and Rodriguez (1982).

[35]The model considered in this section is developed in greater detail in Mussa (1984). Other models that emphasize the importance of real factors in determining the real exchange rate include those presented by Bruno and Sachs (1982), Buiter and Miller (1983), Neary and Purvis (1983), and Svennson and Razin (1983).

[36]The equations of the present model are all assumed to be linear in the levels or logarithms of the endogenous and exogenous variables. This assumption allows for the explicit solution of the forward looking difference equation system that constitutes the reduced form of the model. The assumption that $\beta > 0$ implies that the Marshall-Lerner condition is satisfied; an increase in the relative price of domestic goods, holding other factors constant, worsens the current account.

[37]The c schedule is frequently identified with the activities of foreign exchange speculators. From a theoretical perspective, however, there is no good reason for such an identification; the c schedule represents desired behavior of all economic agents with respect to acquisition of foreign assets. For further discussion of this point, and of the meaning ofthe "balance of payments equilibrium condition" represented by equation (4.22), see Mussa (1984).

[38]Kouri (1976) develops the idea that the current exchange rate, which depends primarily on the conditions of asset market equilibrium, affects the current account balance which determines the rate of change of foreign asset positions; change of these asset positions, in turn, feedback through the conditions of asset market equilibrium to determine the rate of change of the exchange rate. A similar view of the essential elements in the dynamic interaction between the exchange rate and the current account is embodied in

the models developed by Branson (1977), Branson, Haltunen and Masson (1977), Calvo and Rodriguez (1977), Dornbusch and Fischer (1980), Flood (1981), Niehans (1977), and Rodriguez (1980).

[39]The importance of these elements in understanding the dynamic behavior of the real exchange rate and its relation to the current account is emphasized in Mussa (1980). The "accounting framework" for the analysis of exchange rate dynamics developed by Dooley and Isard (1981) and Isard (1983) also incorporates these elements. Models developed by Marion (1981), Obstfeld (1981), Sachs (1981), and Helpman and Razin (1983) consider the effect of temporary expected disturbances in the current account of the behavior of the exchange rate.

[40]The analysis in this section is based on Mussa (1984). A similar approach to combining real and monetary factors in a model of the real and nominal exchange rate is adopted by Bruno and Sachs (1981), Buiter and Miller (1983) and Mussa (1977b). A different approach for incorporating real and monetary factors is motivated by a "finance constraint" (which is also being refered to as the "Clower constraint") requiring goods to be purchased with currency accumulated in advance of the period in which trade takes place; see Stockman (1980), Helpman (1981) and Lucas (1982).

[41]The importance of a risk premium in influencing the relationship between the domestic and the foreign nominal interest rate is analyzed by Kouri (1976), Stockman (1978), Fama and Farber (1981), Hansen and Hodrich (1980, 1983), Frankel (1982) and Frenkel and Razin (1980). This risk premium could be allowed to be a function of any of the variables that appear in the money demand function (4.28) without significantly affecting the formal analysis carried out in this section.

[42]If there is no real balance effect on desired spending and if their is no other source of non-neutrality (such as fixed nominal contracts or incomplete information about the behavior of nominal variables), then the model of the real exchange rate discussed in the preceding section operates independently of the behavior of the domestic money supply. Even if these conditions are not satisfied (4.32) remains valid, but it is necessary to consider the effect of the behavior of money supply and other nominal variables on real exchange rate and the stock of net foreign assets.

[43]The reduced-form money market equilibrium condition (4.30) is used in Mussa (1976b) to derive the result (4.32). The present analysis shows that this reduced form is consistent with a fairly general model of goods and asset market equilibrium.

[44]For applications of these approaches to modelling macroeconomic disequilibrium in an open economy setting see Flood (1979), Saidi (1980) and Stockman (1980).

[45]Exchange rate overshooting in response to a permanent increase in the money supply, due to slowness in the adjustment of the domestic price level, was initially considered by Dornbusch (1976c). Generalizations of Dornbusch's analysis have been considered by Wilson (1979), Rogoff (1979, Obstfeld (1981), Mussa (1982), Bhandari (1982) and Frenkel and Rodriguez (1982). For further analysis and references to the literature on exchange rate dynamics see chapter 18 by Obstfeld and Stockman in this Handbook.

[46]Some of this work is included in Frenkel (1983). A detailed survey of the empirical studies of exchange rates is provided by Levich in Chapter 19 of this Handbook.

[47]The relation between spot and lagged forward rates are examined in Poole (1967), Giddy and Dufey (1975), the relations between spot and lagged forward rates are reported by Frenkel (1977, 1978, 1981b), Krugman (1977), Cornell (1977), Hsieh (1982), Bilson (1981), Hakkio (1979), Hansen and Hodrick (1980) and are surveyed by Levich (1979) and Kolhagen (1978); the relative degree of volatility of spot and forward rates is analysed by Meese and Singleton (1980) and Flood (1981). This is a very partial list of references. For a more complete list see Chapter 19 by Levich in this Handbook.

[48]For some evidence on Purchasing Power Parities see Genberg (1978), Isard (1977), Frenkel (1978, 1981a) and for surveys see Officer (1976) and Katseli-Papaefstratiou (1979).

[49]See Mussa (1977, 1979a), Dornbusch (1978), Bilson (1978a).

[50]See Dornbusch (1980), Frenkel (1981b), Genberg (1984), Isard (1983) and Edwards (1983).

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