Optimum Currency Areas
and Natural Variability in Exchange Rates

By Ronald I. McKinnon*

Since the breakdown of the Bretton Woods and Smithsonian agreements to fix exchange rates, casual observers have been surprised by the intensity of exchange-rate fluctuations over the succeeding six years. Movements of spot exchange rates of 15 percent quarter to quarter, 5 percent week to week, or even 1 percent on a day-to-day basis are not now unusual.[1] Except for economies with chronically high inflation, most changes have not been predictable or accurately registered in forward rates of exchange (*Aliber,* 1975). Rather, exchange fluctuations have been cyclical in nature and largely reversed at some later stage. The pronounced swings in the dollar/DM rate of 15 to 20 percent over several six-month intervals have left the two currencies not far from purchasing-power parity at any point in time.

But throughout all this general turmoil, there have been "oases" of virtual stability: where relative exchange rates between convertible national currencies have moved little by comparison. As in the 1950s, the Canadian dollar has floated gently within a fairly narrow range that tracks the U.S. dollar rather closely. A group of "small" European countries — some formally aligned with the DM and some not — have kept their exchange rates within similarly narrow bands around the German currency.

Apart from official exchange parities, should one expect some floating exchange rates across particular pairs of countries to be naturally more stable than others? Combining the old literature on optimum currency areas (*Mundell,* 1961; *McKinnon,* 1963) with the modern asset-adjustment approach to the determination of exchange rates (*Kouri,* 1976; *Dornbusch,* 1976), I develop a theoretical explanation of the *natural degree of exchange-rate variation.* The theory explains the

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[1] The International Monetary Fund *Annual Report,* 1975, p. 26, has provided average daily changes in selected currency rates against the U. S. dollar.

differential movements in relative currency values across differently situated groups of countries. In addition, it explains why some exchange movements have been unexpectedly large with private stabilizing speculation in the foreign exchange being weak or absent.

A monetary rather than monetarist approach to the short-run determination of exchange rates is employed. Indeed, the Keynesian liquidity preference model of the rate of interest is generalized to the case of an open economy. A novel theoretical twist is to incorporate *explicitly* the demand for domestic money by foreign-exchange dealers (speculators). Then I show how the supply of private speculative capital for stabilizing particular exchange rates depends on the degree of economic integration with particular trading partners, along the lines of the older arguments defining optimum currency areas.

Keynesian Liquidity Preference and the Rate of Interest in an Open Economy

Since my main concern is the foreign exchanges, I shall drastically simplify orthodox Keynesian monetary theory for closed economies. Although there are many variants of the Keynesian orthodoxy, all hold that changes in the nominal stock of money affect the final demand for goods and services primarily through the prices of securities in capital markets, rather than through any direct "wealth" effect. Insofar as monetary policy has any influence at all, it operates through "the" rate of interest as the intermediate policy variable. The *negative* relationship between the quantity of real money and real interest rates is defined by the liquidity-preference function; and, in a closed economy there is the presumption that monetary authorities can in fact control the *real* rate of interest and the *real* stock of money by varying the nominal stock of money. Hence, the real rate of interest and the real stock of money are *not endogenous* to the economy but can be, to some significant degree, manipulated by the monetary authorities.

Unsurprisingly, since the authorities can increase the real stock of money by increasing nominal cash balances, the Keynesian closed-economy world is one where the price level is stable and expected to remain so over the relevant time horizon. More precisely, any given proportional change in the nominal stock of money leads to a substantially smaller proportional change in the price level. The same would be true for shifts in liquidity preference itself: changes in the private demand for money (for a fixed supply) would lead to much smaller proportional changes in commodity prices. Over prolonged periods, this assumption of stable prices and price expectations seems most plausible when there is substantial unemployment and slack in the economy (prices being fairly sticky in not moving downward) or when individuals have had historical experience with a stable price level at close to full employment and believe that the authorities are committed to, and will be successful in, maintaining that stability. Otherwise, this assumption of sticky prices and price expectations is best confined to the very short run, where firms or individuals are either taken by surprise by shifts in monetary policies or are unable to make price adjustments.

Can domestic prices remain rigid in an open economy subject to exchange-rate fluctuations of the kind observed in 1973 - 79? In a world producing and consuming only Tradables II[2] — primary commodities — the Keynesian assumption of short-term price rigidity would be untenable. Fluctuations in exchange rates would be quickly transmitted to the domestic price level: a 5 percent devaluation of a "small" country's currency leads quickly to a 5 percent increase in the domestic prices of Tradables II. However, if the world is composed largely of non tradables and Tradables I — manufactured goods whose price quotations are relatively fixed in terms of the domestic money (for convertible-currency countries), unanticipated exchange fluctuations lead to much smaller proportional changes in domestic price indices. Indeed, *Aliber* (1975) showed that short-run deviations of national price levels from their purchasing-power parities, due to fluctuations in exchange rates, were quite pronounced. In this chapter, therefore, *I simply assume that the domestic price level is, in the first instance, relatively invariant to exchange-rate fluctuations.*

This assumption then permits us to interpret Keynesian liquidity-preference theory as if the economy were closed to foreign trade in the goods market, while nevertheless open to capital inflows or outflows from abroad. In Figure 1, *LP* represents the domestic liquidity preference schedule relating the rate of interest to the stock of money in such an economy; and *M* represents the given supply of nominal money under the exogenous control of a government authority, who is *not* committed to maintaining a fixed rate[3]. The discrete move from M_0

[2] Tradables II are what *Hicks* (1974) calls "flexprice" goods, whereas Tradables I correspond to his definition of "fixprice" goods. Why heterogeneous manufactures (Tradables I) tend to be invoiced in the home currency with their prices fixed for discrete time periods is analyzed in *McKinnon* (1973), Chapter 4.

[3] A pegged exchange rate would, of course, force the monetary authority to endogenize the money supply by buying and selling the domestic currency on demand. One could not then perform the conceptual experiment of arbitrarily varying the stock of money in order to derive the liquidity-preference schedule.

