THEORIES OF EXCHANGE RATES DETERMINATION: A REVIEW*

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I. Introduction

Theories of exchange rates determination have changed since the exchange rate system shifted to the floating rates system. Traditional theories, developed during the period of fixed exchange rates, including the elasticity approach and the absorption approach, focused mainly on the real sector. However, especially in the current period of floating exchange rates, the monetary sector is another important element determining exchange rates. I review recent developments in the theories of exchange rates determination in this paper. I emphasize that asset markets are important in determining exchange rates. Moreover, I pay special attention to the interaction between asset markets and the current account, and to the interaction between stocks, flows, and stock adjustments.

In Sections 2 and 3, I consider the two traditional theories: the elasticity approach and the absorption approach. These theories were initially concerned with the effects of devaluation on the trade balance. Here I apply them to exchange rate determination. The elasticity approach focuses on the domestic goods market and the foreign goods market, while the absorption approach focuses on the expenditures of economy as a whole. However, neither approach models the monetary sector explicitly.

In Section 4, I consider the Mundell-Fleming model, where the exchange rate is determined by interactions between the real sector and the monetary sector. In contrast to the traditional approaches which focused only on flows, this model also considers stocks.

In Section 5, I consider the asset market approach. Models which belong to this category share an emphasis on the role of expectations in determining asset market equilibrium, although they differ in terms of the roles played by money and other assets.

I consider the monetary approach as the basic model of the asset market approach. An essential element in the monetary model is purchasing power parity. However, we know from the recent experiences that purchasing power parity does not hold at least in the short-run. Two related models which relax the *ppp* assumption include the overshooting model and the portfolio-balance approach. The overshooting model assumes rigid prices and perfect substitutability between domestic and foreign bonds. On the other hand, the portfolio-balance approach assumes imperfect substitutability between domestic and foreign bonds.

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In Section 6, I consider models developed to emphasize the interaction between asset markets and the current account. These models consider the current account in connection to asset stock adjustments in a dynamic setting. Modelling the dynamic adjustments through the current account makes it possible to explain the deviation of actual exchange rates from ppp in the adjustment processes even though ppp holds in the steady state.

In Section 7, I apply the asset market approach to explain theoretically the dollar appreciation in the early 1980s. I emphasize the U.S. budget deficits as a main cause of the dollar appreciation. And then I review an application of a simulation model to explain the dollar appreciation done by Sachs & Roubini. Their result is that the dollar appreciation and the U.S. and Japanese trade imbalances are mainly caused by the differential fiscal policy stances of the U.S. and Japan.

In Section 8, I consider the pass-through effects of exchange rates on domestic prices.

II. Elasticity Approach

Now consider how the elasticity approach can explain the determination of exchange rates under the flexible exchange rate system. In order to stress the role of the goods market rather than that of the asset market, assume a state without any international capital flows.

Consider two countries: one domestic and one foreign. Assume that the domestic country and the foreign country specialize in the production of goods 1 and 2 respectively. Both goods are traded. For simplicity, assume there are no non-tradable goods.

(1)
$$P_1 = EP_1^*$$

(2)
$$P_2 = EP_2^*$$

(3)
$$IM = IM(P_2) + \alpha$$

- (4) $X = X(P_1) + \beta$
- (5) $IM^* = IM^*(P_1^*) + \alpha^*$
- (6) $X^* = X^*(P_2^*) + \beta^*$
- (7) $X = IM^*$
- (8) $X^* = IM$
- (9) $B = P_1 X P_2 I M = -EB^* = 0$

where P_1 =the domestic price of good 1, P_1^* =the foreign price of good 1, P_2 =the domestic price of good 2, P_2^* =the foreign price of good 2, E=the exchange rate (the relative price of domestic currency in terms of foreign currency), IM=the domestic import demand for good 2, X=the domestic export supply of good 1, IM^* =the foreign import demand for good 1, X^* =the foreign export supply of good 2, α =a shift parameter for domestic import demand, β =a shift parameter for domestic export supply, α^* =a shift parameter for foreign import demand, β^* =a shift parameter for foreign export supply.

Eqs. (1) and (2) represent the law of one price. Eqs. $(3)\sim(6)$ are the demand and supply functions for each good. For simplicity, assume that all of the cross elasticities are zero. Eqs. (7) and (8) are market clearing conditions. Eq. (9) assumes balance in the trade accounts of both countries.

An equilibrium exchange rate can be derived from the above system of equations.

(10)
$$E=E(\alpha, \beta, \alpha^*, \beta^*)$$

Thus, the equilibrium exchange rate depends on the shift parameters of import demand and export supply in both countries. Furthermore, the effect on the exchange rate of a change in one of the shift parameters depends on each elasticity. For example, an effect of a change in domestic import demand on the exchange rate is derived:

(11)
$$\frac{dE}{E} = \frac{(\eta^* - \varepsilon)(\eta + 1)}{\varepsilon \varepsilon^* (\eta + \eta^* + 1) - \eta \eta^* (\varepsilon + \varepsilon^* + 1)} \frac{d\alpha}{M}$$

where ε , ε^* , η , and η^* are the price elasticities of deand for good 2, demand for good 1, supply of good 1, and supply of good 2, respectively.

The numerator in eq. (11) is unambiguously positive. However, the sign of the denominator is ambiguous. Exchange rate stability requires that the sign of the denominator be positive in a state without any capital flows. This constraint is called the Bickerdike condition. The Marshall-Lerner condition is sufficient for the Bickerdike condition (Whatever the supply elasticities may be, if the absolute demand elasticities sum to at least 1, the Bickerdike condition holds.)

III. Absorption Approach

Now consider how the absorption approach can explain the determination of exchange rates under a flexible exchange rate system. Use a two country formulation along the lines of Harberger's (1950) model. Both the domestic and foreign countries are assumed to specialize in production. Moreover, for simplicity, assume that there are no international capital flows. This is a short-run analysis in the sense that domestic prices are fixed, with each country supplying any desired amount of output at the given prices, normalized at unity.

- (12) Y = A + X EIM
- (13) $Y^* = A^* + X^* IM^*/E$
- (14) A = A(Y, E) + a
- (15) IM = IM(Y, E) + b
- (16) $A^* = A^*(Y^*, E) + a^*$
- (17) $IM^* = IM^*(Y^*, E) + b^*$
- (18) $X EIM = X^* IM^*/E = 0$

where Y=income, A=absorption, a=a shift parameter for home absorption, b=a shift parameter for home import demand, $a^*=a$ shift parameter for foreign absorption, $b^*=a$ shift parameter for foreign import demand.

Eqs. (12) and (13) represent equilibrium in the home goods market and in the foreign goods market respectively. Eqs. (14) \sim (17) represent the absorption and the import functions in each country. Eq. (18) represents balance in the trade account in the absence of capital flows.

