ISSUES IN FOREIGN EXCHANGE POLICY IN JAPAN:
STERILIZED INTERVENTION, CURRENCY SUBSTITUTION
AND FINANCIAL LIBERALIZATION

By
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DECLARATION

Except where otherwise indicated
this thesis is my own work.

Colin R. McKenzie

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ABSTRACT

Three important issues for exchange rate management policy in Japan, sterilized intervention, currency substitution and financial liberalization, are discussed in this thesis. The analytic starting point for the analysis of these issues is the open economy portfolio balance model. The empirical importance of these three issues depends on three critical assumptions relating to: the degree of substitution between bonds denominated in different currencies (sterilized intervention); the degree of substitution between monies denominated in different currencies (currency substitution); and the stability of asset demand functions (financial liberalization).

Three methods are used to investigate whether bonds denominated in dollars and yen are perfect substitutes. One method is based on a vector autoregression; the second is based on a demand function for yen-denominated bonds taken from a portfolio model; and the third is based on a ‘market efficiency’ model. For bonds of three-month maturity, the evidence is broadly consistent with the two types of bonds being imperfect substitutes. For bonds of one-month maturity, the evidence is rather ambiguous. Strong support for the portfolio model that suggests sterilized intervention will be effective is not found. Account was taken of the possibility that some of the major Japanese financial liberalizations influenced the degree of substitutability between bonds.

Currency substitution is concerned with the degree to which monies denominated in different currencies are substitutes for one another and are substitutes for bonds in different currencies. Evidence on this will assist in determining the importance of private sector switching between monies denominated in different currencies and switching between money denominated in one currency and bonds denominated in another. The appearance (or non-appearance) of foreign interest rates and the expected rate of change of the exchange rate in the domestic money demand function are two issues that are of importance for currency substitution. Estimates from a number of money demand functions for yen-denominated money suggest that currency substitution is not important for the yen even following a regulatory change in 1980 that might have been expected to increase the possibilities for currency substitution.
Over the past ten years, a great deal of financial liberalization has occurred in Japan. Much of the international pressure for Japanese liberalization has been motivated by a desire to achieve an appreciation of the yen. Some of the general arguments linking liberalization and the value of the yen are evaluated and it is concluded that, in the short-run, an appreciation of the yen is not a necessary consequence of financial liberalization. Some of the arguments suggested that a depreciation of the yen was a likely consequence. A number of recent regulatory changes in Japan are examined to determine what characteristics a regulatory change should incorporate if it is to impact on asset demands and the exchange rate.
ABBREVIATIONS

AR(p)    A p-th order autoregression
BA       Banker's Acceptance
CD       Certificate of Deposit
CIRP     Covered Interest Rate Parity
CP       Commercial Paper
EPA      Economic Planning Agency
GLS      Generalized Least Squares
G5 Countries Group of Five Industrialised Countries - France, Great Britain, Japan, United States of America and West Germany
IV       Instrumental Variable
MA(q)    A q-th order moving average
MMC      Money Market Certificate
OECD     Organization for Economic Co-operation and Development
OLS      Ordinary Least Squares
UCIRP    Uncovered Interest Rate Parity
2S2SLS   Two-Step Two-Stage Least Squares
2S2SLS [H] Two-Step Two-Stage Least Squares allowing for heteroskedasticity
2S2SLS [MA(q)] Two-Step Two-Stage Least Squares allowing for an MA(q) error
2S2SLS [MA(q) H] Two-Step Two-Stage Least Squares allowing for MA(q) and heteroskedastic errors
P.       Tends in probability
D.       Tends in distribution
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CHAPTER 1

EXCHANGE RATE DETERMINATION: THE ROLE OF THE CENTRAL BANK AND THE PRIVATE INVESTOR

The era of floating exchange rates has brought with it substantial movements of nominal and real exchange rates\(^1\). Much of this movement of exchange rates has been attributed to movements of capital between assets denominated in different currencies. These movements of capital can occur when private investors rearrange their portfolio holdings through switching between bonds denominated in different currencies (bond substitution), switching their money holdings between monies denominated in different currencies (currency substitution) or switching between money denominated in one currency and bonds in another\(^2\). This asset substitution may be in response to changes (or expected changes) in economic conditions that lead to an expectation of exchange rate changes, changes in international political conditions that alter investor perceptions about the riskiness of certain currencies or changes in the financial system that lead to one-off portfolio shifts. The ease with which these desired portfolio reallocations can be achieved is very dependent on regulations governing the movements of capital across national boundaries and currencies, and the regulations governing the development of new financial assets.