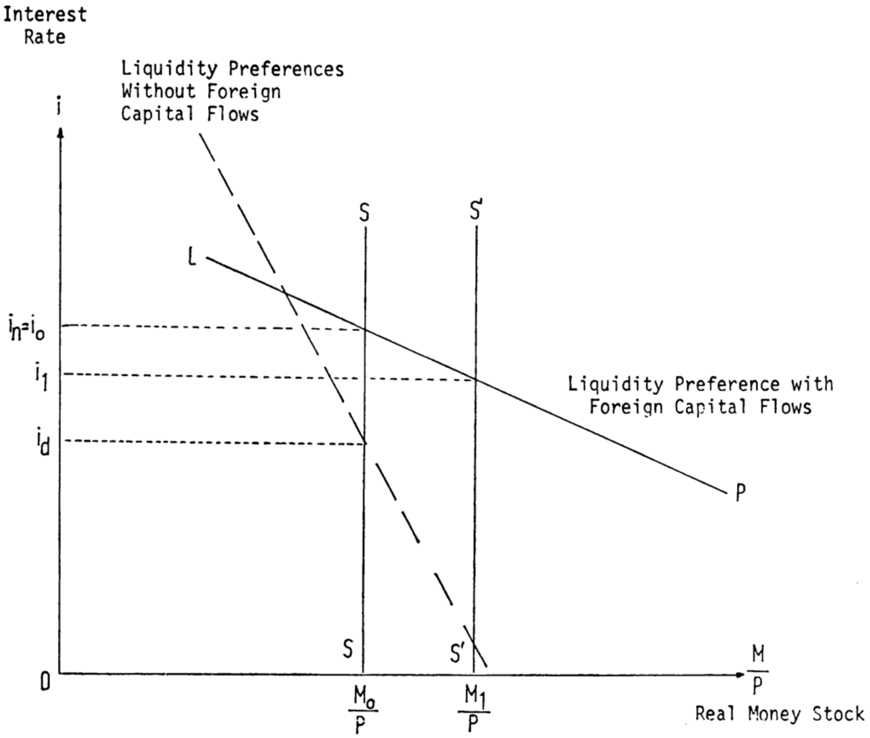

Fig. 1: Liquidity Preference in an Open Economy with a Flexible Exchange Rate

to M_1 at time zero portrays an expansion in nominal money where the real stock increases equiproportionately from $\frac{M_0}{P}$ to $\frac{M_1}{P}$. The sticky domestic price level within the "short" time frame under consideration ensures the Keynesian equivalence between real and nominal monetary changes. Given the usual downward slope to the liquidity-preference function, the rate of interest i on 90-day bonds falls at time zero in order to maintain portfolio balance between bonds and the increased supply of real cash balances: the ordinary short-run liquidity effect of easy money.

But how does the money market in an open economy differ from that in a closed one? While in practice a commercial bank may perform several different functions, for analytical convenience let us distinguish among three classes of financial firms or individuals:

(1) *Domestic Wealth Holders (DWH)* strongly prefer the national currency as their habitat. They hold no working balances of spot

foreign exchange and all purchases of foreign bonds are immediately covered. (Covered interest arbitrageurs are, perforce, part of this group.) Hence Domestic Wealth Holders own a mixture of foreign and domestic bonds. Correspondingly, they have a well-defined transaction demand for domestic currency as a function of the level of money income and the rate of interest.

(2) *Foreign Exchange Dealers* have no particular monetary habitat and hold noninterest-bearing working balances in both the foreign and the domestic currencies. They freely take open (or hedging) positions in the forward market, and sell cover to Domestic Wealth Holders owning foreign bonds.

(3) *Foreign Rentiers* sell (or buy) an infinitely elastic supply of foreign currency bonds at the fixed interest rate, i_n, and hold neither domestic cash balances nor domestic currency bonds[4]. Foreign currency is, therefore, the Rentiers' sole monetary habitat.

The demand for domestic money, as portrayed by the *LP* schedule in Figure 1, comes from Domestic Wealth Holders on the one hand, and from Foreign Exchange Dealers on the other. The *DWH* focus on the single nominal rate of interest on bonds — domestic and covered foreign bonds are perfect substitutes — as the opportunity cost of holding noninterest-bearing cash balances, whereas Dealers focus on the expected future movement in the exchange rate, R_s, as the opportunity cost of holding domestic as opposed to foreign cash balances.

Specifically, let us partition domestic currency into M^a — that held by Domestic Wealth Holders — and M^b, that held by Foreign Exchange Dealers. In order to abstract from the complexities of fractional reserve banking that are not essential to the present analysis, I follow the usual simplification of assuming M to be currency plus demand deposits; reserve requirements of 100 percent are held against the latter. Then holdings of domestic money are completely allocated to *DWH* or to Dealers

$$M = M^a + M^b \ . \tag{1}$$

[4] Somewhat asymmetrically, I am assuming that foreigners do not hold domestic currency bonds either covered or uncovered, whereas Domestic Wealth Holders can freely take net positions in covered foreign-currency bonds. This asymmetry has the analytical advantage of *not* incorporating the portfolio decisions of Foreign Rentiers formally into the analysis — other than to say they maintain i_n at a fixed level. At the same time, however, covered interest arbitrage between domestic and foreign currency bonds flourishes through the interaction of Foreign Exchange Dealers and Domestic Wealth Holders.

For our beginning-of-period analysis, the demand for money by *DWH* is inversely related to the domestic rate of interest i, assuming that both money income Y and financial wealth W^a are given. Only the domestic rate of interest is relevant for this portfolio decision as long as *DWH* cover any purchases of foreign bonds *and* the Interest Rate Parity Theorem holds, as described below.

$$M^a = M^a(\underset{-}{i}; \underset{+}{Y}, \underset{+}{W^a}) \quad (2)$$

Domestic Wealth Holders have the conventional "closed economy" function describing the demand for money as it arises from the transactions and precautionary motives. However, *DWH* own only a portion — although perhaps the major portion — of the total stock of domestic money.