Eqs. (12) \sim (18) determine a reduced form equilibrium exchange rate:

(19) $E = E(Y, Y^*; a, b, a^*, b^*)$

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The determination of the exchange rate depends on the absorption and the import demand in both countries.

This model can be used to consider how a change in absorption or import demand affects the exchange rate in a case with repercussion effects. In a stable state, the partial differential coefficients of the shift parameters of home absorption and home import demand in eq. (19) are positive. As for foreign absorption and foreign import demand, their partial coefficients are negative.

IV. Mundell-Fleming Model

In the Mundell-Fleming model, the exchange rate is determined by the interaction between the real sector and the monetary sector. The Mundell-Fleming model focuses on both flows and stocks of the economy while the elasticity approach and the absorption approach focus only on flows. Consider the determination of exchange rates in the Mundell-Fleming model.

Assume a small open economy, with fixed prices. Further assume perfect international capital mobility. This makes domestic bonds and foreign bonds perfect substitutes.

- (20) S(Y) + T(Y) = I(i) + G + NX(Y, E)
- (21) M = L(Y, i)
- (22) $i=i^*$

(23)
$$B = NX(Y, E) + K(i^*) = 0$$

where S=savings, T=tax, I=investments, G=government expenditures, NX=net exports, i=the domestic rate of interest, i^* =the foreign rate of interest, M=the supply of money, L=the demand for money, B=the balance of payments, and K=the capital account.

Eq. (20) represents equilibrium in the goods market. Eq. (21) represents equilibrium in the money market. Eq. (22) assumes that perfect capital mobility equalizes the domestic and foreign rates of interest, given static expectations of the exchange rate. Eq. (23) assumes that the balance of payments will equilibrate under the flexible exchange rate system.







Fig. 1 shows the above-mentioned system. In the upper panel, the IS schedule and the LM schedule represent goods market and money market equilibria, respectively. The XX schedule and the FF schedule in the lower panel represent an internal equilibrium and an external equilibrium respectively.

This discussion focuses on the effects of monetary and fiscal policies on the determination of the exchange rate in the Mundell-Fleming model.

First, consider expansionary monetary policy, for example, the central bank buys domestic bonds putting downward pressure on the interest rate. This pressure forces capital from the home country to the rest of world, which in turn creates a tendency toward a balance of payments deficit. And thus, the exchange rate depreciates. Moreover, this depreciation leads to both a trade balance surplus and an increase in income for the home country (Fig. 2).

Next, consider an expansionary fiscal policy; for example, an increase in bond-financed government expenditures. This leads to excess demand in the goods market. The excess demand puts upward pressure on income and on the interest rate as well through money demand pressures. The upward pressure on the interest rate forces capital from the rest of world into the home country. The balance of payments tends toward surplus, which leads to an appreciation of the exchange rate. This appreciation deteriorates the trade balance, and thus lowers income back to its initial level (Fig. 3).

Monetary and fiscal policies have asymmetric effects under the flexible exchange rate system. Expansionary monetary policy has both an expansionary effect on income and a depreciating effect on the exchange rate. Expansionary fiscal policy, on the other hand, has no effect on income but an appreciating effect on the exchange rate.

V. Asset Market Approach

(1) Taxonomy of Asset Market Approach

A taxonomy of models for the asset market approach to flexible exchange rates was

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proposed by Frankel (1983). The most important dichotomy is whether or not domestic and foreign bonds are assumed to be perfect substitutes in the asset-holders' portfolios. The assumption of perfect substitutability implies that asset holders are indifferent regarding the composition of their bond portfolios as long as the expected rates of return on the two countries' bonds are the same. Given this assumption, uncovered interest parity holds.

Models in which domestic and foreign bonds are assumed to be perfect substitutes belong to the monetary approach. Given that uncovered interest parity holds, bond supplies become irrelevent. The responsibility for determining the exchange rate is shifted onto the money market.

Models in which foreign and domestic bonds are assumed to be imperfect substitutes belong to the portfolio-balance approach. In this approach asset holders wish to allocate their portfolios in shares that are well-defined functions of expected rates of return.

Models engendered by the monetary approach are further subdivided by whether prices are flexible or sticky. The monetarist model assumes perfect price flexibility. Given this assumption, purchasing power parity must hold in both the long-run and the short-run. The overshooting model assumes the sticky prices. In this model overshooting of the exchange rate is explained by assuming that the adjustment speed of goods prices is slower than that of assets price. Purchasing power parity holds only in the long-run.

Models engendered by the portfolio-balance approach are classified into the uniform preference model, the small country model, and the preferred local habit model according to Frankel (1983). Frankel's criterion is based on the structure of asset holders' portfolio preferences. Alternatively, Fukao (1983) classified them into the inflation risk model, the real exchange rate risk model, and other models according to the role of risk.

(2) Monetarist Model

The monetraist model consists of equations defined by money market equilibrium, purchasing power parity, and uncovered interest parity.

(24) $m=p+\phi y-\lambda i$

(25)
$$m^* = p^* + \phi y^* - \lambda i^*$$

- (26) $e = p p^*$
- (27) $i-i^*=\dot{e}^e$

where \dot{e}^e = the expected rate of depreciation: Any lower-case variable (except for the interest rate) is the logarithm of the corresponding upper-case variable.

Assume that expectations are rational and the system is stable. For simplicity, assume that income growth is exogeneous and equal to zero. From the equation for purchasing power parity, it can be shown that the expected rate of depreciation is equal to the current relative monetary growth rate $(\mu - \mu^*)$. The exchange rate is determined according to the following equation:

(28)
$$e = (m - m^*) - \phi(y - y^*) + \lambda(\mu - \mu^*)$$

The determination of the exchange rate in the monetarist model is based on the purchasing power parity equation. Therefore, the monetarist model requires that *ppp* always holds. As such, the assumption of perfectly flexible prices is essential to the monetarist model.

(3) Overshooting Model

The overshooting model consists of the money market equilibrium equation (24), the uncovered intreest parity equation (27), and the dynamic adjustment of the goods market equation (30). However, the *ppp* equation (26) holds only in the long-run. Assume that individuals have perfect foresight in their expectations of the exchange rate.

- (24) $m=p+\phi y-\lambda i$ (26a) $\tilde{e}=\bar{p}-\bar{p}^*$
- $20a) e^{-p-p}$
- (27) $i-i^*=\dot{e}^e$
- $(29) \quad \dot{e}^e = \dot{e}$
- (30) $\dot{p} = \nu [u + \delta(e-p) \sigma i + \gamma y + \xi y^* y]$

where \dot{e} =the actual rate of depreciation, \dot{p} =the rate of inflation, u=a shift parameter for goods demand or supply. Bars over variables represent long-run equilibrium levels.