Governments and central banks have rearranged their portfolio holdings of assets with the aim of influencing exchange rate movements. This portfolio rearrangement, achieved by asset switching similar to the private sector’s asset switching, has been called intervention. The influence that this intervention has on the exchange rate will very much depend on how the intervention is performed. Two principal types of intervention can be identified: sterilized intervention and unsterilized intervention\(^3\). Sterilized intervention is where the monetary authority sells bonds denominated in one currency and purchases bonds denominated in

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\(^1\)Bryant (1980a) and Bergstrand (1983) contain discussions of the degree of exchange rate variability in the floating exchange rate period.

\(^2\)This switching between money and bonds has sometimes also been referred to as currency substitution.

\(^3\)Bryant (1980b, pp.359-365) discusses a number of other types of intervention.
another currency. \textit{Unsterilized intervention} is where the monetary authority buys (sells) money denominated in one currency and sells (buys) bonds denominated in another currency. Both forms of intervention are equivalent to the other form of intervention and an appropriate open market operation. There is an important difference between the two types of intervention. Sterilized intervention leaves the outstanding stocks of money and bonds unchanged but changes the currency composition of the outstanding stock of bonds while unsterilized intervention changes both the outstanding stock of money and bonds. A third though less discussed form of intervention, which McKinnon (1985, p.19) calls \textit{symmetrically unsterilized intervention}, is where the monetary authority buys money denominated in one currency and sells money denominated in another currency. This operation leaves the currency composition of the outstanding stock of bonds unchanged but alters the currency composition of the outstanding stock of money.

In addition to changes in the government’s portfolio holding of assets, capital controls have often been introduced, strengthened, relaxed or eliminated with a view to achieving exchange rate objectives. Typically, capital inflow controls have been strengthened (weakened) and capital outflow controls have been relaxed (strengthened) when a government has sought to encourage a depreciation or discourage an appreciation (encourage an appreciation or discourage a depreciation). Changes in the domestic financial system are usually not made with the aim of influencing the exchange rate but they also have the potential to do so.

The experience with floating exchange rates since 1973 has generated a great deal of uncertainty about how exchange rates behave and as to the theoretical paradigms that best explain nominal and real exchange rate movements. As a result, there is also uncertainty about how and to what extent governments can influence the exchange rate. The effect of the actions of governments or the monetary authorities on important macroeconomic variables is a matter of primary interest and argument in the economics literature. Here the general interest is on how government actions will affect the exchange rate. In particular, we are interested in the channels through which sterilized intervention theoretically affects the exchange rate and in providing some empirical evidence on the existence of these channels. Sterilized intervention is one possible tool the government has to influence the exchange rate, yet there is a deal of scepticism about its effectiveness\footnote{For example, Jurgenson (1983).}. As currency substitution has the potential to undermine government attempts to control the growth of domestic monetary aggregates, the empirical importance of currency...
substitution is also of interest. A further area of interest is the effect of financial innovation and deregulation of the financial system on the exchange rate and its determination. As the three issues, sterilized intervention, currency substitution and financial liberalization are closely interconnected, it is appropriate to deal with them jointly.

The focus of attention in this thesis is the yen/American dollar foreign exchange market. An examination of the yen/dollar rate can serve to highlight the importance of examining government actions in the form of intervention and capital controls, and currency substitution in determining some of the fundamental factors that influence exchange rates. Most intervention by the Bank of Japan is conducted in yen/dollar market and it is yen/dollar rate that has been the centre of attention in the recent trade disputes between the United States and Japan. In addition, capital controls have been used extensively by the Japanese authorities to prevent undesired exchange rate movements. McKinnon (1982) has argued that the yen is one of the major traded currencies that is the subject of a high degree of currency substitution.

The next section discusses a number of issues including the extent of the Bank of Japan's intervention and its potential policy importance; the importance of private investor portfolio behaviour for exchange rate determination and government attempts to influence that behaviour; and the relationship between this study and the existing literature on exchange rates. The concluding section briefly sets out the structure of the thesis.