Notice also that the balance-sheet position of the *DWH* consists of their initial holdings of domestic money M_0^a *plus* some initial *net* holding of bonds: G_0 represents net bonded claims on the domestic government (outside bond holdings), B_0 represents net covered claims on foreigners as described more precisely below.

$$W^a = M_0^a + B_0 + G_0 \quad (3)$$

A government open-market operation can, therefore, be represented as an exchange of M_0^a for G_0, money for bonds in the portfolios of *DWH*.

Foreign Exchange Dealers and the Domestic Money Market

A rather large literature bourgeoned the 1950s and 1960s on whether or not private speculation in the foreign exchanges is stabilizing or destabilizing. Surprisingly, the portfolio position of foreign exchange "speculators" was never spelled out with any analytical precision. Indeed, events in the foreign exchange market were divorced from direct association with the domestic money and bond markets[5].

[5] In his nice review of this literature, Robert *Stern* (1973, pp. 77 - 89) simply assumed that forward and spot exchange rates are always equal so that domestic and foreign rates of interest are also equalized — even in the short run when the exchange rate is moving. In the absence of speculative activity, contributors to the debate simply posited that the exchange rate moved in certain arbitrary patterns — such as a simple sine wave. Then the question was asked [*Friedman,* 1953] whether speculators without liquidity constraints could make profits by taking long or short positions that "aggravate" the underlying exchange fluctuations. Counter examples flew thick and fast because of the arbitrary nature of the initial conditions: the predetermined "nonspeculative" wave motion in the exchange rate. Because the joint determination of interest rates, exchange rates, and the money supply was disregarded in this peculiar literature, "rationally" based private expectations simply could not be introduced.

Table 1

The Portfolio Position of Foreign-Exchange Dealers

Assets		Liabilities	
Spot Position[a)]			
Cash in Guilders	M^b	$W^b = M^b + R_s\,{}^kM^b$	Net Wealth
Cash in Kronor	${}^kM^b$		
Forward Position[b)]			
Long in Kronor	B^k	$R_f B^k$	Short in Guilders

a) R_s is the spot exchange rate (guilders per krona). R_f is the corresponding forward rate.
b) Cover for the foreign bonds of Domestic Wealth Holders.

In our monetary approach to exchange-rate determination, on the other hand, Dealers (speculators) are important but constrained actors in the domestic money market. Our "pure" Foreign Exchange Dealers hold no bonds — either as borrowers nor lenders. Unlike Domestic Wealth Holders, Dealers have no preferred monetary habitat and perform an important economic function (in addition to speculating) of clearing international payments. If the only spot holdings of Dealers are working cash balances of domestic (guilders) and foreign (kronor) currencies, what determines their liquidity preference?

Focus first on the Dealers' spot position. Financing requires capital equal to 100 percent of both the krona and guilder cash balances, which yield no direct interest. On the other hand, forward positions can be held with a much lesser allocation of capital, which is assumed here to be negligible — effectively a zero margin requirement. Hence the net wealth position of our Foreign Exchange Dealers W^b is simply the sum of their spot currency holdings. If more domestic currency is to be acquired, therefore, foreign currency must be given up in exchange. This tight wealth constraint, which forecloses access to the bond market, is not unrealistic in modelling the immediate (beginning-of-period) response of foreign exchange dealers to a discrete increase in the domestic supply of money[6].

A further and more dominant consideration in the portfolio selection of guilders and kronor is their effective productivity in allowing Dealers

[6] In effect, all arbitrage between the money and bond markets in response to interest-rate changes is being assigned to firms in their capacity as Domestic Wealth Holders, rather than as Foreign Exchange Dealers.

to make and clear international payments on behalf of their nonbank customers[7]. Clearly if R_s is expected to increase steadily (guilders depreciate relative to kronor), guilder balances will be reduced in order to raise their marginal product in clearing international payments. This marginal balancing yields a determinant demand for domestic (and foreign) money by dealers that can be written:

$$M^b = M^b(\underset{-}{\dot{R}_s^e};\ \underset{+}{W^b}) \tag{4}$$

where $\dot{R}_s^e$ is the expected percentage rate of change in the exchange rate (depreciation of guilders); and W^b is the wealth constraint on Foreign Exchange Dealers[8].

In equation (4), W^b is fixed over the Dealers' short decision horizon. However, Foreign Exchange Dealers can freely reshuffle their asset portfolios between guilders and kronor. Indeed, the corresponding asset demand for foreign exchange (kronor) is simply:

$$^kM^b = [W^b - M^b(\dot{R}_s^e;\ W_b)] \cdot \frac{1}{R_s}\ . \tag{5}$$

In reducing his guilder balances in response, say, to an increase in R_s^e, equation (5) implies that our Dealer acquires an equivalent amount of kronor at the beginning of our 90-day time horizon.

But how then can the demand for money by Dealers be portrayed as a function of the rate of interest as per Figure 1? Before introducing uncertainty[9], one can comfortably assume that the Interest Rate Partity Theorem *(IRPT)* holds exactly, and that the forward rate R_f is an unbiased estimate of the expected future spot rate. If the rate of interest on foreign currency bonds is always inelastically fixed at i_n, these two assumptions imply that

$$i - i_n = f = \frac{R_f - R_s}{R_f} = \dot{R}_s^e \tag{8}$$

where f is the forward premium on the foreign currency (kronor) in terms of the domestic currency (guilders); and $\dot{R}_s^e$ is the expected percentage movement (gradual) in the exchange rate (depreciation of the guilder) over the next 90 days. If we simplify further by starting from a position at time zero of "long-run" stationary equilibrium where the domestic and foreign rates of interest are equal, i. e. $i_n = i_0$, then any

[7] Who remain in the shadows in this paper.

[8] Over longer periods of time, the amount of capital committed to dealing in foreign exchange would depend on the flow of foreign trade.

[9] Other than the initial unanticipated shock, such as a government open-market operation.

fall in i below i_0 connotes the same expected appreciation over 90 days of the domestic currency — and vice versa. As i varies around i_0, therefore, so does $\dot{R}_s^e$ and the effective opportunity cost to Foreign Exchange Dealers of holding domestic cash balances.