Two dynamic adjustment equations are derived from the system in terms of deviation from long-run equilibrium levels.

- (31) $\dot{e} = (p \bar{p})/\lambda$
- (32) $\dot{p} = \nu [\delta(e \bar{e}) + (\delta + \sigma/\lambda)(\bar{p} p)]$

Using eqs. (31) and (32), schedules for $\dot{e}=0$ and $\dot{p}=0$ are drawn in Fig. 4. A dynamically stable system requires that the economy must always stay on a saddle path (shown as the AA schedule in Fig. 4). For example, suppose there is an expansion of the money supply in the home country (Fig. 5). Then the new long-run equilibrium is the point E_2 . In the adjustment process, the economy immediately jumps from the initial equilibrium point E_0 to the point E_1 on the AA schedule (notice the overshooting). Therefore, the economy moves to the new long-run equilibrium point along the AA schedule. Thus, the overshooting in this model is attributed to the stickiness of goods prices.

Next, using the above-mentioned two country model, the exchange rate determination equation in the overshooting model can be derived. As for expectations of the exchange rate, assume that in the short-run, when the exchange rate deviates from its equilibrium path, it is expected to close that gap with a speed of adjustment θ ; while in the long-run, when the exchange rate lies on its equilibrium path, it is expected to increase at the expected rate of relative inflation $\mu - \mu^*$:



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(29a) $\dot{e}^{e} = -\theta(e-\bar{e}) + \mu - \mu^{*}$

Eqs. (24), (25), (26a), (27), and (29a) determine the exchange rate equation:

(33)
$$e = (m - m^*) - \phi(y - y^*) + \lambda(\mu - \mu^*) - (1/\theta)[(i - \mu) - (i^* - \mu^*)]$$

Eq. (33) is identical to the monetarist equation (28) except for the addition of a fourth explanatory variable, the real interest differential. In this model, a deviation of the actual exchange rate from *ppp* in the short-run is explained by a real interest differential.

(4) Portfolio-balance Approach

In the portfolio-balance approach, domestic and foreign bonds are assumed to be imperfect substitutes. There are many reasons why two assets can be imperfect substitutes. This section focuses on the exchange risk.

Assume domestic and foreign bonds differ in only one aspect: their currency of denomination. Investors, in order to diversify the risk that comes from exchange rate variability, balance their bond portfolios between domestic and foreign bonds in proportions that depend on the expected relative rates of return on risk premia.

Assume that all active participants in the market have the same portfolio preferences. Then it is possible to add up individual asset demand functions into an aggregate asset demand equation (34):

(34) $B/EF = \beta(i - i^* - \dot{e}^e)$

where B=the stock of domestic-denominated bonds, F=the stock of foreign-denominated bonds, β =a positive-valued function representing portfolio preferences.

The simplest portfolio-balance model specifies static expectations; $\dot{e}^e = 0$. Then the exchange rate is simply determined by relative bond supplies and the interest differential:

$$(35) \quad e = -\alpha - \beta(i - i^*) + b - f$$

where $b \equiv \log B$, $f \equiv \log F$.

It is obvious from eq. (35) that the stocks of domestic and foreign bonds are important in determining the exchange rate in the portfolio-balance approach. Since flows of foreign assets are reflected in the current account, it is necessary to consider the interaction between the assets market and the current account.

VI. Asset Market Approach and the Current Account

This section discusses the models which introduced the interaction between the assets market and the current account into the asset market approach. In particular, consider the Kouri model, the Dornbusch-Fischer model, and the Branson model.

(1) Kouri Model

Kouri (1976) used a dynamic model to show that the exchange rate is determined by monetary assets market equilibrium and short-run expectations. In the Kouri model, the time path from the monetary short-run equilibrium to the long-run equilibrium is determined by a process of asset accumulation through the current account.

The Kouri model assumes a small open economy. It is further assumed that the assets in the economy consist of home currency and foreign currency. The economy produces only traded goods and their relative prices are fixed in the world market.

- (36) $\dot{F} = CA = Y C(Y T, W) G$
- (37) W = M/P + F
- (38) $M/P = L(\dot{e}^{e}, Y, W)$
- (39) $F = F(\dot{e}^{e}, Y, W)$
- (40) P = E

where \dot{F} =the capital flow, CA=the current account, W=the stock of monetary assets.

The assets market equilibrium equation (41) and the capital flow=current account equation (42) can be derived in the following reduced forms.

(41)
$$E = A(F; Y, M, \dot{e}^{e})$$

(42) $F = CA(E; F, Y, M, G, T)$

In the short-run, the exchange rate is determined at the level at which the assets market equilibrates (given the stock variables of domestic money and foreign assets (eq. (41)). The exchange rate determined in the assets market does not always equilibrate the current account. Eq. (42) shows a process of asset accumulation through the current account.

Fig. 6 demonstrates the characteristics of this model. The assets market equilibrium



equation (41) is shown as the AA schedule in the right panel. The exchange rate is determined, given the stock of foreign assets at each point in time. The capital flow=current account equation (42) is shown as the *BB* schedule in the left panel. If the current account is not balanced at the short-run exchange rate, the imbalance increases or decreases the stock of foreign assets, shifting the *BB* schedule. Finally, the economy reaches the longrun equilibrium.

(2) Dornbusch-Fischer Model

The Dornbusch-Fischer (1980) model extends the Kouri model by considering dynamically the relationship between the exchange rate and the current account. The role of expectations are explicitly shown in the model.

The model assumes exported goods and imported goods. The terms of trade may be explicitly shown in this model. Domestic residents are assumed to hold domestic money and foreign bonds. Individuals have perfect foresight in their expectation of the exchange rate.

(43) $m = k(i^* + \dot{e}^e)[y + \rho f]$

(44)
$$y = D(\rho, w) + X(\rho)$$

 $(45) \quad w \equiv m + \rho f/i^*$

(46)
$$S = S(w) = \rho f / i^*$$

(47) $\dot{e}^{e} = \dot{e}$

where $\rho(\equiv EP^*/P)$ =the terms of trade, D=the domestic demand for the domestic goods, X=the foreign demand for the domestic good, $m \equiv M/P$, $w \equiv W/P$, $f \equiv F/P$.

Eq. (43) represents money market equilibrium. Eq. (44) represents goods market equilibrium. Eq. (45) is the definition of real wealth. Eq. (46) implies that the current account (the current account is equal to savings as there is no government sector nor investment in this model) is equal to the capital flow. Eq. (47) represents perfect foresight regarding the rate of depreciation.

