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Liberalization of Financial Markets and the Volatility of Exchange Rates: The Experience of the Japanese Yen since 1980

by

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I. INTRODUCTION

Since around the mid-1970s, monetary authorities have removed or greatly relaxed various restrictions that were traditionally imposed on both financial institutions (especially private banks) and financial markets. In particular, asset holders and investors in most advanced economies have been given much greater latitude than before to lend and borrow abroad. More specifically, they have been allowed to more freely take "speculative asset positions" in foreign currencies. Thus, the financial markets of the advanced economies have become quite intimately interconnected with each others. Furthermore, the trend of financial deregulation seems to have been intensifying since 1980.

Japan is no exception in this trend of financial deregulation and internationalization. Although various financial regulations, especially those on international capital flows, were relaxed only at quite a slow pace during the 1970s, the pace of deregulation has greatly accelerated since 1980 when the liberalized version of Foreign Exchange Law went into effect. (Recent processes of financial deregulation in Japan are well documented by Sakakibara-Kondoh (1984) and Frankel (1984)). During the first half of the 1980s, huge savings-investment imbalances in both Japan and foreign countries were accommodated rather smoothly by international capital flows, especially between Japan and the United States.

How has this financial globalization been influencing the stability of

financial markets? In particular, has it been contributing to the stabilization of exchange rates, or has it rather been making them more volatile? This is both an important and interesting issue. According to some economists, exchange rates have shown far more instability under the regime of flexible exchange rates than most people had expected. For example, as McKinnon (1984) describes it:

> "Since the industrial economies abandoned their fixed dollar parities in the early 1970s, the world dollar standard has become less stable. Exchange rates have shown great volatility day-to-day or week-to-week, and a tendency toward misalignment for months or even years."(p.4)

Private capital flows have been accused of being at least one of the major factors that cause volatile fluctuations in exchange rates. More than a few economists favor effective control on private capital flows. (See, for instance, Tobin (1982) and Dornbusch (1983).) However, other economists emphasize that private speculative capital flows are very useful in stabilizing exchange rates. They argue that the speculation under the regime of flexible exchange rates is indispensable. According to McKinnon(1979), the volatile fluctuations of exchange rates during the 1970s were mainly due to the fact that foreign exchange dealers represented by commercial banks could not supply a large enough amount of speculative funds in the financial markets. (See McKinnon (1979; pp.181-195))

It is very difficult to determine whether exchange rates have in fact experienced "excessive" volatility or not. However, we can hardly deny that the range of fluctuations in exchange rates has been wider than most of us had ex-

pected before 1973. As will be noted late in this paper, this seems particularly true of the Japanese yen. At least for the period since 1980, the exchange rate of the Japanese yen has been fluctuating much more than those of the major currencies.

Needless to say, a great number of factors are responsible for changes in exchange rates. Especially, those that are related to the slippery factor of investors' expectations are important. Therefore, it is very difficult to give a general account of actual fluctuations in exchange rates. The purpose of the following investigation is to discuss, in relation to the internationalization of the financial markets, the "volatility" that the Japanese yen has experienced since 1980. The experience of Canadian dollar and other major currencies during the same period will be chosen as important yardsticks with which to compare the Japanese yen's experience.

The main point of this paper is that the "volatility" of the yen exchange rate has been directly related to the specific process of the internationalization of Japan's financial markets. Since 1980, this internationalization has taken the form of a rapid increase in the substitutability between securities denominated in yen and those denominated in foreign currencies. In contrast, currency substitution between yen and other currencies does not seem to have increased very much. It is well known that the Japanese yen has played quite a limited role as a currency in international financial markets. (See Hamada-Horiuchi (1987)) This will be reconfirmed here by a simple empirical analysis concerning "currency substitution". From a theoretical model of asset markets, we can deduce that financial internationalization accompanied by only limited "currency substitution" tends to make the exchange rate more volatile. Thus, we may consider one important reason for the "volatility" of the yen exchange rate

to be the limited state of substitution between the yen and other currencies, especially the US dollar.

In section II which follows, we explain the mechanisms of determination of both the domestic interest rate and the exchange rate of a financially small country by means of the so-called asset approach. In particular, we focus our attention on how the volatility of an exchange rate is related to "currency substitution" and "capital mobility", respectively. (These two concepts being defined in the section.) From this simple model we cab deduce that the increase in "currency substitution" will, ceteris paribus, tend to stabilize movement in an exchange rate, while the increase in capital mobility will tend to make it more volatile.

In section III, we first present the "volatility" of the Japanese yen in comparison with the movements of the Canadian dollar and other major currencies. Then, we proceed to estimate the degree of currency substitution in Japan. Taking into account both this result and the rapid increase in securities transactions between Japanese and foreign markets, we tentatively conclude that the specific process of the financial internationalization of Japan's financial markets can explain some of volatility that the Japanese yen has experienced since 1980. In the last section, we summarize the main points of the this paper.

II. Currency Substitution, Capital Mobility, and the Volatility of Exchange Rates

In this section, we discuss the volatility of exchange rates in reference to the process of the internationalization of financial markets. The volatility of exchange rates has been a major topic in open macroeconomics. This reflects the fact that exchange rates have shown much greater variation under the regime of floating rates than most had expected.

One of the most influential hypotheses concerning exchange rate volatility was provided by Dornbusch(1976), according to which relatively slow adjustment of commodity prices is the cause of abrupt fluctuations ("overshooting") in exchange rates. On the other hand, monetarists have proposed another hypothesis, which argues that the wide fluctuations in exchange rates can be accounted for by the appearance of new information in efficient foreign exchange markets. (Frenkel-Mussa(1985;pp.725-728))

However, the factors emphasized by these hypotheses seem to be equally applicable to almost every economy. Thus, they are not very useful in explaining the significant cross-border differences in volatility of exchange rates that will be empirically shown in the next section. Why does the Japanese yen seem to be much more volatile than, say, the Canadian dollar? On the basis of a simple asset market model, we will explain the difference in volatility by the specific processes of financial internationalization each currency has taken.

Internationalization and speculations: The financial internationalization of an economy should imply, among other things, that the residents can freely choose their net holdings of foreign exchange. Therefore, with an economy

financially open, investors will actively engage in foreign exchange speculation by taking the expected rates of return on both domestic and foreign assets into consideration when making their choices of asset holdings. They will also freely choose where they borrow, and in what currencies their liabilities are denominated.

How do the intensification of such speculative activities affect the movement of foreign exchange rates? Emphasizing the importance of commercial banks as speculators in foreign exchange markets, McKinnon argues:

> ... the supply of private capital for taking net positions in either the forward or spot markets is currently inadequate. Exchange rates can move sharply in response to random variations in the day-to-day demands by merchants or from monetary perturbation, no prospective speculator is willing to hold an open position for a significant time interval in order to bet on a reversal -- whence the large daily and monthly movements in the foreign exchanges and sometimes high bid-ask spreads. (McKinnon (1979; p.156))

According to McKinnon's model, the more elastic is the demand of speculators for foreign exchange positions, the more stable the movement of exchange rates becomes. Thus, his model implies that the intensification of speculative activities due to financial internationalization and/or deregulation will stabilize exchange rates. However, as will be shown later, this result crucially depends on McKinnon's implicit assumption that the increase in speculative activities will always take the form of 'currency substitution'.

In the theoretical analysis of this section, we will prove the following proposition: If financial internationalization is accompanied by an increase in

substitutability between securities (denominated in the domestic currency) and foreign securities (denominated in foreign currencies), it will tend to make exchange rates fluctuate more widely. In order to differentiate this from the 'currency substitution' emphasized by McKinnon, we call the increase in substitutability between domestic and foreign securities 'capital mobility'.

This differentiation of 'capital mobility' from 'currency substitution' depends upon an analysis by Cuddington(1983). However, our result contradicts that of Cuddington, since he argues that, within the framework of general equilibrium analyses of asset markets, it is almost meaningless to distinguish between currency substitution and capital mobility. Our differences will be clarified in the following theoretical discussion.

A model of the asset approach: We present a simple version of asset market equilibrium model with a view to explaining short-run variations both in the exchange rates and the interest rate. This version follows McKinnon (1979) rather faithfully.(Branson-Henderson(1986) present a full-scale model of the asset approach.) The basic assumptions of the model are the following:

(A.1) An economy in our model is a small country in which any changes in domestic financial markets cannot influence conditions prevailing in foreign financial markets. Thus, we can regard interest rates on foreign securities as exogenously given.

(A.2) We explicitly consider four financial assets; i.e., the domestic currency whose supply is controlled by the central bank, the domestic security, the foreign

currency, and the foreign securities denominated in the foreign currency.

(A.3) There are two kinds of investors. One is that of domestic wealth holders (DWH) who do not take net position in the foreign currency. Their holdings of foreign securities are always covered in the forward market. The other is that of speculators (foreign exchange dealers in McKinnon's model) who not only hold domestic financial assets but also take net positions in the foreign exchange market. Specifically, they take net positions in the forward market. (It is well known that speculations in the forward markets can be regarded as perfectly equivalent to speculations in the spot markets. Therefore, this assumption concerning speculator's behavior is not restrictive at all.)