With this asset-adjustment machinery in place, consider the reaction of Dealers to a discrete increase in the domestic money supply while assuming *full information* about the future course of monetary policy over the next 90 days. If the money supply increases from M_0 to M_1, some of the newly created guilder balances normally flow into the portfolios of Foreign Exchange Dealers. But Dealers can only be induced to acquire additional working balances of guilders (in return for working balances of kronor) if R_s is expected to fall smoothly over the next 90 days. Hence, the guilder will depreciate discretely at time zero by an amount sufficient to set up the expectation of gradual appreciation back to a "normal" level.

The Interest Elasticity of the Liquidity-Preference Function

In Figure 1, the *LP* schedule for an open economy is shown to be more interest elastic than the dashed line, which portrays liquidity preference in an economy closed to foreign capital flows. But what allows the domestic rate of interest in an open economy to differ at all from the foreign rate? A rather large literature in macroeconomic international finance now identifies "perfect capital mobility" with a situation where the domestic rate of interest is firmly pegged to the foreign rate[10]: the *LP* schedule is perfectly horizontal at i_n over some relevant time horizon. In a regime of floating exchange rates, this literature is in apparent conflict with Keynesian liquidity preference analysis which presumes that the domestic rate of interest and the real stock of money can be influenced by the monetary authority.

This conflict can be resolved, in part, if we identify Keynesian Liquidity-Preference analysis with instantaneous beginning-of-period *stock adjustment*. An open-market operation at time zero forces an immediate discrete reshuffling of asset portfolios by Domestic Wealth Holders, Foreign Exchange Dealers and Foreign Rentiers. Then a new expectation is established of exchange-rate movement over a finite interval of time — say 90 days or even two years — at the end of which a new equilibrium is established, where new flow additions to wealth could be absorbed. The older macroeconomic literature ignored continuous transitional movement in the exchange rate which allows temporary

[10] The seminal contribution utilizing this definition of perfect capital mobility is *Mundell* (1963). See also *McKinnon and Oates* (1966).

interest differentials to develop (my main concern here) and is *implicitly* confined to describing the new equilibrium at the end of the period[11] — where i is again equal to i_n.

Focussing on beginning-of-period adjustment in interest rates, how does the market for domestic and foreign bonds respond to a discrete central bank open-market operation that simultaneously removes bonds and injects domestic money? The demand for bonds by Domestic Wealth Holders — the obverse of their demand for money — depends on the current flow of money income *(GNP)* and their total stock of liquid assets — both of which can be taken as given at time zero. But the domestic rate of interest, i, measured on the vertical axis of Figure 2, is immediately adjustable to balance the demand for bonds by *DWH* with the total supply inclusive of covered foreign bonds. Graphically, the domestic demand for bonds is most conveniently portrayed as desired net claims on foreigners, which are measured on the horizontal axis of Figure 2. The line *DD* then represents the net domestic demand for covered foreign bonds and is simply the difference between the gross demand for bonds by *DWH and* the available stock of purely domestic bonds as determined by the monetary authority. Hence an open-market operation that reduces the supply of domestic bonds shifts the *DD* curve to the right to $D'D'$: the effective domestic demand for covered foreign bonds increases. The *slope* of the demand schedules, however, depends purely on the liquidity preference of private *DWH*.

The supply of covered foreign bonds, as a function of the rate of interest, is represented in Figure 2 by the *SS* curve. Its elasticity depends on the portfolio behavior of Foreign Exchange Dealers in two respects: (1): their willingness to acquire guilder cash balances (and to reduce krona balances) in the spot market as the counterpart of purchase of krona bonds from Foreign Rentiers by Domestic Wealth Holders; and (2) the willingness of Dealers to provide forward cover for these foreign bond holdings of the *DWH*. Both important roles of Foreign Exchange Dealers in the domestic money market will be explored further. Here it suffices to note that the supply of covered foreign bonds is less than perfectly elastic around i_n — which is why the liquidity preference schedule *LP* in Figure 1 is also less than perfectly elastic over our short 90-day time horizon.

When the money supply expands from M_0 to M_1 as shown in Figure 1, the stock of domestic bonds contracts by the same amount as measured

[11] For the distinction between beginning-of-period stock-adjustment models and end-of-period adjustment inclusive of flows over the period, see *Foley* (1975).

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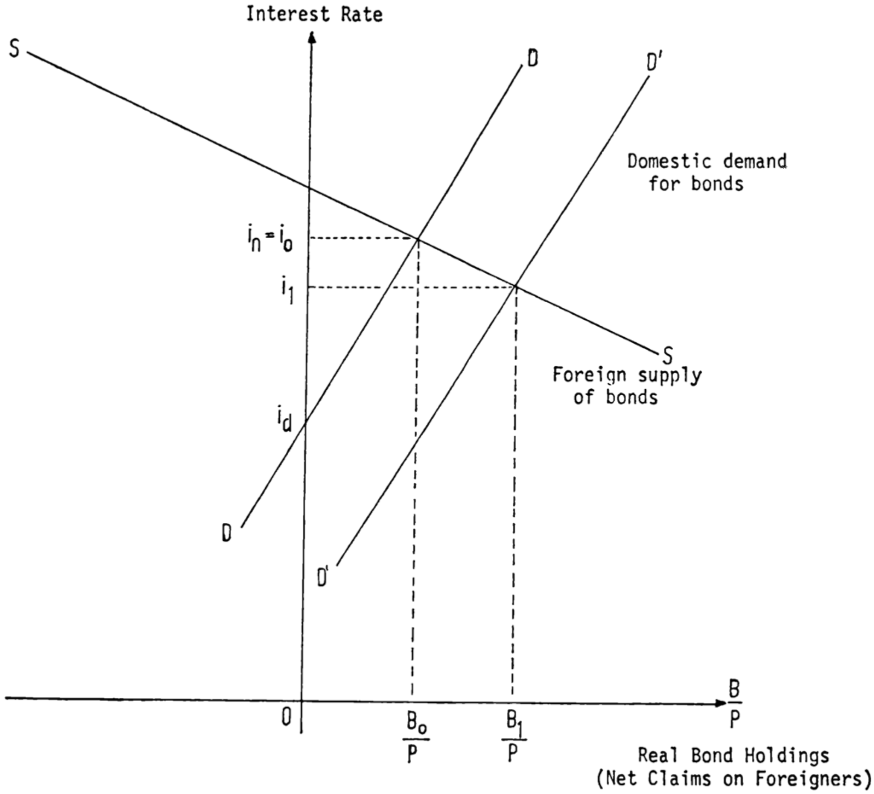