The dynamic of the exchange rate and the accumulation of foreign assets can be derived as follows:

(48)
$$\dot{e} = \gamma(f, E/(M/P^*))$$



FIG. 8



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(49)
$$\hat{f} = \phi(f, E/(M/P^*))$$

Fig. 7 shows the dynamic system generated by eqs. (48) and (49). In the Fig. 7 the FF schedule shows the saddle path, along which the economy converges to the long-run equilibrium.

This model can show the dynamic effects of certain' disturbances. For example, the following case is interesting: suppose it is announced now that the nominal money supply will increase in the future (Fig. 8). The dynamic system defined by this model suggests that the current account improves at first. Then as the exchange rate begins depreciating, the current account declines.

(3) Branson Model

While the Kouri and Dornbusch-Fischer models allow for only domestic money as a domestic asset, the Branson (1977) model considers domestic money, domestic bonds, and foreign bonds as assets. After that, Branson (1984) extended the model to a rational expectations framework. ations framework. The model assumes a small open economy. The assets available in the home country

are aggregated into the domestic money_stock, the holdings of domestically issued assets (denominated in the home currency), and the net holdings of foreign-issued assets (denominated in the foreign currency).

- (50) $M \equiv R + Bc = m(i, i^* + e^e) \cdot W$ (51) $Bp = b(i, i^* + e^e) \cdot W$ (52) $EFp = f(i, i^* + e^e) \cdot W$

- $(53) \quad W = M + Bp + EFp$
- $(54) \quad Bc + Bp = B$
- (55) Fp + R = F
- (56) $\dot{F} = NX(E/P, W, z) + i^*F$
- (57) $\dot{e}^{e} = \dot{e}$

where R=central bank foreign reserves, Bc=government debt held by central bank, Bp= government debt held by the private sector, F_p =net claims on foreigners held by the domestic private sector, z = an exogenous shift factor.

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Eqs. (50), (51), and (52) represent money, domestic bonds, and foreign bonds market equilibria conditions, respectively. Eq. (53) is a balance sheet constraint. Eqs. (54) and (55) allow domestic and foreign bonds to be held by both the private sector and the central bank. Eq. (56) shows how an accumulation of net foreign assets might occur. Eq. (57) implies perfect foresight regarding the exchange rate.

A dynamic model of the interaction between foreign assets and the exchange rate can be derived by solving eqs. $(50) \sim (57)$.

- (58) $\dot{e} = \Phi(EFp/W, M/W)$
- (59) $\dot{F} = NX(E/P, W, z) + i^*F$

This system is drawn in Fig. 9. The $\dot{e}=0$ schedule represents a locus along which the exchange rate does not change. The F=0 schedule represents a locus along which the

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stock of foreign assets does not change. Equilibrium of the system is shown in Fig. 9. There is one saddle path into the equilibrium shown by the PP schedule. For a given value of Fp, it is assumed that following a disturbance, the market will pick the value for e that puts the system on the saddle path toward equilibrium.

 $\cdot F^{\mathrm{P}}$

Reaction to exogenous shocks can be observed in this model. In the case of an unanticipated expansionary open-market operation, fixed prices would yield overshooting of the exchange rate. If the domestic price level immediately reacts by rising by the same proportion as the money stock, the system would yield overshooting or undershooting, depending on the initial portfolio distribution and the degree of substitutability among 1987]

domestic money, domestic bonds, and foreign bonds (Fig. 10). The model shows undershooting of the exchange rate in response to unanticipated real disturbances (Fig. 11).

VII. The Dollar Appreciation in the Early 1980s

Fig. 12 shows that the dollar appreciated in the early 1980s. Fig. 13 shows the relatively high U.S. interest rates in the same period. Many economists regard this "strong dollar" as deriving from the expansionary U.S. fiscal policies. The explanation is that expansionary



Note: Foreign Exchange Rates (Inter-bank Rates, U.S. Dollar Spot Closing, Yen per Dollar). Source: Economic Statistics Annual, The Bank of Japan.





Notes: U.S. Interest Rate: Yield of U.S. Treasury Bonds (Over 10 years). Japan's Interest Rate: Yield of Japanese Government Bonds (Longest-term Life Bonds). Sources: Federal Reserve Bulletin, Federal Reserve Board: Economic Statistics Annual, The Bank of Japan.

U.S. fiscal policies serve to invrease U.S. interest rates, leading to capital inflows into the U.S. The capital inflows appreciate the dollar, worsening U.S. trade deficits.

In the first part of this section, I give a theoretical explanation for the dollar appreciation and higher interest rates, using the Branson's model which I explained in the previous section. The U.S. budget deficits are regarded as a main cause of the dollar appreciation. Their effect on foreign asset decumulation through the tarde deficits as well as their direct effects on the goods and money markets play important roles in explaining the dollar appreciation. While the direct effects occur immediately, the decumulation effects occur over time.

In the latter part of this section, I review an application of a simulation model to explain the dollar appreciation in the early 1980s done by Sachs & Roubini (1987). Sachs & McKibbin (1985) made a global simulation model, which is termed MSG model. Sachs & Roubini employed the developed MSG model, which they term MSG2 model, to examine whether the budgetary shifts in the OECD economies in the 1980s can account for the movements of the trade balances and exchange rates. They conclude that the dollar appreciation and the U.S. and Japanese trade imbalances are mainly caused by the differential fiscal policy stances of the U.S. and Japan.

(1) A Theoretical Explanation

In this subsection, I apply the developed Branson's model (1984, 1985) to explain the dollar appreciation and higher interest rates in the early 1980s. This model is good for the explanation because it can explicitly explain the stock adjustment of foreign assets through the trade imbalances.

For simplicity, the model assumes a small open economy without any inflation. The assets available in the home country are aggregated into the domestic money stock, the holdings of domestic bonds (denominated in the home currency), and the net holdings of foreign bonds (denominated in the foreign currency). These assets are assumed to be imperfect substitutes. The model further assumes rational expectation regarding the exchange rate.

- (60) $M = m(i, i^* + \dot{e}^e) \cdot W$
- (61) $B = b(i, i^* + \dot{e}^e) \cdot W$
- (62) $EF = f(i, i^* + e^e) \cdot W$
- $(63) \quad W = M + B + EF$
- (64) $i (i^* + e^e) = \omega(B/EF)$
- (65) G T = S(i) I(i) NX(E)
- (66) $G T = \vec{B}$
- (67) $\dot{F} = NX(E) = S(i) I(i) (G T)$
- (68) $\dot{e}^{e} = \dot{e}$

Eqs. (60), (61), and (62) represent money, domestic bonds, and foreign bonds market equilibrium conditions, respectively. Eq. (63) is a balance sheet constraint. Eq. (64) shows the equilibrium condition for rates of return without any inflation. ω is the market-determined risk premium. Given the imperfect substitution between domestic and foreign bonds, the risk premium on domestic bonds increase with their relative supply; $\omega'(B/EF) > 0$. Eq. (65) represents equilibrium in the goods market. For simplicity, savings and investments are assumed to be functions of only the domestic interest rate. And net exports are assumed to be a function of only the exchange rate. Eq. (66) represents bond-financed fiscal deficits. Eq. (67) shows how an accumulation of net foreign assets might occur. Eq. (68) implies perfect foresight regarding the exchange rate.