(A.4) The covered interest rate arbitrage is perfect, so the domestic interest rate i is always equal to the comparable foreign interest rate i* plus a forward premium f.

(A.5) Investors' expectations of future changes in the exchange rate are 'regressive' in the sense that investors firmly believe an equilibrium level of the exchange rate to be determined by fundamentals, and that the instantaneous depreciation (say) of the currency generates expectations of future appreciation. Here we do not discuss what are the fundamentals, and how

they determine the investors' expectations of an equilibrium exchange rate. The expected level of equilibrium exchange rate is exogenously given. (The assumption of this regressive type of expectation may be somewhat restrictive. However, the assumption has been found to be rational in Dornbusch (1976) and others).

(A.6) The wealth effects that accompany variations in both interest rates and the exchange rate are totally negligible.

Asset demand of the DWH: The domestic wealth holders allocate their wealth Wa to the domestic currency Ma, the domestic security Ba, and the foreign security Ga covered in the forward market. Therefore;

$$Wa = Ma + Ba + Ga. \qquad (1)$$

For the DWH, the domestic security and the foreign security covered with the forward sale are perfectly substitutable. So, we can present the opportunity cost of money holding for the DWH either in terms of the domestic interest rate i or in terms of the covered foreign interest rate $i^* + f$. We then present the DWHs demand for money as follows;

$$Ma = Ma\,(i;\ Y,\ Wa)\ ;\ Mai < 0, \qquad (2)$$

where Y is nominal GNP that is exogenously given.

It is clear from the above that the DWHs' demand for both domestic and foreign securities can be represented by the following function.

$$Ba + Ga = Wa - Ma\,(i;\ Y,\ Wa). \qquad (3)$$

In asset market equilibrium, the total amount of domestic security B available to private investors must be absorbed into the DWHs' porfolios. The amount of (Ba + Ga - B) is, therefore, the DWHs' demand for the covered foreign security, which in turn is equal to their supply of the foreign currency in the forward market Fa. (Strictly speaking, the DWHs' supply in the forward markets Fa will equal (1 + i*) (Ba + Ga - B). In the following, we will assume the interest rate factor (1 + i*) be nearly equal to unity for simplicity.)

$$Fa = Wa - B - Ma\ (i;\ Y,\ Wa\ ). \qquad (4)$$

Speculators' behavior: We will explain speculators' behavior as did McKinnon. The speculators (i.e., foreign exchange dealers) distribute their wealth Wb among domestic currency Mb and the foreign currency Nb. For the speculators, the opportunity cost of holding domestic money is represented by the expected rate of appreciation of the foreign currency x. Thus;

$$Mb = Mb\ (x;\ Y,\ Wb)\ ;\ Mbx < 0 \qquad (5)$$

Because of wealth constraints, the speculators' demand for the foreign money Nb is equal to Wb - Mb.

The speculators' demand for foreign currency in the forward markets is assumed to be an increasing function of the expected rate of return on net positions in the forward foreign exchange r. This rate of return r is equal to the expected rate of appreciation of foreign currency x minus the forward premium f. Since we assume the covered interest rate arbitrage to be perfect, r is equal to (x + i* - i). Thus, the speculators' demand for net positions in the forward exchange market Fb is

$$Fb = Fb\ (r;\ Wb\ )\ ;\ Fbr > 0, \qquad (6)$$

where $r = x + i^* - i$.

The equilibrium of asset markets: The asset market equilibrium in the economy consists of the following three equations;

$$Ma\ (\ i;\ Y,\ Wa\ ) + Mb\ (x;\ Y,\ Wb\ ) = M \qquad (7)$$

$$Wa - B - Ma\ (i;\ Y,\ Wa) - Fb\ (r;\ Wb\ ) = 0 \qquad (8)$$

$$Nb + Fb = F \qquad (9)$$

Equation (7) and (8) indicate equilibria in the market of the domestic currency and the forward foreign exchange market respectively. Equation (9) implies that, in equilibrium, the investors' net positions in the foreign exchange must be equal to the accumulated current accounts F of this economy, which can be regarded as given at a specific moment. Since we have a wealth constraint for the whole economy,

$$Wa + Wb = M + B + F, \qquad (10)$$

(9) will be automatically derived from (10), (7), and (8). Thus, our asset market model has two independent equilibrium conditions which will determine the equilibrium levels of two endogenous variables, i.e., the domestic interest i and the expected rate of appreciation of the foreign currency x. Because of the assumption of regressive type expectations (A. 5), there is a unique correspondence between the expected rate of appreciation of the foreign currency x and the levels of spot exchange rate e (measured in terms of the domestic currency). Therefore, we can deduce an equilibrium level of the spot exchange e from the equilibrium level of x determined by the above model. The extent of variations in x is positively correlated with the extent of variations in e.

In Figure 1, MM represents the locus of combinations of i and x that satisfy the equilibrium condition in the domestic currency market (7). This MM

is negatively sloped. The equilibrium in the forward market (8) is described by the positively sloped FF. The intersection of MM and FF determines an equilibrium set of i and x corresponding to a set of exogenous variables M, B, F, i*, and others.

The easy money policy by the central bank means an increase in M and an accompanying decrease in B. In Fig.1, the policy effect is represented by downward shifts in both MM and FF. Since the extent of shift is unambiguously larger in the case of MM than in the case of FF, the easy money policy will reduce the equilibrium level of the domestic interest i and of the expected rate of appreciation x, which means an instantaneous depreciation in the domestic currency.

An increase in the foreign interest rate i* will shift FF to the left by an extent just equal to the increase in i*, while it leaves MM intact. Thus, it will pull the domestic interest rate i and cause the expected rate of appreciation in the foreign currency x to decrease. As the slope of FF is less than unity, it is clear that the increase in i* is always greater than the increase in i. The results of our model so far are quite commonplace.

Internationalization of financial markets: We can consider the financial internationalization from two angles: i.e., the increase in 'currency substitution', and the increase in substitutability between domestic and foreign securities ('capital mobility').

On one hand, the degree of substitutability between the domestic currency and the foreign currency is measured by the extent to which speculators' demand for the domestic currency Mb responds to variations in the opportunity cost x, i.e., the absolute value of Mbx. Thus, the increase in 'currency substitution'

means a larger absolute value of Mex.

On the other hand, the increase in substitutability between domestic and foreign securities is synonymous with an increase in the absolute value of Fbr. In an extreme case where domestic and foreign securities are perfectly substitutable for speculators, Fbx is infinite, and therefore we obtain.

$$r = x + i^{*} - i = o. \qquad (11)$$

This is the equation of uncovered interest rate arbitrage in the case of 'perfect capital mobility'.(McKinnon (1979) assumes this extreme case.)

It can be easily shown that an increase in 'currency substitution' makes the MM curve in Fig.1 steeper, while an increase in 'capital mobility' makes the FF curve both steeper and less responsive to a change in monetary policy.(The maximum of the FF curve is unity, which is attained in the case of the 'perfect capital mobility' (11).) We can now proceed to investigate what relations 'currency substitution' and 'capital mobility' have with exchange rate volatility.

The effect of monetary policy: Fig.2 depicts a case of easy money policy. In Fig.2a, we present two cases of 'currency subsitution'(CS): i.e., the higher degree of CS corresponding to the steeper MM, and the relatively lower degree of CS corresponding to the gentle slope of MM. From this figure, it is obvious that a given change in monetary policy will produce milder changes both in the domestic interest rate i and the expected rate of appreciation of the foreign currency x, when CS is high than when CS is low. The higher degree of CS will make the exchange rate less responsive to changes in domestic monetary policy.

Fig.2b describes how the difference in the degree of 'capital mobility'(CM) affects the volatility of the exchange rate. The figure is a little complicated

because changes in CM not only change the steepness of FF, but also the responsiveness of the curve to the monetary policy. However, as presented in Fig.2b, the higher is CM, the larger the change in i, and the smaller the change in x associated with a given change in monetary policy. This means that, as CM increases, the variations in the exchange rate due to domestic monetary policy will become smaller.

In short, our analysis indicates that financial internationalization will contribute to stabilizing the exchange rates regardless whether it takes the form of an increase in CS or an increase in CM. We can extend this result to the case in which the demand for the domestic currency will change. In other words, active speculation is useful in reducing the extent of exchange rates variations. This is exactly what McKinnon(1979) obtained.

The influences of the foreign interest rate i*: We proceed to the problem of how strongly changes in the foreign interest rate affect the equilibrium exchange rate. This is more interesting and important than the case of domestic monetary policy that we have just analyzed above, because rather drastic variations in the US interest rates seems to have exerted a profound influence on the exchange rates of most currencies, including the Canadian dollar and the Japanese yen since 1980.

Fig.3 depicts the cases in which the foreign exchange rate i* rises (from initial i*(0) to i*(1). The rise in i* shifts the FF curve to the left. Thus, as in Fig.3a, the higher CS is (i.e., the steeper MM curve is), the higher the rise in i* will pull up the domestic interest i, and the smaller will be the reduction in x. Also in this case, a higher CS seems to promote stability of the exchange rate.