Fig. 2: The Domestic Market for Bonds
(Net Claims on Foreigners)

by the horizontal distance between the D and D' curves in Figure 2. At the old rate of interest, $i_0 = i_n$, Domestic Wealth Holders find themselves with excess domestic cash-guilders. They immediately purchase covered foreign bonds, and the domestic rate of interest is driven down to i_1 because the supply is less than perfectly elastic. Hence the *DWH* only partially reconstitute their bond holdings: the increase in net bond claims on foreigners increases from B_0 to B_1, which is less than the increase in the domestic money supply. *Thus the fall in the domestic rate of interest induces Domestic Wealth Holders to absorb a portion of the newly created domestic money, whereas the remainder must be absorbed by the Foreign Exchange Dealers.*

Algebraically, one can see that in the new beginning-of-period equilibrium

$$\Delta M^b = B_1 - B_0 < M_1 - M_0 = G_0 - G_1 \tag{7}$$

where $B_1 - B_0$ is the induced bond purchases by *DWH* from Foreign Rentiers and is also the increment in the money supply flowing into the hands of Foreign Exchange Dealers: ΔM^b. The reduction in domestic bonds held by the *DWH* corresponds to the government's open-market purchase: $G_0 - G_1$. Hence ΔM^a, the increment in the domestic money supply going to Domestic Wealth Holders, is simply

$$\Delta M^a = (M_1 - M_0) - (B_1 - B_0) \ . \tag{8}$$

In an open economy, the interest elasticity of the Keynesian liquidity preference schedule depends, in part, on the willingness of Foreign Exchange Dealers to absorb newly created domestic (guilder) cash balances. But Dealers (speculators) face a capital or wealth constraint on what assets they can acquire. Moreover, their business of transacting in the foreign exchanges requires that they keep a balanced portfolio of foreign and domestic monies. Thus Dealers do not have an infinitely elastic demand for domestic money, which the *DWH* wish to sell in order to acquire foreign bonds at the given foreign rate of interest. In the very short run, therefore, an open-market increase in the stock of domestic money will force down short-term interest rates *and* raise the domestic currency price of foreign money: a Keynesian liquidity effect. And it remains to be spelled out how much exchange rates will actually fluctuate in response to such monetary disturbances. In the longer run, however, domestic short-term rates of interest will tend to gravitate back to the levels of their foreign counterparts[12].

In summary, Keynesian liquidity preference-analysis, focussing on a variable rate of interest to maintain portfolio balance between bonds and money, holds up well in the very short run when applied to an open economy experiencing discrete monetary shocks. While I have traced out the consequences of one such shock — an autonomous open-market operation by the central bank — the same framework could be used equally well to examine exogenous shifts or instability in the domestic demand for money. As long as the exchange rate can move, in neither case will the domestic rate of interest be rigidly pegged to the foreign rate even when financial capital is perfectly mobile internationally.

[12] In the absence of any *Fisher*-like expectations of an exchange rate continuing to move in only one direction — an effect that would show up in permanently higher nominal interest rates on bonds denominated in the depreciating currency.

Exchange-Rate Fluctuations Under Full Information

What are the consequences of these monetary disturbances for the foreign exchanges? Modest movements in the domestic rate of interest in our modified model of liquidity preference imply correspondingly modest movements in the premium or discount of the forward exchange rate over the spot, if the *IRPT* holds. However, I shall show that the spot and forward exchange rates *together* may well vary more widely than either the domestic rate of interest or the domestic money supply. Hence, the surprisingly violent *short-run* fluctuations in foreign exchange rates in the 1973 - 1979 period could easily be induced by relatively moderate shifts in supplies or demands in each national money market.

Given the short-run rigidity in national commodity price levels, the key element that remains to be spelled out is the formation of private expectations regarding near-term movements in the spot exchange rate. Take, for example, the discrete increase in the domestic money supply portrayed in Figures 1 and 2 above. If the domestic rate of interest falls by one percentage point an 90-day bonds, the *IRPT* tells us that the forward discount on foreign currency also falls (or the forward premium widens) by one percentage point. If prior to the monetary disturbance $R_f = R_s$ in long-run equilibrium, then immediately afterwards $R_f < R_s$. R_s will be driven up (the domestic currency is discretely devaluated at time zero) as individuals use their newly created cash balances to buy foreign bonds spot. Similarly, R_f for 90 days hence will be driven down (relatively) as individuals cover their bond purchases by selling foreign exchange forward at time zero such that:

$$f = \frac{R_s - R_f}{R_s} = .01 = i_n - i_1 \tag{9}$$

After this sharp (discrete) rise in R_s that was unanticipated, equation (9) implies that private wealth holders then come to expect (speculate) that R_s will fall gradually by one percent over the next 90 days. The discount on foreign currency to be delivered in 90 days reflects the expected appreciation of the domestic currency.

While all of this is well and good, nothing has yet been said about how much R_s will have to rise initially in order to set up the presumptive expectation that it will fall gradually for 90 days thereafter. The domestic currency can initially depreciate a lot or a little in response to the "modest" unanticipated domestic monetary expansion because purchasing-power parity need not hold in the very short run. The nature and strength of private expectations regarding the "equilibrium" spot rate in the future will be critical. Is the experienced monetary expansion transitory? Or is it a once-and-for-all permanent increase in the money supply? Or a harbinger of further monetary expansion? Not only the rise in R_s, but also the interest elasticity of the liquidity preference function depend on how these private expectations are formed.