Substituting Eq. (68) into Eq. (64), we can derive the following dynamic equation:

(69)
$$\dot{e} = i - i^* - \omega(B/EF)$$

Eqs. (67) and (69) show the dynamics of the exchange rate and the accumulation of foreign assets.

Fig. 14 shows the dynamic system generated by Eqs. (67) and (69). The e=0 schedule represents a locus along which the exchange rate does not change. The F=0 schedule represents a locus along which the stock of foreign assets does not change. There is one saddle path into the equilibrium shown by the *PP* schedule in quadrant I. For a given value of *F*, it is assumed that following a disturbance, the market will pick the value of *e* that puts the system on the saddle path toward equilibrium. The *IS* schedule in quadrant II represents the goods market equilibrium.

Note that all schedules in quadrants I, II, and IV can interact with each other, For example, an increase in the domestic interest rate shifts both the $\dot{e}=0$ schedule downward and the $\dot{F}=0$ schedule upward in quadrant I.

We can observe the impact effects and the long-term effects of budget deficits in this model (Fig. 15). The budget deficit shift all the schedules downward, except for the e=0 schedule in quadrant II, which remains unchanged. Since it takes time to adjust stock variables such as foreign assets, the impact effects are an overshooting of the exchange rate appreciation, and an increase in the domestic interest rate with foreign bonds unchanged.

As foreign bonds decumulate through trade deficits, the $\dot{e}=0$ schedule shifts upward in quadrant II. In quadrants I and IV, the economy gradually moves from point B to point C along the saddle path. In addition, given the bond-financed budget deficits, the deficits





will increase holdings of domestic bonds in the domestic economy. This shifts the $\dot{e}=0$ schedule upward in quadrant II, leading to a further increase in the interest rate and a further depreciation of the exchange rate.

Thus, the budget deficits immediately appreciate the exchange rate (an overshooting) and increase the domestic interest rate. However, as the stock variables such as foreign bonds adjust toward the equilibrium levels, the exchange rate depreciates over time while the interest rate increases further. In contrast, if the government began to cut the budget deficits, for instance by implementing the Gramm-Rudman-Hollings law to balance the budget by 1991, the effect on the exchange rate would be an immediate depreciation followed by a gradual appreciation. On the other hand, the domestic interest rate would immediately decrease and then gradually decrease further.

(2) A Simulation Study

In this subsection, I review an application of a simulation model to explain the dollar appreciation in the early 1980s done by Sachs & Roubini (1987). Sachs & MaKibbin (1985) made a global simulation model (MSG model). And Sachs and others applied it to several international economic issues (Sachs (1985), Ishii, McKibbin & Sachs (1985), McKibbin & Sachs (1986)). Sachs & Roubini employed the developed MSG model, which is termed the MSG2 model, to examine whether the budgetary shifts in the OECD economies, especially in the U.S. and Japan in the 1980s, can account for the movements of the trade balances and exchange rates.

First, I overview the MSG2 model. The MSG2 model is a dynamic general equilibrium model of a six-region world economy, divided into the United States, Japan, Canada, the rest of the OECD economies (ROECD), non-oil developing countries (LDCs), and OPEC. It is distinctive in that it solves for a full intertemporal equilibrium in which agents have rational expectations of future variables. In addition, it incorporates Keynesian properties by assuming slow adjustment of nominal wages in the labor markets in some regions. THEORIES OF EXCHANGE RATES DETERMINATION: A REVIEW

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The model has several attractive features. First, all stock-flow relationships are carefully observed. Budget deficits cumulate into stocks of public debt: current account deficits cumulate into net foreign investment positions: and physical investment cumulates into the capital stock. Secondly, the asset markets are efficient in the sense that asset prices are determined by a combination of intertemporal arbitrage conditions and rational expectations. As for international capital flows, perfect capital mobility and zero risk premia are assumed in the model. Thirdly, the specification of the supply side has several attractive features. First, factor input decisions are based on intertemporal profit maximization by firms. In particular, a capital stock is adjusted according to a "Tobin's q" model of investment. Furthermore, the differences in the wage-price process in the U.S., Europe ,and Japan are incorporated in the model. The model assumes flexible nominal wages in Japan, nominal wage rigidities in the U.S. and Canada, and relative rigidities of real wages in the ROECD. Last, the model makes allowance for the fairly significant lag in the passthrough of exchange rate changes into import price changes. It assumes that exporters into the U.S. market set their prices in dollars one period in advance, in order to equate the export price with the expected home market price in the following period.

Sachs & Roubini employed the model to explain the sources of trade and international financial patterns of recent years. As for the patterns during 1980–85, they considered the shifts in the trade balance, exchange rates, etc., as resulting from five distinct factors and assessed whether the combined effect of these changes could explain the observed phenomena. The five shifts are as follows:

A rise in the U.S. structual budget deficit of approximately 4.4 percent of U.S. GNP;
 A reduction in the Japanese structural budget deficit of approximately 3.4 percent of GNP;

—An increase in the structural budget deficit in Canada of approximately 2.2 percent of GNP, and an increase in the structural budget surplus in the ROECD of approximately 0.5 percent of GNP;

-An exogenous reduction in the net flow of new borrowing (i.e. the current account deficit) of the LDCs in the magnitude of 1.4 percent of U.S. GNP;

-An assumed offset of monetary policy in Canada, Japan, the U.S. and the ROECD to maintain an unchanged level of employment.

The combined effect of these changes (as a deviation from a baseline) is shown in Table 1. The effect is that the dollar appreciates sharply and the U.S. trade balance worsens significantly as a percent of GNP. In Table 2, the predicted effects on the trade balance, dollar exchange rate, and the short-term real interest rate are compared with the actual effects observed between 1978–80 and 1985. The model does quite well in explaining the shifts in the U.S. and Japanese trade balances and the Yen-dollar exchange rate. In Table 3, the overall predicted shift in the U.S. trade balance and real bilateral exchange rates are apportioned to the various underlying disturbances. It shows that the largest factors in explaining the exchange rate changes are both the U.S. and Japanese fiscal policies, and that the offsetting monetary policy accounts for about 20 percent of the exchange rate changes. As for the U.S. and Japanese trade balance changes, the largest explanatory factor is the fiscal policy in the own country. Cross-country effects play a small role for the U.S., though a fairly important role for Japan. The cutoff in lending to the LDCs accounts for about 20 percent of the trade balances.