In contrast, both the domestic interest rate i and the expected rate of appreciation x will be influenced more greatly in the case of higher CM,which implies a steeper FF curve, than in the case of lower CM. This is obvious at a glance from Fig.3b, which indicates that more active speculation in domestic and foreign securities markets tends to make variations in exchange rates more volatile.

A reservation Our theoretical model may look too simple to derive any practical implications. In particular, we ignored the effects of changes in exogenous variables on investors' expectations of the fundamentals which determine the long-run equilibrium level of exchange rates. We can analyze the influence of changes in investors' expectations concerning the long-run equilibrium level of the exchange rate in our model. The effect of changes in expectations is totally absorbed by instantaneous variations in the spot exchange rate. The extent to which the spot rate changes is independent of both the degree of currency substitution and the degree of capital mobility. Therefore, although changes in investors' expectations concerning 'fundamentals' very strongly influence exchange rates, they are not related to our problem of the relationship between the volatility of exchange rates and the specific process of the internationalization of financial markets.

Interpretation of the results Our analysis indicates that what form the financial internationalization takes does matter with respect to the volatility of exchange rates. If the internationalization proceeds in the form of increasing currency substitution, the active speculation almost inevitably accompanied with it will make exchange rates more stable to some extent. This is because

the 'currency substitution' can be a shock absorber when some disturbances affect the securities markets. For example, a flight of investors from assets denominated in the home currency to foreign assets will exert downward pressure on the domestic currency. This pressure will give rise to expectations of appreciation in the home currency. The higher the currency substitution is, the more strongly does this appreciation expectation work to reverse the direction of the initial flight from domestic financial markets.

On the contrary, however, if internationalization is advanced mainly through increasing speculations between domestic and foreign securities markets (i.e., the increase in 'capital mobility'), the exchange rate will become more volatile when confronted with disturbances arising in foreign financial markets. In the next section, we posit that this theoretical implication from a simple asset approach model has something to do with rather abnormal volatility the Japanese yen has been experiencing since around 1980.

III. THE VOLATILITY OF THE JAPANESE YEN AND CURRENCY SUBSTITUTION

The volatility of nominal exchange rates: The Japanese yen appears to have been much more volatile than most of major currencies in terms of nominal effective exchange rates. For instance, the coefficients of variation (standard deviation per the average) of nominal effective exchange rates (MERM) during the period from January 1980 to June 1986 are 0.126 in the case of the Japanese yen, 0.040 in the Canadian dollar, 0.035 in the Deutsche mark, 0.042 in the Swiss franc, and 0.090 in the UK pound respectively. (The US dollar, however, showed a value of 0.152 for the coefficient of variation during the same period, which was slightly higher than that of the yen.)

When we measure the volatility in terms of exchange rates per US dollar, the relative volatility of respective currencies will be substantially different from the above one. From January 1980 to June 1986, the coefficients of variation of exchange rate per US dollar are 0.123 in Japan, 0.060 in Canada, 0.200 in the UK, 0.150 in Germany, and 0.129 in Switzerland. So, except for the Canadian dollar, other major currencies showed equal or a little larger volatility than the yen. This difference of relative volatility indirectly suggests that the primary cause of exchange rates fluctuations during the first half of 1980s came from the US economy. Specifically, the high interest rates at the beginning of the 1980s and their declines after that time necessitated rather drastic adjustment between the US dollar and other currencies. So, in terms of the exchange rate per US dollar, the Japanese yen does not appear to have been exceptionally volatile. In the following, we will talk of exchange rate variability in terms of US dollar, and more carefully measure the relative volatility of each currency. Anyway, chart 1, which compares the nominal yen

rate per US dollar with that of Canadian dollar, shows the short-run variability of the former clearly.

Of course, it is probable that differences in the variability of the exchange rate of respective currencies simply reflect different attitudes of the countries' monetary authorities toward exchange rate fluctuations. If the central bank of an economy emphasizes stabilization of its exchange rate as an objective for monetary policy, the exchange rate will tend to be relatively less volatile. Conversely, countries with greater flexibility in their exchange rates tend to put more emphasis on internal objectives than countries with pegged exchange rates. (Black(1983))

We measure here the degree of volatility of exchange rates by their sensitivity to exogenous disturbances. Thus, we may call the currency whose exchange rate shows relatively greater responsiveness to disturbance being more volatile. According to the model in the previous section, the current level of an exchange rate depends on the domestic money supply, foreign interest rates, among other factors. Thus, we may estimate the following reduced form of nominal exchange rates of the yen and the Canadian dollar respectively:

$$\begin{aligned} e(t) = {} & \text{const.} + a1e(t-1) + a2e(t-2) \\ & + b0m(t) + b1m(t-1) + b2m(t-2) \\ & + c0g(t) + c1g(t-1) + c2g(t-2) \\ & + d0ius(t) + d1ius(t-1) + d2ius(t-2) + u(t), \end{aligned} \tag{12}$$

where e(t) is the nominal exchange rate per US dollar, m(t) the quarterly growth rate of money supply (M1 in the case of Canada , United Kingdom, and Germany, and M2 in the case of Japan), g(t) the quarterly growth rate of real GNP, and ius(t) the TB rate (three month) in the United States. We use the growth rates, instead of the levels of money supply and real GNP simply to exclude time

trends of those variables. Furthermore, in order to make straightforward comparison between the estimated results of these economies we standardize e(t), m(t), and g(t) by deflating them by their respective sample averages. We arbitrarily choose two period time lags.

Table 1 summarizes the results of the estimations over the sample period of 1980I to 1986II. We present the sums of the estimated coefficients on the respective explanatory variables, and F-statistics which indicate the significance of the null hypothesis that the coefficients are all zero. The larger value for the F-statistics implies a refutation of the null hypothesis. Both the sums of estimated coefficients for domestic monetary policy m(t), and for financial disturbances from abroad ius(t) are overwhelmingly larger in the cases of the Japanese yen, and the Deutsche mark than in the case of the Canadian dollar, and the UK pound, though we should be cautious concerning the low values of the F-statistics.

This table shows that the exchange rates of both the yen and the Deutsche mark have been affected by given changes in exogenous variables much more greatly than either the Canadian dollar or the UK pound. (The effective exchange rate of the Deutsche mark has been more stable than the mark-US dollar rate, because DM exchange rates against currencies other than US dollar have been rather stable, and because the importance of those currencies in German international trade.) In this sense, the yen has shown, along with the Deutsche mark, rather striking volatility during the first half of the 1980s. The relative variability of the yen is also indicated by its lower coefficient of determination (R2). Thus, our impressions of the rather abnormal volatility of the Japanese yen bears some semblance to reality, at least in comparison with the Canadian dollar and the UK pound.

Japan's capital mobility It is quite likely that the volatility of the yen we have just observed is related with the specific process of the internationalization of Japanese financial markets. The Japanese monetary authorities have a gradually relaxed a number of regulations on international capital flows since the early 1970s. However, during the 1970s, the Japanese government sometimes reintroduced restrictions on capital flows with the purpose of preventing 'undue' fluctuations in exchange rates.

Generally speaking, the government sought to moderate fluctuations in the exchange rate by adopting a stop-and-go policy with regard to capital movements. When the yen was under pressure to appreciate, the government was active in relaxing restrictive controls on capital outflow but strengthening controls on capital inflows. Conversely, in phases of abrupt depreciation, control on capital outflows was reinforced, while some measures were adopted to promote capital inflows.

For example, during 1977 and 1978, the Japanese monetary authorities took rather positive attitudes towards international capital movement. This was clearly stimulated by the fact that the yen was steadily appreciating during these years. At the same time, however, in November 1977, they stopped issuing treasury bills for public subscription in order to prohibit nonresidents from acquiring them, and they raised the required reserve ratios on yen-denominated deposits held by nonresidents. Furthermore in March 1978, nonresidents were prohibited from acquiring Japanese securities of a maturity of more than five years and one month. These were measures to prevent capital inflows that would appreciate the yen furthermore.

Then a phase of yen depreciation started in the summer of 1978. The

government either relaxed or removed the controls on capital inflows by the beginning of 1979. In November 1979, a package of policy measures aimed at 'defending the yen exchange rate' was introduced. The package consisted mainly of measures to hinder capital outflows such as a prohibition on yen-denominated syndicated loans to foreign agents.

This stop-and-go policy probably obscured the stance of Japanese authorities toward capital movements. The ambiguous attitude of the government was likely to impose 'political risk' on investors and, in effect, hindered the internationalization of Japanese financial markets.(Otani-Tiwari(1981)) In this sense, the Foreign Exchange and Foreign Trade Control Law of December 1980 seems to have been important in that it confirmed the Japanese authorities' attitude towards deregulation. This Law "formally established a presumption that international capital flows are permitted, in place of the previous presumption that they were not" (Frankel(1984;p.20)) with some exceptions.