Even if individual market participants such as commercial banks and merchant traders cannot directly observe what money supply changes occurred or will occur, they can see derivative movements in interest rates and exchange rates. It does not seem farfetched, therefore, to model their behavior *as if* they focussed their expectations with greater or lesser confidence on what the future money supply will be, with known consequences for the interest and exchange rates. In other words, private expectations are being "rational" in focussing on the supply (or demand) of domestic money that really does drive nominal interest and exchange rates in the short run.

In classifying possible expectations effects, let us consider first a hypothetical *full information system*. On the one hand, the quantitative amount of the discrete increase in the money supply is actually published, and then a strong consensus view develops among private speculators regarding future monetary action by the government. This latter effect is equivalent to the government actually publishing credible guidelines on what its future monetary policy will be. (The full information approach has the formal analytical advantage of suppressing the vexing question of uncertainty that must ultimately be considered.) To be concrete, suppose the initial discrete expansion in the money supply at time zero is known to be two percent of the outstanding stock. Within our short 90-day time horizon, consider three possible full information views of the future course of monetary policy:

(1) The increase of two percent in the money supply is purely transitory and is reduced gradually back to its normal level within 90 days.

(2) The discrete two percent increase becomes a permanent but nonrecurrent addition to the money stock.

(3) The increase signals a policy of further monetary expansion, where the money supply increases another two percent in the period following and then ceases to expand[13].

Each of the three assumptions implies a different initial shock to the exchange rate, and perhaps (but not necessarily) a differently sloped

[13] To maintain stationary economy in which *Fisher* effects on interest rates are absent, I rule out for now consideration of a permanently higher rate of monetary growth.

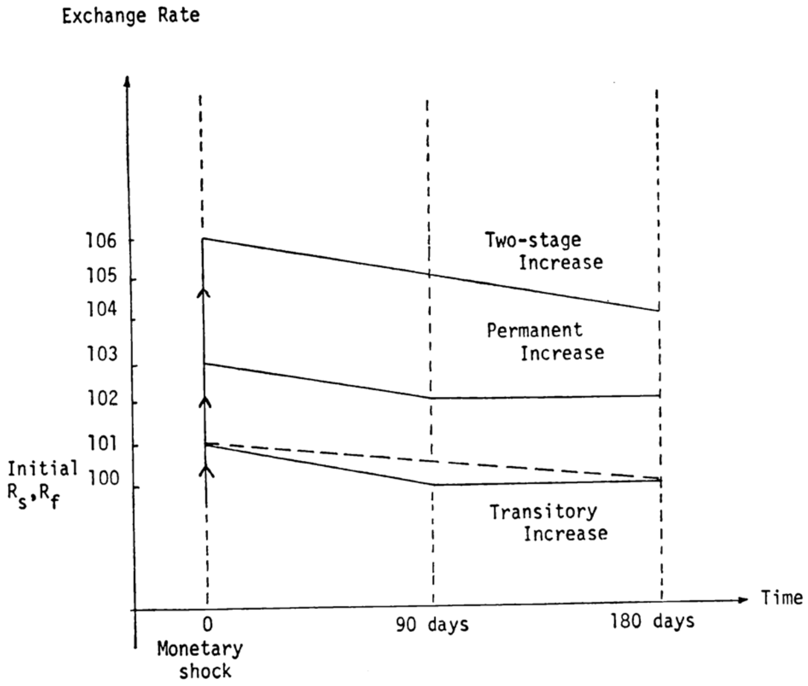

Fig. 3: Exchange-Rate Effects of a Discrete Increase in the Money Supply under Full Information

liquidity-preference function ower a short time horizon. In order to focus first on discrete exchange rate movements *per se*, I simply assume that the slope of the liquidity preference relationship is the same in all three cases: the domestic rate of interest falls by one percentage point as portrayed in Figures 1 and 2. The initial and consequential exchange rate effects of the discrete monetary expansion are portrayed in Figure 3 above.

In interpreting Figure 3 under each of our three "full-information" patterns of exchange-rate movement, an additional assumption has been imposed that arises naturally out of the monetary approach. Confining our analysis to stationary states, I assume that the domestic price level (tradables and nontradables) and the *PPP* exchange rate, R_s^{PPP}, are both eventually determined by *the level* of the domestic money supply according to the Quantity Theory of Money:

(10) $R_s^{PPP} = \alpha M, \;\; P_T = \Theta M$ and $P_N = \gamma M$. P_T is tradables price
P_N is nontradables price.

In the long run the velocity of money is constant and the relative price of tradable and nontradable goods is also fixed. The *sustained* level of the domestic money supply eventually determines the internal commodity price level and the average exchange rate, which is at parity with the purchasing power of foreign currencies as described by equation (10). Of course, unanticipated short-run variations in the money supply will cause departures from these relationships in the foreign exchange and commodity markets. However, our full information approach assumes that private traders use the relationships in equation (10) to establish where they think R_s will ultimately move. And the expected final resting place for the exchange rate is important in understanding near-term exchange rate movements.

In Figure 3, therefore, 100 is the equilibrium *PPP* exchange rate prior to the exogenous monetary "shock". If that two percent discrete increase is known to be transitory such that the money supply is eventually reduced (falls smoothly) by two percent over 90 days, then R_s will return to 100. The initial one percent discrete spot depreciation in the foreign value of the domestic currency is the foreign-exchange counterpart of the fall by one percentage point in the domestic rate of interest on 90-day bonds.[14] It sets up on the expectation that the domestic currency will appreciate by one percent over 90 days (R_s will fall by one percent) as shown by the downard slope of each graph in Figure 3. Reflecting this expectation, R_f would remain unchanged at 100 at time zero in the face of the exogenous shock. Throughout, the "sticky" commodity price level remains largely unchanged because of the transitory nature of the exchange-rate movement.