<u></u>		1981	1982	1983	1984	1985
U.S. Economy						
Output	%	-0.00	0.07	0.08	0.05	0.01
Priv. Consumption	%GNP	1.50	2.89	3.38	3.66	3.59
Priv. Investment	%GNP	0.27	0.08	-0.04	-0.14	-0.17
Govt. Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.91	-0.96	-1.08	-1.15	-1.13
Imports	%GNP	0.55	0.61	0.69	0.73	0.71
Imports (quant.)	%GNP	0.86	1.93	2.19	2.33	2.27
Trade Balance	%GNP	-1.46	-1.57	-1.77	-1.88	-1.84
Labor Demand	%	0.05	0.05	0.05	0.04	0.03
Inflation	D	-0.75	-2.19	-2.52	-2.68	-2.56
Int. Rate (sh)	D	-2.45	-3.98	-3.09	-1.50	-1.50
Int. Rate (lg)	Ð	-0.83	-0.64	-0.37	-0.17	-0.09
Tobin's Q	%	-0.49	-1.10	-3.16	-4.49	-4.49
Real Exchange Rate						
\$/ecu	%	-14.52	-15.65	-17.60	-18.63	-18.11
\$/yen	%	-20.98	-23.74	-27.40	-29.63	-28.96
\$/can	%	-5.94	-5.75	6.44	-6.60	-6.40
ROECD Economies						
Output	%	-0.42	-0.11	-0.17	-0.22	0.26
Priv. Consumption	%GNP	0.45	-0.69	-0.85	0.94	-0.89
Priv. Investment	%GNP	-0.24	-0.24	-0.25	-0.24	-0.23
Govt. Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.32	0.18	0.22	0.23	0.16
Imports	%GNP	-0.10	-0.12	-0.15	-0.16	-0.15
Imports (quant.)	%GNP	-0.59	-0.63	0.70	-0.73	-0.70
Trade Balance	%GNP	0.14	0.30	0.37	0.39	0.31
Labor Demand	%	-0.01	-0.01	-0.01	-0.00	0.00
Inflation	D	0.56	0.73	0.96	1.10	1.13
Int. Rate (sh)	D	0.64	1.30	1.63	1.71	1.63
Japanese Economy						
Output	%	-1.09	-0.16	-0.28	-0.37	-0.43
Priv. Consumption	%GNP	-1.58	-2.15	-2.47	-2.34	-2.30
Priv. Investment	%GNP	-0.62	-0.49	-0.44	-0.36	-0.33
Govt. Consumption	%GNP	-0.50	-1.00	-1.50	-2.20	-2.20
Exports	%GNP	0.38	2.00	2.38	2.61	2.52
Imports	%GNP	-0.20	-0.27	-0.33	0.36	-0.36
Imports (quant.)	%GNP	-1.22	-1.48	-1.75	-1.92	1.89
Trade Balance	%GNP	1.62	2.27	2.71	2.97	2.88
Labor Demand	%	-0.07	-0.00	-0.00	-0.00	-0.00
Inflation	D	1.13	0.01	0.03	0.05	0.04
Int. Rate (sh)	D	1.47	2.01	1.72	0.48	0.44

TABLE 1 1981–1985 GLOBAL SCENARIO WITH MONEY STABILIZING EMPLOYMENT

Source: Sachs & Roubini (1987)

Thus, according to the Sachs & Roubini's simulation study, the increase in the U.S. budget deficits and the reduction in the Japanese budget deficits account for the greater portion of both the dollar appreciation and the U.S. trade deficits and Japanese trade surpluses. In addition, monetary policy is one of the explanatory factors of the exchange

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	Actual	Predicted	-
		Treatered	
Trade Balance Change (percent of GDP)			
U.S.	1.9	1.8	
Japan	3.2	2.8	
Rest of OECD	1.0	0.3	
Real Exchange Rate Change of the U.S. relative to:			
Japan	24	28	
Rest of the OECD	41	18	

TABLE 2ACTUAL AND PREDICTED CHANGES IN TRADE BALANCES AND REALEXCHANGE RATES (1985 compared with average of 1978–1980).

Source: Sachs & Roubini (1987)

TABLE 3 DECOMPOSITION OF CHANGES IN TRADE AND EXCHANGE RATES

	Sum of Effects of:							
	Total Predicted		Fiscal Policies in		Cutoff in	Offsetting		
	Effect	U	J	R+C	Lending	Policy		
Effect on:				· · · · •				
U.S. Trade	1.04	1.01	0.00	0.02	0.40			
Balance	-1.84	-1.01	-0.23	-0.03	-0.40	0.17		
Japan Trade	2 00	1.26	1.01	0.00	0.61	0.00		
Balance	2.00	1.30	1.91	-0.06	-0.61	0.28		
U.SJapan Real	20.0	11.0	10.0	0.00				
Exchange Rate	28.9	11.8	10.6	-0.03	-0.11	6.64		

Source: Sachs & Roubini (1987)

rate changes, while the cutoff in lending to the LDCs is one of the explanatory factors of the trade imbalances.

VIII. Pass- through Effects of Exchange Rates

(1) Model

The model considers the pass-through effects of exchange rates on domestic prices. I focus on effects of exchange rates on domestic prices of imported goods.

I extend a model of pricing with lags in demand adjustment [Dohner (1984), Phelps & Winter (1970)]. Suppose that an import trader imports foreign goods to domestic markets. That is, an import trader buys foreign goods from foreign producers at a foreign currency price, P^* , and sells them to domestic consumers at a domestic currency price, P, with transaction costs. The foreign currency prices of imported goods are assumed to be given by the world markets. The stock of customers (x) that the import trader maintains depends upon its pricing policy. There is some 'prevailing price,' \overline{P} , such that if the import trader charges \overline{P} its stock of customers neither rises nor falls over time. A lower price than \overline{P} causes the import trader to gain customers, and a higher price causes it to lose customers.

It is assumed that the flow of customers caused by the pricing policy is proportional to the import trader's stock of customers, a measure of the import trader's 'presence' in the market, and that there are diminishing returns to price reduction in customer aquisition. The customer adjustment assumptions are summarized as following:

(70)
$$\dot{x} = \delta(P; \bar{P})x; \, \delta(P; \bar{P}) = 0: \, \delta' < 0; \, \delta'' < 0.$$

Assume that the import trader can rationally expect how the prevailing price, \overline{P} , will respond to disturbances in a steady state. For simplicity, assume that all import traders are alike, and, in particular, share customers equally in the initial state.