The deregulation accompanied with a high savings rate in the domestic economy has remarkably promoted capital exports from Japan. Especially, Japanese residents' investment in foreign securities has increased tremendously. In 1978, the amount of residents' annual net acquisition of foreign stocks and bonds was US $8.9 billion. In 1985 the amount was US $54.5 billion, having grown more than six times in seven years. (Table 2) Most of those investments were directed to the United States. For example, Japanese bought some US $298 billion of foreign securities in 1985. Of those , $232 billion (around 78%) was bought from the US markets.(By the way, $4.5 billion was bought from Canada in 1985.)

It is noteworthy that the institutional investors such as insurance companies have been quite active in diversifying their portfolio towards foreign

securities. Since their asset scales have become very large mainly due to Japanese people's high saving ratio, their investment into foreign securities is a significant part of the variations in capital outflows from Japan.(It was reported that Japanese insurance companies and investment trust funds exercised self-control in investing abroad in 1982 and 1984. This self-control seemed to reflect an implicit administrative guidance by the Ministry of Finance which wanted to suppress the abrupt depreciation of the yen continuing at that time.)

We should also point out the rapid increase in the importance of yen-denominated bonds in the international bond markets: i.e., the Euro bond market and Japan's international bond market. In 1977, nonresidents were permitted for the first time to issue Euro-yen bonds. Due to a rather drastic liberalization of controls imposed on Euro-yen bonds issued by nonresidents, this market has shown substantial growth during the last few years. The amounts of Euro-yen bonds issued by nonresidents were ¥30 billion in 1977 and ¥1,587 billion in 1985, respectively. On the other hand, nonresidents issued Yen-denominated bonds in Japanese markets of ¥529 billion in 1977 and by ¥1,393 billion in 1985, respectively.

At the same time, foreign investors have been permitted to invest rather freely in Japanese financial markets, such as in corporate stocks and bonds. They have been one of the most active investors in some of the Japanese securities markets. For example, in May 1979, foreign investors were permitted to participate in yen-denominated transactions in the Gensaki market. This liberalization made full scale interest rate arbitrage between domestic money markets and Euro-yen markets possible, substantially narrowing the divergence between the domestic (Gensaki) rate and Euro-yen rate that had been observed before 1979. (Frankel(1984; pp.21-22)) It is reported that during 1981-1983

when there were rather strong expectations of yen appreciation, the amount of nonresidents' holdings accounted for around 15% of the total amount of outstanding Gensaki's. When the expectations subsided, the share of nonresidents' investment in Gensaki markets was steadily reduced to a few percent. These phenomena indicate that active capital flows occurred via the Gensaki market. In Table 2, we present the relative importance in Japanese securities markets of both sales and purchases by nonresidents. This table confirms that nonresidents' activities have been very important since the early 1980s.

Thus, it can be safely said that mainly because of both financial deregulation by the Japanese government and active portfolio diversification by Japanese investors, substitutability between securities denominated in the yen and those denominated in foreign currencies (especially the US dollar) has been greatly increased since 1980. In reality, the huge current account surpluses of Japan have been accommodated by capital outflows mainly in the form of residents' investment in foreign securities.(Ueda(1985)) Ueda-Fujii(1986) goes so far as to suggest that the great pressure of capital outflow caused by deregulation was partially responsible for the depreciation of the yen and the current account surplus in the early 1980s.

Currency substitution in Japan, Canada, and other countries What about currency substitution in Japan after 1980? It is well known that the Japanese yen has a relatively low status as an international money. This is evidenced by the following facts: according to some data from monetary authorities, only 33% of Japanese exports and 3% of imports were invoiced in the yen in 1984, being substantially lower than the international standard (Krugman(1984; p.270)); the size of Euro-yen deposits has remained minor compared with those of both the

Euro-dollar and the Euro-Deutsche mark, although its relative importance has been gradually increasing.(Hamada-Horiuchi(1987))

Furthermore, foreign currencies and foreign currency deposits held by Japanese people are quite small compared with their holdings of money denominated in yen. Before the Foreign Exchange and Foreign Trade Control Law of 1980, the monetary authorities had very rigorously regulated residents' holdings of deposits denominated in foreign currencies. It was only in 1981 when Japanese people started to hold foreign currency deposits rather freely. According to data from the Ministry of Finance, Japanese residents other than financial intermediaries held US $20.9 billion in March 1986. This was only 1% of the M2 held by them.

It is not surprising that these conditions might have limited substitutability between the yen and other currencies. Even if the substitutability were not negligible, the absolute effect of the substitution might be minor in comparison with the grand scale of asset market adjustments.

In the following, we examine formally the state of currency substitution in Japan, Canada, United Kingdom, and Germany. The main purpose of the investigation is to see whether the difference in the degree of currency substitution corresponds to differences in the volatility of the respective currencies.

Following methods used by Cuddington(1983) and Bordo-Choudhri(1982), we first estimate the most simple version of the closed economy demand functions for money.(Goldfeld(1976)) In the demand function, the domestic money market rate represents an opportunity cost of holding money. Then, an uncovered rate of return on foreign securities and an expected rate of currency appreciation will be added to the simple regression equation in order to evaluate the relative importance of the investors' choice between domestic and foreign financial

assets.

As explained in the previous section, if there is significant currency substitution, people's demand for money will be directly influenced by changes in their expectation of foreign exchange appreciation. The expectation will be significant in the regression of the money demand function. We add the uncovered rate of return on foreign securities to examine whether it directly influences people's demand for money. If this variable has enough significance, foreign securities are most likely to be highly substitutable for domestic ones. (However, the insignificance of the variable in the estimated money demand function would not necessarily mean the lack of 'capital mobility'. More will be discussed about it later.)

It is always a nasty problem of deciding how to formulate expectations of exchange rates. Here, following Cuddington (1983), the forward premium is used as a proxy for the expectations. Specifically, we regard the 3 months forward premium (annual rate) against US dollar x as representing the investors' expectations of domestic currency's appreciation. Thus, the uncovered rate of return on foreign (US) assets in defined by (ius - x), where ius is US treasury bill rate (3 months). If investors were risk neutral, the forward exchange premium would represent an unbiased expectation of the spot exchange rate. Since we do not assume investors' risk neutrality, this procedure may be problematic. However, it is not only convenient, but also not so bad as an approximation.

The results of the regression for Japan and the other three countries over the sample period of 1980I -1986II are summarized in Table 3. Two forms of demand functions are regressed: one is a real money demand function in which real money is derived from deflating nominal money by GNP deflator, and in the other demand function, the dependent variable is the Marshallian k, i,e.,

nominal money divided by nominal GNP.

In the case of the Canadian simple version of demand that includes neither the uncovered rate of return on foreign assets (ius - x) nor the expected rate of appreciation (x), the domestic money market rate i is marginally significant(t = -2.02 or -1.41). However, with x included, the significance of i is substantially reduced and x itself is relatively significant(t = 2.48 or 1.96). When we add (ius - x) to the simple version, almost the same results are obtained, i.e., the domestic interest rate i tends to become insignificant and (ius - x) becomes significant.

These suggest multicollinearity between i and x, or i and (ius - x). However, it is obvious that our regression cannot deny the existence of currency substitution in Canada. This contradicts the results obtained by Cuddington(1983) for the period of 1970III-1979IV. According to Cuddington(1983), while the t-value of i is unaffected by the inclusion of x, the latter variable is insignificant.(We add Cuddington's results to Table 3.) This difference between our results and Cuddington's concerning the Canadian demand for money may suggest that in Canada currency substitution has proceeded after the late 1970s.

On the other hand, it is impossible to find currency substitution in the Japanese demand function for money. The domestic money market rate i keeps its significance regardless of whether either the expected rate of appreciation x or the uncovered expected return (ius - x) is included or not in our regression. For example, the inclusion of x increases the standard error of regression slightly, with x being statistically insignificant (t = 1.23 and 0.22). Meanwhile, i keeps its significance, though marginally (t = 1.72 and 1.51). Thus, the supposed multicollinearity between i and x cannot explain the insig-

nificance of the latter variable. In sum, there is no evidence of currency substitution in the estimate of Japanese demand functions for M2. (The reasonable results could not be obtained from the regression of Japan's M1 demand functions. For example, the domestic interest rate was not significant in the simple M1 demand function of the closed economy.)

This is true of (ius - x) as well. However, the insignificance of the variable does not necessarily mean the lack of capital mobility. It is possible that a slight change in (ius - x) strongly affects investors' choice between domestic and foreign securities and causes a great change in capital flows while it scarcely influences their demand for money.

We cannot obtain stable estimates of the UK demand for real M1. The money market interest rate does not have a significantly negative sign even in the most simple version of the demand function. Instead, the Marshallian k type demand function produces rather plausible results. The money market rate has marginally significant (negative) coefficients. (t = 1.63 or 1.83) At the same time, the expected rate of depreciation of the US dollar has a positive sign, although its significance (t = 1.58) is not very great. Thus, if use a Marshallian k type demand function, we may say that currency substitution can be observed in UK.