1.1 Exchange Rates, Intervention and Financial Innovation

Up until 1971, the major Western countries maintained the Bretton Woods system of fixed exchange rates among the major currencies. Countries agreed to let their currencies fluctuate within a tight band around agreed parity rates. Changes in the parity rates were rather infrequent and were subject to institutional constraints under International Monetary Fund notification arrangements. In the case of Japan, throughout the fifties and sixties, the yen's exchange rate against the dollar was maintained at 360 yen to the dollar. Intervention using foreign exchange reserves was often necessary to maintain these fixed rates. Given the adherence to a particular fixed rate, this intervention was not at a country's discretion. The effect of intervention on the domestic money supply was potentially at a country's discretion provided private investors did not attempt to offset the government's

5Hereafter, the yen/American dollar exchange rate is referred to as the yen/dollar rate. Unless otherwise specified, dollar in this thesis denotes American dollar.
actions\textsuperscript{6}. A government could attempt to offset the effect of intervention on the money supply by an open market operation or by some other change in monetary policy. The alarming levels of intervention required to maintain the fixed exchange rates, a perceived lack of domestic monetary independence and the necessity for governments to regain control over their domestic money supplies were among the reasons why the effort to maintain fixed rates was abandoned in March 1973.

Since 1973, the principal advanced Western economies, including Japan, have permitted their exchange rates to float more or less freely in a regime of what might be called almost-floating exchange rates. The description 'almost-floating' is used because there have been times when intervention in the foreign exchange market by some central banks has been extremely heavy and defense of particular values of the exchange rate have been attempted. At other times, intervention has been non-existent or limited to short-term smoothing. Stringent capital controls have at times also been used to prevent some capital flows and moderate exchange rate movements.

The notion of 'almost-floating' is reinforced by the major holdings of foreign exchange reserves that exist in most countries\textsuperscript{7}, despite arguments that official foreign exchange reserves were no longer necessary in a floating exchange rate regime. The Japanese government, through the Bank of Japan, has used its foreign exchange reserves to intervene heavily in the yen/dollar market since 1973. For example, Japanese foreign exchange reserves were $18.1 billion in March 1973 and $26.3 billion in December 1984. During that period, reserves were as high as $33.1 billion in January 1978 and as low as $11.6 billion in January 1974\textsuperscript{8}. Bronte (1982) reports that the Bank of Japan has on occasions bought up to $1.5 billion in a single day and up to $4 billion in a week in order to break a fall of the dollar. Figure 1-1 provides a rough indication of the size of the Bank of Japan's intervention in the foreign exchange market between 1973 and 1984\textsuperscript{9}. As can be

\textsuperscript{6}The literature on the 'offset coefficient' in the fixed exchange rate regime is concerned with the degree of monetary independence that governments actually achieved: see Kouri and Porter (1974), Obstfeld (1982b) and Horne (1983).

\textsuperscript{7}Williamson (1976) and Frenkel (1978).

\textsuperscript{8}Figures are taken from the Bank of Japan's Economic Statistics Monthly and refer to Japan's 'Gold and Foreign Exchange Reserves'.

\textsuperscript{9}These intervention figures are 'rough' because the Bank of Japan does not publish figures on the extent of its intervention so it is necessary to estimate the intervention. Intervention, $I_t$, in Figure 1-1 was calculated as follows: if $RF_{t-3}$ and $FE_t$ denote the three-month Euro-dollar deposit rate and Japan's foreign exchange reserves at time $t$ respectively then $I_t=(FE_t- FE_{t-1})-FE_{t-1}RF_{t-1,3}/1200$. Positive values of $I_t$ indicate dollar purchases and negative values indicate dollar sales.
FIGURE 1-1: INTERVENTION BY THE BANK OF JAPAN
($ BILLION)
seen from the figure the intensity of intervention has varied considerably over the period\(^{10}\). The wide-spread use of intervention by the Bank of Japan suggests that intervention continues to be an important tool of policy in Japan. On the other hand, a policy of non-intervention, completely withdrawing from the foreign exchange market following a period of intervention, has sometimes also been used by the Bank of Japan when it has sought to calm the market\(^{11}\).

A noticeable regularity in the post-1973 experience with floating exchange rates is that intervention by central banks tended to be used to ‘lean against the wind’, that is, to resist exchange rates changes. The Bank of Japan was probably the most consistent practitioner of this policy. For example, Quirk (1977) estimates that over the period March 1973 to October 1976, each one percent monthly movement of the yen/dollar exchange rate was on average accompanied by net intervention of approximately $240 million. The intervention was of the form of buying dollars when the yen rose and selling them when the yen fell. In contrast, Hutchison (1984), using data from March 1973 to November 1981, concluded that the Bank of Japan’s intervention was systematically biased against yen appreciations. That is, an appreciation of the yen/dollar rate was more strongly resisted by intervention on average than was a depreciation.