Consider the second case of a permanent nonrecurrent increase of two percent on the money stock shown in the middle graph of Figure 3. R_s must now increase three times as much — to 103 — in order to set up an expectation of a subsequent fall of one percentage point on the one hand, and a new long-run equilibrium that is two percent higher (at 102) on the other. That is, the initial fall of one percent in the short-run rate of interest is the same for a permanent change in money stock as with the transitory one analyzed above. But now R_f jumps immediately to 102, so that the IRPT described in equation (9) still holds at time zero.

While the interest-rate implications of the permanent increase in the money stock are the same as for the transitory one, the implications

[14] Note that for simplicity of exposition all interest rates are being calculated on a 90-day basis corresponding to the time maturity of short-term bonds. Measured on an annual basis, short-term interest rates would fall by four percentage points to correspond to the fall of one percentage point described above.

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for the goods market (as well as for the foreign exchanges) are somewhat different. The new price level in long-run equilibrium is higher: the ultimate PPP value of R_s is 102. The middle graph in Figure 3 is drawn as if the commodity price level rises gradually by two percent throughout 90 days. This increase reduces the real value of the money stock by two percent and hence allows restoration of the initial money-market equilibrium. While the domestic commodity price level is invariant to the initial monetary shock and jump in R_s, nevertheless it does gradually rise through time with its stopping place defined by the quantity theory of money.

For comparative analytical simplicity, I have assumed full commodity price adjustment within 90 days to the permanent increase in the money supply. As an empirical matter, the price level could take longer to adjust, in which case the interest rate would not fall quite as much initially but would be depressed for a somewhat longer period of time. Nothing really essential in this analysis would be altered by this stretching out process. We would still get an initial jump in R_s that was substantially greater in comparison to the "transitory" case of the lower graph.

By now the analytics of the last two-stage case must be well nigh self-evident to the reader. Because the initial two percent shock is a precursor of a further monetary expansion of two percent, R_s must jump even more sharply to reflect the total percentage monetary expansion now and in the future *plus* a margin to allow R_s to fall subsequently by two percentage points over 180 days (one percentage point over the immediately succeeding 90 days). Hence, R_s jumps to 106 immediately and then declines gradually to 104 in 180 days. Full monetary equilibrium is restored 180 days later because the price level rises gradually by four percent and reduces the real stock of money back to its original level. The immediate exchange-rate effect is accentuated, however, by the anticipated future monetary expansion.

In summary, the main contention of my "full information" analysis is that discrete jumps in the spot exchange rate can, plausibly, be greater in percentage terms that immediate changes in the domestic supply of (or demand for) money, or in the domestic rate of interest.

Uncertain Expectations

Under uncertainty, a temporary monetary expansion could be mistaken for a permanent one and vice versa. Hence it is difficult to say whether or not exchange-rate fluctuations would be more or less pronounced for any given monetary shock in comparison to the "Full Information" model described above.

If the monetary authority's behavior is basically stable over the long run, then this should be well advertised so that short-term fluctuations in exchange rates are reduced to the same order of magnitude as interest-rate changes — as portrayed in the lower graph of Figure 3. One way of so stabilizing private expectations is for the government to announce that it will keep the exchange rate within a well-defined band — say, one percent on either side of "parity" as per the Bretton Woods system or the gold standard. Some short-run manipulation of interest rates is then feasible in the Keynesian mode without inducing major exchange-rate changes. Everyone knows any monetary expansion or contraction must be transitory in order that this band of exchange variation not be violated. The official band, if credible, is a signal to the market regarding the longer-term stability of the government's monetary policy.

Otherwise, if private uncertainty is very great, a transitory monetary expansion such as portrayed in Figure 1 could depreciate the currency sharply because Foreign Exchange Dealers are loath to unbalance their portfolios by absorbing newly created domestic money. For the same reason, the liquidity-preference schedule portrayed in Figure 1 would be less elastic and the domestic interest rate would fall more sharply until Domestic Wealth Holders are rewarded sufficiently to absorb virtually all the newly created domestic money.

Currency Areas and Speculation

Consider now the flow of commodity trade — whether any pair of countries is heavily or lightly linked by the exchange of exports and imports. Suppose that the money markets of these trading countries are buffeted by essentially transitory disturbances in either the creation of domestic money or the demand for it. While some uncertainty exists about the future, private traders and dealers (speculators) do *not* expect monetary expansion in any single country to permanently exceed that of others — but all such dealers face a capital constraint of the kind outlined above. Ruling out any conscious official harmonization of short-run monetary policies across closely linked countries, under what empirical circumstances would the above theoretical analysis predict that the Canadian-American exchange rate would fluctuate relatively little while the American-German or Canadian-German exchange rates fluctuate a great deal?

In the Canadian-American case, the normal inventories of Canadian dollars and American dollars held by Foreign Exchange Dealers should be "large" relative to the volume of Canadian dollars held by Domestic Wealth Holders in Canada. (For this purpose the U. S. can be considered the "large" outside world.) Because dealers hold cash balances in order to finance international trade and clear international payments, the greater the proportion of foreign trade in GNP *ceteris paribus,* the larger will be dealer holdings of foreign and domestic currencies. And Canadian imports from the U. S. amount to about 20 percent of Canadian GNP. Hence the wealth constraint on dealers (equation 4) is less binding in comparison to two countries whose trade links are not so close. Any monetary expansion by the Bank of Canada as per Figure 1, therefore, would be largely absorbed by dealers taking substantial amounts of Canadian dollars into their portfolios in exchange for American dollars in response to a relatively modest depreciation of the Canadian dollar.