The inclusion of the uncovered rate of return (ius - x) into the UK demand function substantially reduces the significance of the domestic interest rate i, while (ius - x) itself is insignificant (t = 0.50). This suggests the existence of multicollinearity between i and (ius - x). When we include (ius - x) in place of the domestic interest rate in the regression, we obtain a significant (negative) coefficient for (ius - x). Thus, in addition to currency substitution, capital mobility seems to have been an influential factor in the

demand for money in the UK economy.

Lastly, we cannot discover any currency substitution in the German demand functions for money. The significance of the domestic interest rate i is rather high in both of the two types of demand function. However, the expected rate of dollar depreciation x is not significant at all (t = 0.43 or 0.14), and its inclusion does not greatly reduce the significance level of i. Even if we replace i with x in our regression, x cannot be significant.

In sum, according to some simple tests, we have observed a rather significant degree of currency substitution in Canada, and also to some degree in the UK. On the other hand, currency substitution (between the US dollar and domestic currency) does not seem to be important in either Japan or Germany. As we have already seen, the currencies of latter two countries have much more volatility than those of former two countries. Therefore, the statistical tests of this section seem to support the relevancy of the arguments in the previous section: that the volatility of a currency should be related to the degree of currency substitution as opposed to capital mobility.

A summary of empirical analyses We can further summarize the investigation of this section in the context of the financial internationalization of Japan. There is a large amount of direct and indirect evidence which indicates the increase in Japanese capital mobility since around 1980. The extraordinarily large surplus of current accounts has been accommodated by Japanese investors' enthusiastic attitudes towards holding securities denominated in foreign currencies, especially the US dollar. There may be some truth in the argument that pressure of capital outflows released by the deregulation accounts for some part of the rapid increase in the current accounts of Japan.

However, we cannot observe currency substitution in Japan. The Japanese demand for money appears to have been independent from changes in both the expected rates of appreciation and expected rates of return on foreign securities. So, the financial internationalization accelerated since 1980 in Japan has been proceeding in the form of not an increase in currency substitution but an increase in capital mobility. As was seen in the previous section, this form tends to intensify the fluctuation in exchange rates.

IV. Concluding Remarks

Financial deregulation during the early 1980s stimulated international capital flows and promoted the global integration of financial markets. (BIS (1986; pp.149-168)) Needless to say, the active capital flows have been essential to international capital markets to accommodate huge I-S imbalances in the major advanced economies.

However, it is not obvious at all what impact the financial internationalization has had on the variability of exchange rates. It is certain that the internationalization of financial markets will expose the economy to disturbances arising in foreign markets. The exposure will add some noise to variations in exchange rates and other financial variables. But, the behavior of agents will also be greatly influenced by the internationalization. In this paper, the influences were represented by the increase in either substitutability between currencies (CS) or substitutability between domestic and foreign securities (CM). We argued, in section II, the issue of how agents' behavior is altered is crucially related to what effects the internationalization has on exchange rate volatility. On one hand, the increase in CS will, ceteris puribus, stabilize the short-run fluctuations of exchange rates, while on the other hand, the increase in CM will tend to amplify them.

By all appearances, the yen exchange rate has shown much more volatility than many major currencies since 1980. Does this have anything to do with the process of the internationalization of Japanese financial markets? This paper gives an affirmative answer. The process of financial internationalization of Japan can be characterized by the increase in 'capital mobility' (CM) rather than by the increase in 'currency substitution' (CS). Thus, according to our

theoretical analysis in section II, the specific process of Japanese internationalization tends to make short-run movements of the exchange rate relatively more volatile.

In my opinion, the lack of currency substitution in Japan reflects the low status of the yen as an international currency. Much more than half of the Japanese exports are invoiced in the US dollar, mainly because Japan has continued to depend heavily on trade with the United States. Only a few percent of Japanese imports are invoiced in yen. This is because the bulk of Japan's imports is in primary products such as materials and energy sources which are mostly invoiced in dollars. Therefore, there seems to be only limited scope for both traders and foreign exchange dealers to choose between the yen and other currencies as a medium of exchange. Under the circumstances, it is not strange at all for us to observe no currency substitution in Japan.

Thus, the lack of currency substitution is connected intimately with the Japanese trade structure, and cannot be changed overnight. For the time being, there will continue to exist those factors which make the Japanese yen relatively more volatile than other currencies such as the Canadian dollar, though we can expect that the increase in capital mobility will gradually make the yen more attractive as a medium of exchange.

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Mathematical Appendix

In this appendix, we present formal proofs of the explanation in Section II.

From (7) and (8), we get the following equation:

$$\begin{vmatrix} Mai & Mbx \\ Mai - Fbr & Fbr \end{vmatrix} \begin{vmatrix} di \\ dx \end{vmatrix} = \begin{vmatrix} dM \\ -dB - Fbrdi* \end{vmatrix}$$

In our model, the monetary policy changes M and B simultaneously, but in the opposite direction. Thus,

$$dM = -dB$$

Therefore, the impact of monetary policy on x can be represented by

$$dx/dM = Fbr/[MaiFbr - Mbx(Mai - Fbr)] < 0.$$

It is quite easy to see that an increase in the absolute value of Mbx(i.e., the increase in CS) will reduce and an increase in the absolute value of Fbr(i.e., the increase in CM) will rise the absolute value of dx/dM.

From the above equation, we can also derive

$$dx/di* = -MaiFbr/[MaiFbr - Mbx(Mai - Fbr)] < 0.$$

An increase in the absolute value of Mbx will reduce the absolute value of dx/di* as well, while the increase in Fbr will make the absolute value of dx/di* greater. The implications of these results are explained in detail in Section II.

Chart 1 : Exchange Rates of the Yen and Canadian Dollar
(1978I - 86II : the period average = 1.00)