Each customer purchases an amount $\eta(P)$, which is a decreasing function of price, so that the flow rate of sales of the import trader is $x\eta$. It is assumed that marginal revenue from current customers is decreasing in quantity and convex to the origin.

(71) $\eta' < 0; 0 \leq \eta'' \leq 2^{\prime 2}/\eta.$

The import trader's trading is done according to a decreasing returns to scale production function and the transaction costs are assumed proportional to the domestic price of imported goods. Thus, the transaction cost is:

(72) $P\phi(x\eta(P)), \phi' > 0, \phi'' > 0.$

Assume that the import trader maximizes discounted real net revenue, and that payment is received immediately. In other words, the import trader maximizes

$$\int_{0}^{\infty} e^{-rt} \left\{ 1/P(t) \right\} \cdot \left[(P(t) - E(t)P^*) x \eta(P) - P(t)\phi(x\eta(P)) \right] dt.$$

Normalizing P^* (=1) and taking logarithms of P and E, we can rewrite:

(73)
$$\int_0^\infty e^{-rt} [(p-e)x\eta(p) - \phi(x\eta(p))] dt.$$

We can write the import trader's maximization problem as: Maximize

(74a)
$$\int_0^\infty e^{-rt} [(p-e)x\eta(p) - \phi(x\eta(p))] dt$$

subject to

(74b)
$$\dot{x} = \delta(p; \bar{p})x$$

and

(74c) $x(0) = x_0$,

where x_0 is the import trader's initial stock of customers.

Eq. (74) defines a dynamic optimization problem which may be solved using optimal control techniques. It is notationally convenient to define the following functions:

$$\begin{split} F(x, p; e) &= (p - e)x\eta(p) - \phi(x\eta(p)), \\ G(x, p; \bar{p}) &= \delta(p; \bar{p})x, \\ H(x, p, q; e, \bar{p}) &= F(x, p; e) + qG(x, p; \bar{p}). \end{split}$$

where the function H is the Hamiltonian, and q is the value, or shadow price, of additional customers. (In mathematical terms, this shadow price is the derivative of the maximized

integral with respect to the stock of customers, x.)

Then the problem posed may be rewritten: Maximize

(74a')
$$V = \int_0^\infty e^{-rt} F(x, p; e) dt$$

subject to

(74b')
$$\dot{x} = G(x, p; \bar{p})$$

and

(74c') $x(0) = x_0$.

Pontryagin-type necessary conditions are: If $\hat{p}(t)$ is an optimal time path of the import trader's price, then there exists a function of time, $\hat{q}(t)$, defined for $t \ge 0$, such that for each $t \ge 0$,

(75a) $\hat{p}(t)$ mazimixes $H(\hat{x}(t), p, \hat{q}(t))$ with respect to p,

 $\hat{q}(t)$ satisfies the differential equation

(75b) $q=r\hat{q}-Hx$.

Here the function $\hat{x}(t)$ satisfies the differential equation

(75c) $\dot{x} = G(\hat{x}(t), \hat{p}(t); \bar{p})$

with initial condition $x(0) = x_0$.

If the maximum in (75a) occurs at a p > 0, we must have

 $Hp(\hat{x}(t), p(t), \hat{q}(t)) = 0,$

identically in t. Translating this condition, (75b), and (74b') back into the original notation, we have the following equations that must be satisfied by an optimal triple $\hat{x}(t)$, $\hat{p}(t)$, $\hat{q}(t)$:

(76a)
$$\eta'[(p-e)-\phi'+\eta/\eta']+q\delta'=0,$$

(76b) $\dot{q}=rq-[\eta\{(p-e)-\phi'\}+q\delta],$
(76c) $\dot{x}=\delta x,$

or

(76a') $Hp(x, p, q; e, \bar{p})=0,$ (76b') $\dot{q}=rq-Hx(x, p, q; e, \bar{p}),$ (76c') $\dot{x}=G(x, p; \bar{p}).$

Since time does not neter explicitly in the functions F(x, p) and G(x, p), an optimal pricing policy $\hat{p}(t)$ for problem (74') actually depends on time only through $\hat{x}(t)$. That is assuming there exists a unique $\hat{p}(t)$ solving (74'), there is some function $\phi(x)$ such that

$$\hat{p}(t) = \psi(\hat{x}(t))$$

characterizes not only the solution to the problem (74'), but also the solutions to all variants of (74') that are obtained by (a) changing the starting time from 0 to an arbitrary T_0 , or (b) changing the initial condition on x.

Given that this is true of $\hat{p}(t)$, it is clear from (76a) that it is also true of $\hat{q}(t)$. There is

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a function $\pi(x)$ such that

 $\hat{q}(t) = \pi(\hat{x}(t)).$

Given the function $\pi(x)$, the pricing rule $\psi(x)$ is defined by

(77) $Hp(x, \phi(x), \pi(x)) \equiv 0.$

Thus we have

(78) $\psi'(x) = -[Hpx + Hpq \cdot \pi(x)]/Hpp > 0$

and $\phi(\bar{x}) = \bar{p}$.

Therefore, the price determined by

$$P(t) = \phi(x(t))$$
(79) $\dot{x} = \delta(p(t))x(t)$
 $x(0) = x_0$

with auxiliary variable

(80)
$$q(t) = \pi(x(t))$$

is optimal.

In therms of the (x, p) plane, these conditions imply Fig. 16, where $p = \phi(x; e, \bar{p})$ denotes the pricing policy function giving optimal price as a function of the import trader's x. The rest point (x, p) is viewed as determined by the intersection of the $\dot{p}=0$ curve and the $\dot{x}=0$ line.

The $\dot{x}=0$ line is derived from eq. (76c):

(81) $\dot{x}=G(x, p; \bar{p})=\delta(p; \bar{p})x=0.$

The $\dot{p}=0$ curve is derived from the system (76) and the relation $\dot{p}=(\partial p/\partial q)\dot{q}+(\partial p/\partial x)\dot{x}$, with Hp=0 used to eliminate q:

(82)
$$\dot{p} = K(x, p; e, \bar{p})$$

=[rFp+FxGp-GFpx] [Fpp-FpGpp/Gp]⁻¹=0.

The optimal pricing policy function, $\psi(x; e, \bar{p})$, passes through the rest point and is positively sloped, as shown in (78).

(2) Effects of a Transitory Change in Exchange Rates Suppose that the exchange rates transitorily change at time T_0 , and that they return

FIG. 16

 \dot{p} \bar{p} \dot{p} \dot{p} \dot{p} $\dot{y} = 0$ $\dot{y}(x)$ $\dot{x} = 0$ $\dot{y}(x)$

to the previous level at time T_1 . Given the assumption of import trader's rational expectation, when the import trader recognizes the disturbance, it can rationally expect that the exchange rates will return to the previous level at time T_1 . Also the import trader might expect that the prevailing price remains unchanged because it doesn't respond to the transitory change in exchange rates in a steady state.