Symmetrically, any transitory increase in the American money supply would induce but a moderate appreciation in the Canadian currency because of the willingness of dealers to *dishoard* Canadian dollars in exchange for American. This dishoarding occurs as Canadians attempt to sell bonds (denominated in U. S. dollars) in the United States in response to easier money conditions there. Since the American economy is very large relative to the Canadian, market conditions in the U. S. — as measured by levels of short-term interest rates — will prevail in both countries. But as long as dealers have, at the margin, a plentiful supply of Canadian dollars to dishoard in response to a transitory American easy money policy, the Canadian dollar should *not* appreciate sharply. And because of the high volume of foreign trade between these two countries, Foreign Exchange Dealers are well situated (without a binding capital constraint) to perform such *stabilizing speculation.*

On the other hand, the direct flow of trade between Germany and the United States is much smaller. German exports to the United States amount only to about three percent of German GNP. Hence dealers holding both DM and dollars would not be major factors in either the German or American money markets. But dealers with capital constraints are the relevant institutional embodiment of potentially stabilizing speculators. Only dealers have *both* the financial capacity and the knowledge and inclination to alter their short-term foreign exchange positions quickly in response to transitory exchange-rate movements. As long as some uncertainty exists about the future actions of central banks, a transitory increase in the American money supply could drive the dollar value of DM sharply upwards (because of the incipient capital outflow to Germany) before knowledgeable dealers are unwilling to sell DM from their limited portfolios in sufficient quantities to stop the upward movement — unlike the Canadian-American case. Hence, the sharp dollar/DM movements observed in practice arise, in part, from the absence of sufficient stabilizing speculation in response to monetary shocks in either national money market — rather than outright destabilizing speculation as is sometimes posited. Even less risk capital is likely to be available to "destabilizing" speculators because of the standard argument (*Friedman*, 1953)[15] that such inefficient speculators are likely to make losses — except possibly in certain highly contrived circumstances.

Currency Areas and Purchasing-Power Parity

There is, however, another related reason why economies that are highly integrated in commodity trade might show lesser variance in money-market conditions and in short-term exchange-rate fluctuations. Our use of Keynesian liquidity-preference analysis assumed that domestic price levels are insulated from each other in the short run, and hence fairly invariant to exchange-rate fluctuations. That is, instantaneous purchasing power parity across currencies does not hold even in the sectors producing and consuming tradable goods. These discontinuities essentially allow exchange rates to be volatile in the short run, and to move much more than commodity price indices measured in individual national currencies.

This assumed absence of purchasing-power parity may hold up rather less well between economies that are highly integrated. Commodity arbitrage could be more intense and prevent significant deviations from purchasing power parity. Thus the scope for exchange-rate fluctuations, and for short-run interest differentials in the Keynesian mode, would be more limited. For example, an open-market operation that expanded the domestic money supply would cause some exchange-rate depreciation (depending on dealer behavior) that would immediately tend to increase the domestic price level. This rise in prices would raise the demand for money by Domestic Wealth Holders,[16] and thereby eliminate the excess liquidity with it concomitant downward pressure on interest and exchange rates. Correspondingly, fluctuations in the domestic *de-*

[15] If destabilizing speculators actually drive the foreign exchange rate away from its long-run equilibium value, on average they will be buying when the price of foreign exchange is high and selling when it is low — whence come their expected losses.

[16] Assuming that the rate of increase in prices is not projected to continue indefinitely into the future: i.e., *Fisher* effects are absent.

mand for money would have immediate effects on commodity prices through the exchange rate so as to leave domestic short-term rates of interest relatively unchanged with but modest exchange fluctuations.

Apart from the degree of integration in commodity trade, economies that produce largely primary products (Tradables II) would find that domestic prices respond quickly to exchange-rate movements. This again would limit the applicability of our Keynesian liquidity-preference analysis.

But commodity price instability is a poor substitute for exchange and interest-rate fluctuations in response to short-run shifts in domestic money-market conditions. Indeed, the Theory of Optimum Currency Areas (*McKinnon*, 1963) would suggest that economies closely integrated in foreign trade might well opt for fixed exchange rates precisely to prevent commodity price instability from occurring in response to transitory monetary disturbances reflected in exchange-rate variations. For small countries in particular, a transitory disturbance in the money market of a major trading partner might well appreciate the domestic currency and put downward pressure on domestic prices even before the monetary impact was manifested in the price level of the trading partner itself — and might never be manifest if the monetary disturbance was indeed transitory. Commodity traders might then be induced to change their "normal" purchasing and selling patterns — not because comparative advantage has changed, but simply because of short-run monetary shocks. Hence the welfare costs of volatile exchange rates would seem much higher among highly integrated trading partners.

Intervention by Central Banks: A Concluding Note

In the very short run, a floating exchange rate is *not* tied by purchasing-power parity and fluctuates according to the capital constraints on foreign exchange dealers and their views of future domestic monetary policy. If central banks are known to initiate only transitory changes in the domestic money supply (perhaps measured from a trend rate of growth), and if private foreign exchange dealers are not constrained in which positions they may take, domestic short-run rates of interest can be successfully manipulated (according to the canons of the Keynesian theory of liquidity preference) with relatively modest associated movements in exchange rates. However, if private dealers have doubts regarding the future course of official monetary policies, and they face severe capital constraints, the exercise of autonomy in national monetary policy can lead to large exchange-rate fluctuations — perhaps much larger in the short run than changes in either interest rates or in

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the domestic money supply itself. And this latter situation better describes the experienced instability in rates of exchange among major convertible currencies in the 1973 - 1979 period.

But the international monetary system is not symmetrical in these respects. *The natural degree of exchange-rate variation is likely to be less across countries closely connected in foreign trade* because private Foreign Exchange Dealers are better able to perform as stabilizing speculators, and because deviations from purchasing-power parity are less common in the presence of free commodity arbitrage. This natural stabilizing tendency among closely connected trading partners may be strengthened by official intervention to further smooth rate movements because of the relatively substantial welfare costs of exchange fluctuations, as described by the old arguments delineating optimum currency areas.

Thus it is not surprising that central banks have been drawn back to take "large" balancing positions in the foreign exchange market, although they no longer have official parity obligations. On the information side, central banks have a potential comparative advantage as "speculators" through their control of the future course of national monetary policy. Unlike commercial banks, moreover, official agencies can take open positions in the interbank market without being so hampered by capital constraints and default risk.

Only if the secular stability of each national monetary policy vis-à-vis other countries is somehow assured, could central banks gracefully withdraw and let the foreign exchanges stabilize themselves.

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