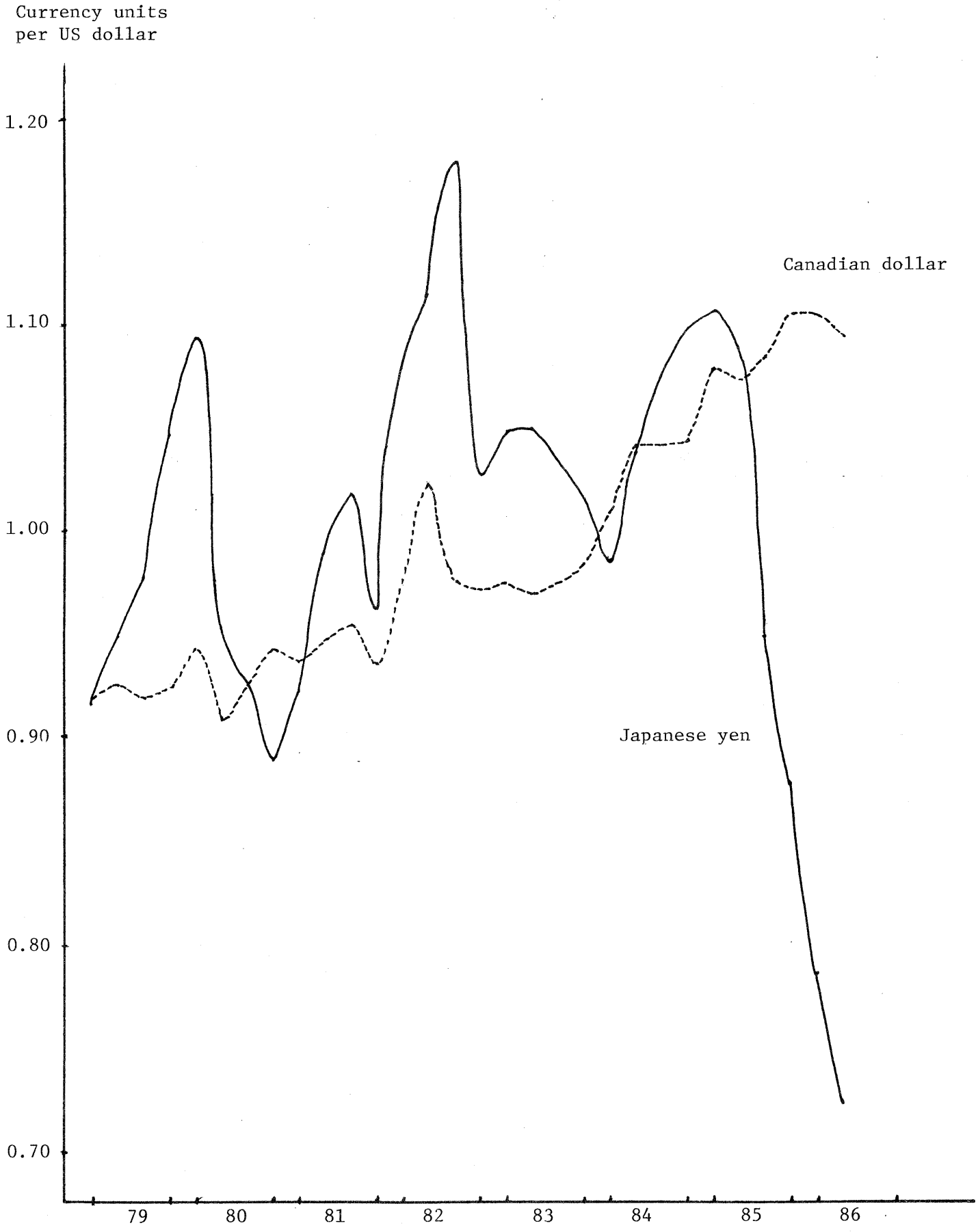
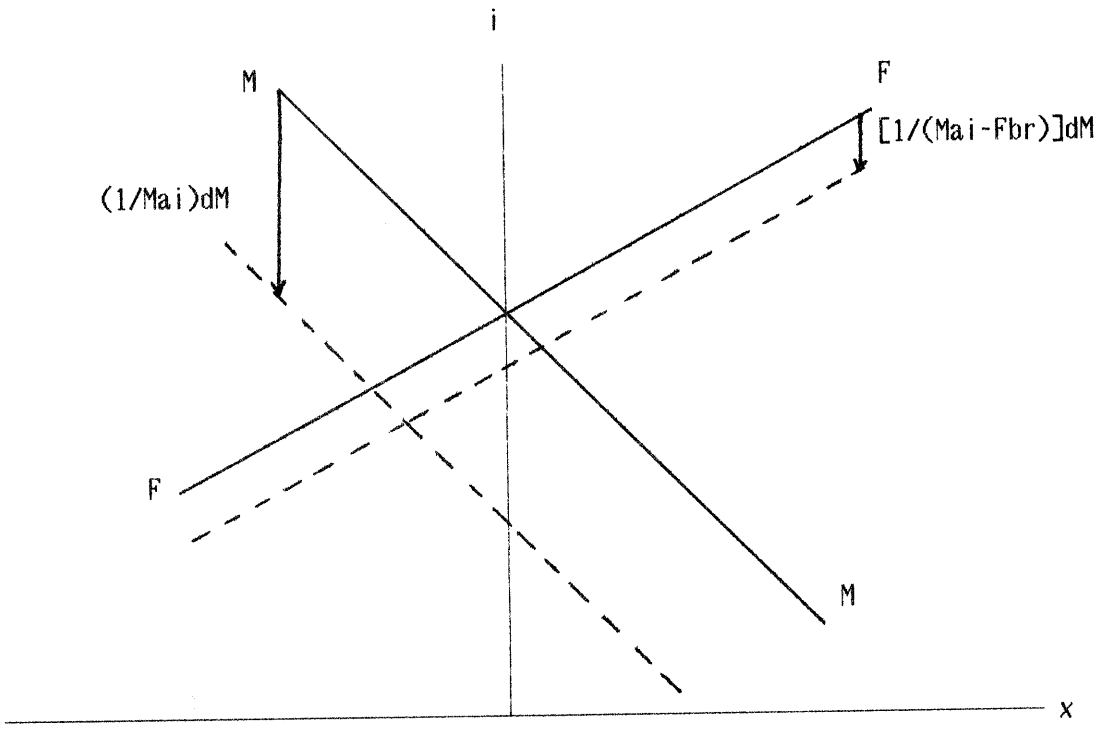
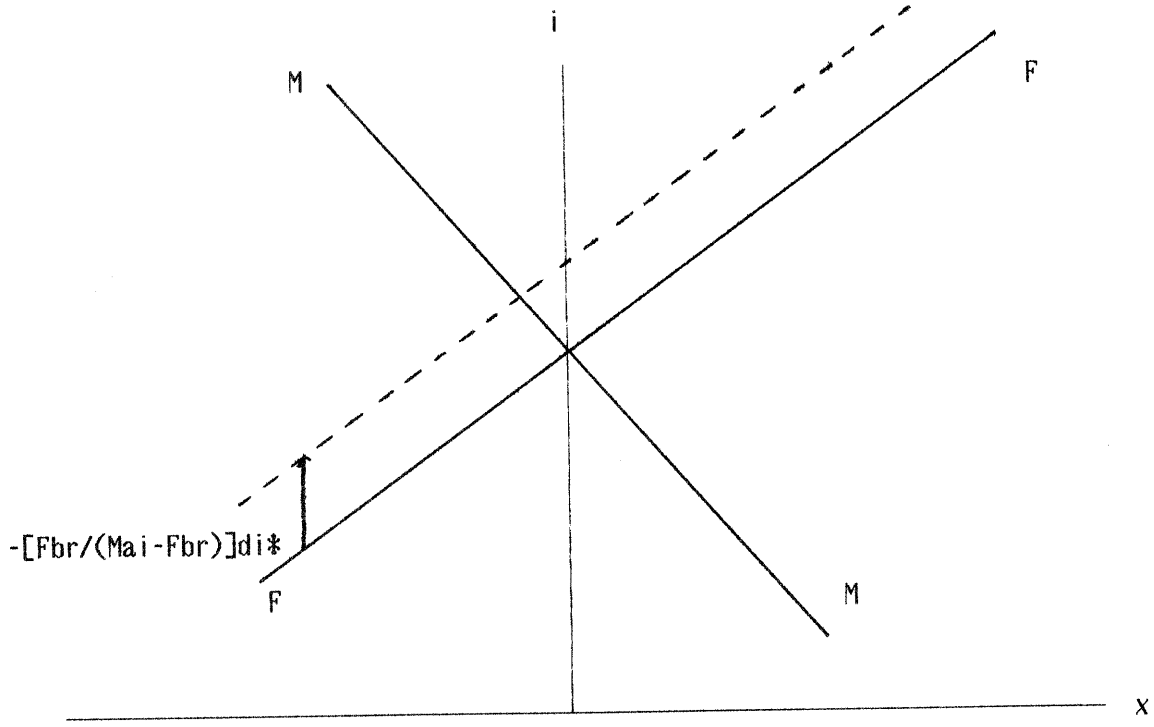


Fig. 1: Equilibrium of the asset markets

(a) The effect of easy money policy



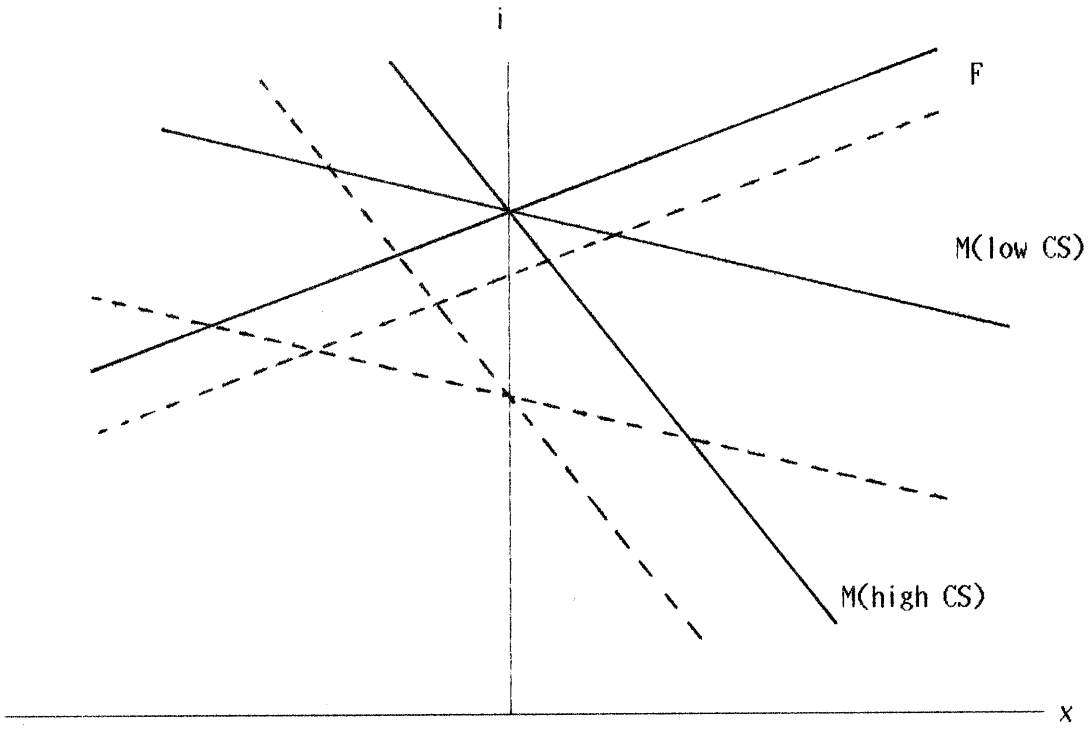
(b) The effect of a rise in the foreign interest rate



i*(1)-i*(0)