Fig. 17 shows the effects of the transitory depreciation of exchange rates. The $\dot{x}=0$ line doesn't shift because the $\dot{x}=0$ line shifts only when the prevailing price changes, as eq. (81) shows. On the other hand, the $\dot{p}=0$ curve shifts because the function K has an argument, e. The symbol on the left of (83) denotes the derivative with respect to e of the ordinate of that curve at the initial \bar{x} :

(83)
$$\frac{dp}{de}\Big|_{p=0} = \frac{rFpe + GpFxe}{-(rFpp + FxGpp)} > 0$$

where the denominator is positive by virtue of Hpp = Fpp - FpGpp/Gp < 0,

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and the rest-point equality rFp = -GpFx. Also, the depreciation shifts up the pricing policy function, $\phi(x; e, \bar{p})$, since it shifts up the $\dot{p} = 0$ curve.

However, since the import trader expects at time T_0 that the exchange rates will return to the previous level at time T_1 , the price and the stock of customers will change as shown in the figure. At first, the price will jump upward from point A to point B at time T when the disturbance occurs. After that, the import trader gradually changes the price to place itself onto the ϕ curve at time T_1 when the exchange rates return to the previous level. That means a gradual movement from point B to point C. From time T_1 , the import trader sets the price according to the optimal pricing policy, which neans a gradual movement from point C to point A.

Fig. 18 shows how the price changes in response to the transitory depreciation as time passes. How much the disturbance affects the price depends on the duration of the transitory disturbance. The effect on the price is the smaller as the duration is shorter. If the depreciation is expected to continue only for an extremely short duration, it would have a very small effect on the prices.

(3) Effects of a Permanent Change in Exchange Rates Next, I consider effects of a permanent change in exchange rates. Given the assump-



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tion of import trader's expectation, the import trader perfectly foresees that the prevailing price in the steady state will be affected by the permanent change in exchange rates Given the law of one price in a steady state, the steady state effect on the prevailing price is:

$$(84) \quad \frac{d\bar{p}}{d\bar{e}} = 1$$

, ,

Fig. 19 shows effects of a permanent depreciation of exchange rates. The depreciation shifts both $\dot{x}=0$ line and $\dot{p}=0$ curve upward.

$$(85) \quad \frac{dp}{de}\Big|_{\dot{x}=0} = 1$$

$$(86) \quad \frac{dp}{de}\Big|_{\dot{p}=0} = \frac{dp}{de}\Big|_{\dot{p}=0} + \frac{dp}{d\bar{p}}\frac{d\bar{p}}{de}\Big|_{\dot{p}=0}$$

$$= -\frac{rFpe + GpFxe}{rFpp + FxGpp} + \frac{GppFx - Gp(Fpx - Fx/\bar{p})}{rFpp + FxGpp}$$

$$= 1 - \frac{r(Fpp + Fpe) + Gp(Fpx + Fex - Fx/\bar{p})}{rFpp + FxGpp} < 1$$

Eq. (85) shows the size and direction of the shift of the $\dot{x}=0$ line. Since eq. (85) is equal to eq. (84), the $\dot{x}=0$ line shifts as much as the steady state effect on the prevailing price. On the other hand, eq. (86) shows the size and direction of the shift of the $\dot{p}=0$ curve. Since the second term is positive, eq. (86) is less than one. That is, the upward shift of $\dot{x}=0$ line is greater than that of $\dot{p}=0$ curve.

Though there is probability that $dp/de|_{\bar{p}=0} < 0$, the pricing policy function, $\psi(x; e, \bar{p})$ should shift upward in response to the permanent change in exchange rates. Eq. (87) denotes the derivative with respect to e of the ordinate of the function at the initial \bar{x} :

(87)
$$\frac{dp}{de}\Big|_{\psi(x)} = \frac{dp}{de}\Big|_{\psi(x)} + \frac{dp}{d\bar{p}} \frac{d\bar{p}}{d\bar{p}}\Big|_{\psi(x)}$$
$$= -\frac{Fpe + Fp(Gpp/Gp + 1/\bar{p})}{Fpp - FpGpp/Gp} > 0$$

Therefore, the movements of exchange rates and the stock of customers are shown in Fig. 19.



Fig. 18



Fig. 19

At first, the price will jump upward from point A to point B at time T_0 when the permanent change occurs. Since the price is undershooting, as shown in the figure, the impact effect on the price is smaller than the steady shift effect. Thus, the domestic prices of imported goods respond less than proportionally to the change in exchange rates in the impact effect.

 \overline{T}_0

≁time

 \overline{T}_{1}

After that, the import trader sets the price according to the optimal pricing policy, which means a gradual movement from point B to point C. At last, the economy reaches the steady state equilibrium.

Fig. 20 shows how the price changes in response to the permanent depreciation as time passes. The duration of adjustment (time T_0 to time T_1) depends on how much the price jumps in the impact effect.

IX. Conclusion

The evolution of a floating exchange rate system gave rise to numerous theories of exchange rate determination. Traditional theories like the elasticity approach or the absorption approach focus on the flows of the economy. Models contained within the assets market approach attach much importance to the stocks of the economy. The asset market approach introduce the interaction between the assets market and the current account in determining the exchange rate.

Purchasing power parity is an important element in determining the exchange rate in the monetary model. The actual exchange rate, however, is often off from *ppp* in both the short-run and the long-run. The overshooting model and the portfolio-balance model attempt to explain this long-run deviation of the actual rate from *ppp* ("misalightment"). Recently several explanations have been given for the overvaluation of the dollar in 1981– 1985. It seems most reasonable to examine this issue within the framework of the asset market approach. This view attributes the overvaluation to the U.S. policy mix of a budget deficit combined with an offsetting monetary policy, though I emphasized only the U.S. budget deficit in my theoretical explanation of the dollar appreciation.

On the study of the pass-through effects, I used the extended model of pricing with lags in demand adjustment to derive the following results:

A transitory change in exchange rates might cause a small jump of the domestic prices of imported goods. How much the prices are affected depends on the duration of the transitory change. If the transitory change is expected to continue only for an extremely short duration, it would have a very small effect on the prices.

A permanent change in exchange rates causes an undershooting of prices. Though the prices jump immediately, the impact effect on the prices is smaller than the stready state effect. The prices change less than proportionally in respond to the change in exchange rates both immediately and during the adjustment process.

Expectations with regard to exchange rates are important in pricing the domestic prices of imported goods. If the assumption of expectations is changed, the dynamics of the prices might change more or less. However, it will be true that the pass-through effects are relatively small in the case of slow demand adjustment.

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