Fig. 2: The effect of easy money policy

(a) currency substitution



(b) capital mobility

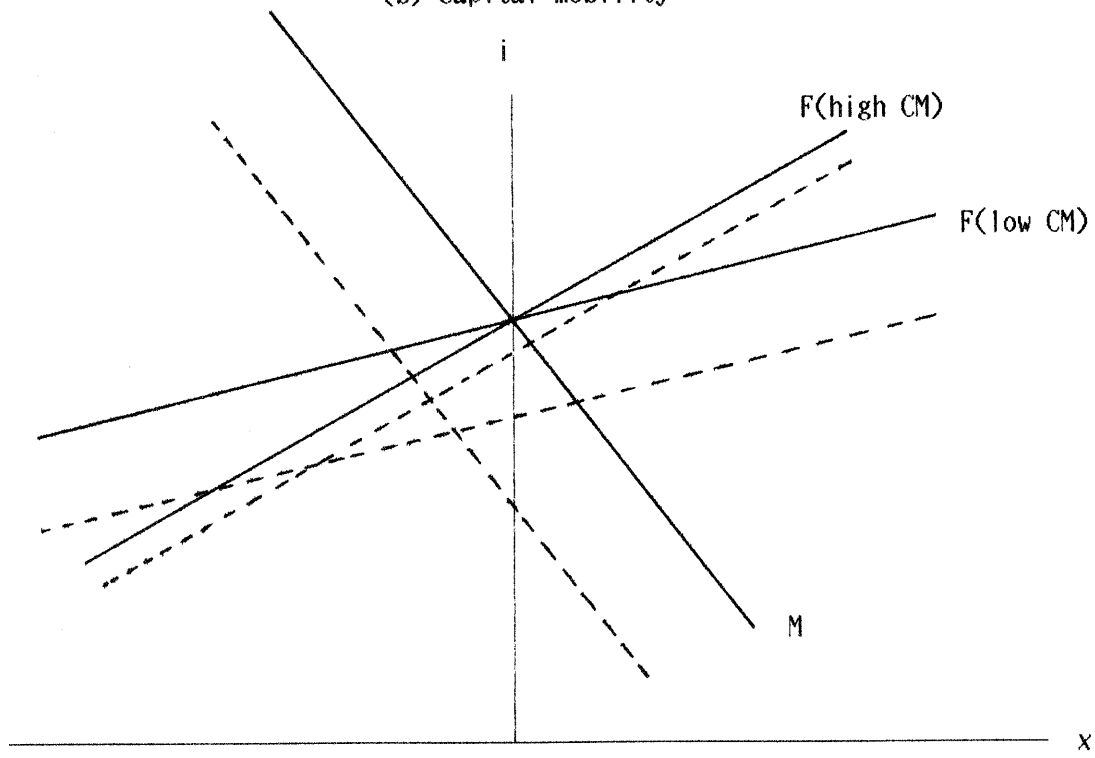
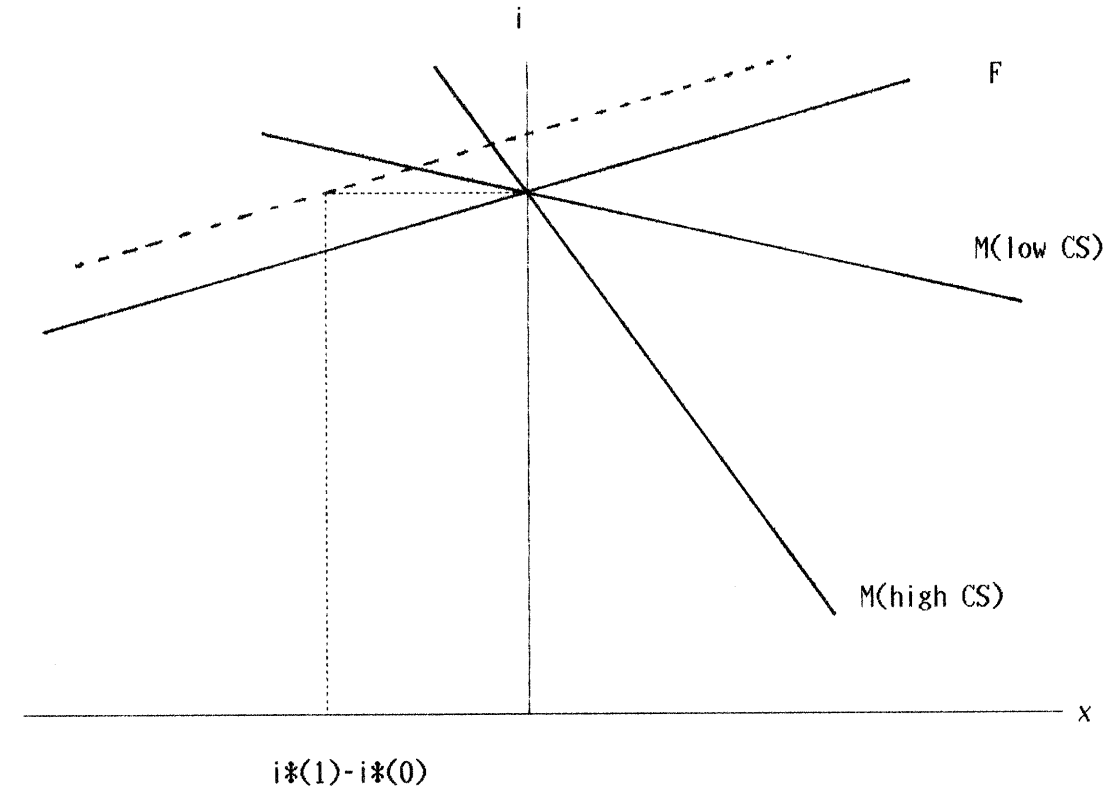


Fig. 3: The effect of a rise in the foreign interest rate



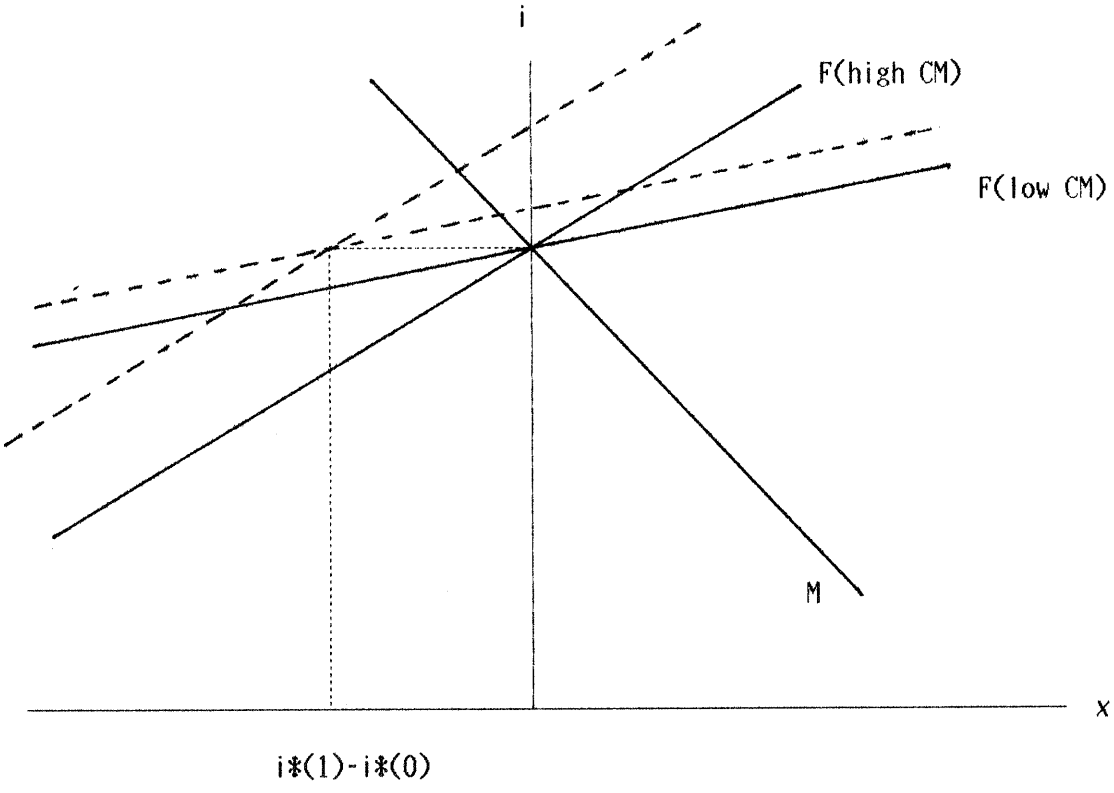


Table 1: Volatility of Exchange Rates: 1980I - 1986II.

Explanatory variables	$m(0)-m(2)$	$g(0) - g(2)$	$i_{us}(0) - i_{us}(2)$	R^2
JAPAN				
Sum of coefficients	0.0400	0.0370	0.0124	0.657
F-value	1.74	0.74	1.81	
CANADA				
Sum of coefficients	0.0002	0.0017	0.0005	0.905
F-value	1.65	0.19	2.47	
UNITED KINGDOM				
Sum of coefficients	0.0209	0.0002	0.0028	0.925
F-value	1.81	0.25	0.36	
GERMANY				
Sum of coefficients	0.0439	0.0136	0.0245	0.865
F-value	2.00	1.41	3.61	

Sources: OECD, Main Economic Indicators, IMF, International Financial Statistics, and Bank of Japan, Economic Statistics Annual.

Table 2: Japanese Residents' Investment in Foreign Securities ($ billions)

	Foreign bonds		Foreign stock	
Year	Sales	Purchases	Sales	Purchases
1978	0.8	9.7	0.3	0.4
1979	14.5	20.0	0.7	1.1
1980	25.7	30.0	1.4	1.1
1981	3.6	9.4	0.7	0.9
1982	10.9	17.0	1.0	1.1
1983	10.4	22.9	1.4	2.1
1984	29.6	56.3	1.5	1.6
1985	237.9	291.4	4.5	5.5

Note: Before 1980, those bonds issued in Japan such as foreign bonds denominated in yen are included in 'foreign bonds' of this table.

Source: Ministry of Finance.

Table 3: The Shares of Nonresidents' Sales and Purchases in Japanese Security Markets (billions of yen and percent)

Fiscal year	Bond markets		Stock market	
	Sales	Purchases	Sales	Purchases
1978	1,106 (2.5)	1,825 (4.0)	1,134 (5.4)	959 (4.5)
79	1,447 (3.0)	1,780 (3.6)	1,038 (4.1)	1,035 (4.1)
80	2,801 (4.8)	3,866 (6.6)	1,813 (7.2)	2,853 (11.2)
81	4,326 (5.3)	5,053 (6.3)	3,830 (11.0)	3,639 (10.4)
82	5,882 (6.1)	7.852 (8.2)	3,051 (10.9)	3,611 (12.6)
83	15.395 (10.8)	16,330 (11.6)	6,525 (15.9)	6,713 (16.2)
84	49,311 (15.1)	50,215 (15.7)	7,705 (15.6)	6.397 (12.9)
85	54,899 (5.5)	56,420 (5.7)	8,808 (13.8)	7,848 (12.2)

Note: Figures in parentheses indicate proportions in the total amount of Sales and Purchases in respective markets.

Source: Nomura Research Institute, and the Bank of Japan.

Table 4: Estimated demand functions for money; Canada(1980I - 1986II)

Depend. varia.	const.	$\ln(M1/P)_{-1}$	i	x	$i_{us} - x$	R^2	DW	SE
ln(M1/P)	0.366	0.896	-0.0037			0.720	2.57	0.0251
	(1.06)	(7.84)	(2.02)					
	0.599	0.818	-0.0025	0.0095		0.771	2.37	0.0227
	(1.75)	(7.18)	(1.43)	(2.48)				
	0.345	0.904	-0.0022		-0.0071	0.725	2.16	0.0249
	(1.00)	(7.96)	(0.42)		(1.18)			

Depend. varia.	const.	$\ln(M1/y)_{-1}$	i	x	$i_{us} - x$	R^2	DW	SE
ln(M1/Y)	-0.013	0.987	-0.0027			0.914	2.49	0.0302
	(0.07)	(14.4)	(1.41)					
	-0.255	0.903	-0.0005	0.011		0.924	2.08	0.0285
	(1.15)	(11.7)	(0.19)	(1.96)				
	-0.038	0.976	0.0096		-0.014	0.926	2.33	0.0282
	(0.21)	(15.3)	(1.05)		(2.12)			

Cuddington's results for Canada's demand for real M1: 1970III-1979IV

const.	$\ln(M1/P)_{-1}$	ln(Y/P)	i	x*	$i_{us} + x^*$	R^2	DW	SE
-1.19	0.87	0.083	-0.65			0.926	2.32	0.0149
(1.93)	(12.8)	(1.86)	(4.20)					
-1.49	0.85	0.11	-0.67	-0.21		0.920	2.39	0.0148
(2.27)	(12.3)	(2.21)	(4.36)	(1.27)				
-1.52	0.85	0.11	-0.39		-0.39	0.918	2.34	0.0149
(2.13)	(11.5)	(2.07)	(1.24)		(0.92)			

M1 = currency plus demand deposits (billions of Canadian dollars, seasonally adjusted)

Y = nominal GDP (billions of Canadian dollars, annual rate seasonally adjusted)

P = GDP deflator, 1980 =100

i = treasury bill rate (3 months)

x = premiums on three-month forward exchange rates (percent per annum based on end-of-period quatation of the Canadian dollar against the US dollar)

(Note) Our regression equations are almost identical to Cuddington's except for the following points : (1) Cuddington uses a 90 day finance company paper rate as a Canadian money market rate whereas we use the three-month TB rate, (2) in Cuddington's regression, forward premiums are defined in terms of Canadian dollars per US dollar, (3) the base year of the deflator is 1970 in Cuddington, while our base year is 1980.

Table 4:(continued) Estimated demand function for money; Japan(1980I - 1986II)

Dep. var.	const.	ln(Y/P)	i	x	i_{us} - x	R^2	DW	SE
ln(M2/P)	-4.61	1.37	-0.0062			0.974	0.91	0.0205
	(5.00)	(18.8)	(1.92)					
	-3.56	1.29	-0.0100	-0.0030		0.932	0.98	0.0318
	(2.15)	(9.91)	(1.72)	(1.23)				
	-4.68	1.37	-0.0075		0.0015	0.978	1.15	0.0174
	(5.95)	(22.2)	(2.27)		(0.68)			

Depend. varia.	const.	$ln(M2/Y)_{-1}$	i	x	i_{us} - x	R^2	DW	SE
ln(M2/Y)	0.0154	0.867	-0.0034			0.943	1.89	0.0101
	(1.85)	(12.1)	(2.09)					
	0.0136	0.884	-0.0030	0.0002		0.947	1.88	0.0103
	(1.17)	(8.40)	(1.51)	(0.22)				
	0.0146	0.869	-0.0027		-0.0006	0.941	1.87	0.0103
	(1.69)	(11.9)	(1.50)		(0.52)			

Table 4 (continued) Estimated demand functions for Money; U.K.(1980I-1986II)

Dep. Var.	const.	$ln(M1/P)_{-1}$	ln(Y/P)	i	x	i_{sr} - x	R^2	DW	SE
ln(M1/P)	-3.06	0.943	0.297	0.0005			0.973	1.68	0.0245
	(3.00)	(17.0)	(2.84)	(0.14)					
	-3.02	0.942	0.297	0.0004	-0.0001		0.951	1.08	0.0329
	(1.99)	(10.5)	(2.10)	(0.08)	(0.22)				
	-3.34	0.944	0.320	0.0031		-0.0024	0.954	1.03	0.0320
	(2.31)	(13.0)	(2.22)	(0.43)		(0.44)			

Dep. var.	const.	$ln(M1/Y)_{-1}$	i	x	i_{us} - x	R^2	DW	SE
ln(M1/Y)	0.036	0.979	-0.0062			0.789	2.25	0.0421
	(0.18)	(9.74)	(1.63)					
	-0.147	0.880	-0.0068	0.0051		0.799	2.52	0.0410
	(0.63)	(7.42)	(1.83)	(1.58)				
	0.059	0.989	-0.0035		-0.0034	0.782	2.17	0.0428
	(0.28)	(9.50)	(0.52)		(0.50)			

Table 4 (continued) Estimated demand functions for money; Germany(1980I - 1986II)

Dep. var.	const.	$\ln(M1/P)_{-1}$	i	x	i_{us} - x	R^2	DW	SE
ln(M1/P)	1.222	0.788	-0.0068			0.925	1.65	0.0143
	(2.69)	(9.70)	(4.49)					
	1.134	0.804	-0.0067	0.0008		0.876	1.01	0.0184
	(1.84)	(7.30)	(3.40)	(0.43)				
	1.064	0.816	-0.0049		-0.0019	0.919	1.54	0.0149
	(2.07)	(8.89)	(1.71)		(0.77)			
Dep. var.	const.	$\ln(M1/Y)_{-1}$	i	x	i_{us} - x	R^2	DW	SE
ln(M1/Y)	-1.073	0.388	-0.0063			0.685	1.76	0.0159
	(4.12)	(2.65)	(3.89)					
	-1.077	0.385	-0.0063	0.0002		0.671	1.77	0.0163
	(4.02)	(2.55)	(3.78)	(0.14)				
	-1.062	0.394	-0.0060		-0.0003	0.671	1.76	0.0163
	(3.78)	(2.50)	(2.07)		(0.12)			

M1 = currency plus demand deposits: £ million for UK and DM billion for Germany (seasonally adjsted)

M2 = M1 plus quasi money: ¥ billions (seasonally adjusted)

Y = nominal GNP : ¥ billions for Japan, £ million for UK, and DM billion for Germany (seasonally adjsted annual rates)

P = GNP deflator, 1980 =100

i = the Gensaki rate of interest (3 months) for Japan, TB rate (91 days) for UK and Call money rate for Germany.

x = premiums on three-month forward exchange rates (percent per annum based on end-of-period quatation of each currency against the US dollar)

ius = US treasury bill rate (3 months)

(sources) OECD, Main Economic Indicators, various issues, IMF, International Financial Statistics, various issues, and Bank of Japan, Economic Statistics Annual, various issues.