Intervention will influence the growth of the domestic money supply, unless it is sterilized. Knoester and van Sideren (1985) calculate that changes in the Bank of Japan’s international reserves contributed 54 per cent, 58 per cent and -7 per cent towards the growth of base money in the periods 1970-75, 1975-80 and 1981-1982 respectively\(^ {12}\). The extent to which unsterilized intervention influences money supply growth depends on what actions the central bank implements concurrently with the intervention operation. A simultaneous open market operation can diminish the effect intervention may have on the money supply. Unfortunately, from the published Japanese data, there is no way to determine the extent to which the Bank of Japan’s intervention was sterilized, that is, to what extent the effect intervention would have on the money supply was offset.

Notwithstanding the Bank of Japan’s extensive intervention in the foreign exchange market, in the period March 1973 to December 1984 the value of the yen

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\(^{10}\) A point argued by Argy (1982).

\(^{11}\) Bronte (1982, p.222).

\(^{12}\) For the purpose of these calculations, base money consists of bank reserves and currency held by the public. It should be noted that the estimates are sensitive to the definitions used. Knoester and van Sideren estimate the contributions in the same periods at -45 per cent, 53 per cent and -28 per cent respectively using an alternative definition of base money.
against the dollar has been as low as 305 yen/dollar in December 1974 and as high as 176 yen/dollar in October 1978. In March 1986, the rate is again around the 180 yen/dollar mark despite having been around the 250 yen/dollar mark at times in 1984 and 1985. Day to day movements of the yen/dollar exchange rate of 3-4 yen (about 2 percent) have not been uncommon. These large changes of the nominal exchange rate, especially if they lead to changes in the real exchange rate, can have important effects on the economy.

These exchange rate effects at the micro-, macro- and international levels have generated strong private and public interest in exchange rates and exchange rate movements. It is therefore not surprising that the value of the exchange rate and changes in its value have remained a major focus of government and central bank attention. At the micro-level, for a Japanese company concerned about its yen earnings even small changes of the exchange rate can dramatically affect returns on export contracts, the cost of imported inputs and the cost of repaying borrowings in foreign currencies.

From the national macroeconomic policy making perspective, exchange rate movements have the potential to influence macroeconomic conditions. Currency depreciations can generate inflationary pressures by raising the price of imported goods and, depending on the kind of wage fixation system, domestic wages. The government might seek to use the exchange rate as an anti-inflationary tool of policy or as a tool to affect trade flows. A currency depreciation may be viewed as reflecting a lack of investor confidence in the fiscal and monetary policies a government is pursuing, a situation the government may wish to avoid.

The extent to which exchange rates have been considered in the setting of domestic monetary policy ranges from policies of “benign neglect” to policies which fully take into account expected exchange rate movements. For example, recent changes in the Bank of Japan’s discount rate that were expected to have a stimulatory effect on the economy were delayed because of a fear that they might cause a weakening of the yen. The United States on the other hand has largely adopted a policy of benign neglect towards the exchange rate and this has led to attempts to convince the Federal Reserve to internationalize its approach to money targeting by taking account of exchange rate and international influences.\(^{13}\)

Movements (or lack of movements) of the exchange rate can become a source of international friction. Recently the United States has been suffering a large current account deficit while Japan has had a large current account surplus with

\(^{13}\) For example, McKinnon (1983a, 1983b).
one of the alleged causes of this state of affairs being the value of the yen/dollar exchange rate. Allegations have been made, particularly in the American Congress, that the Bank of Japan has at times, through its intervention policy, been supporting an ‘undervalued yen’. The alleged purpose of this policy was to promote Japanese exports and reduce Japanese imports. Engineering changes in the exchange rate, through intervention or changes in capital controls, may therefore be useful in the management of the political and economic conflicts between the United States and Japan.

With these public and private interests in mind, a central bank may intervene in the foreign exchange market to achieve domestic stabilization and trade policy objectives amongst other things. The central bank may lean against the wind, in the face of short-run fluctuations of the exchange rate to prevent disorderly market conditions or, in the face of longer term movements, the central bank may lean against the wind to influence trend-like appreciations or depreciations. Attempts may be made to offset capital flows that result from what are believed to be unstable exchange rate expectations. Rather than attempt to slow down exchange rate adjustments, the central bank may use intervention to speed up these adjustments. In September 1985, the G5 central banks\textsuperscript{14} came to a view that certain exchange rates were over-(under-)valued. Intervention in the foreign exchange market at this time could have been used as a direct means to influence the exchange rate or as a signal to the private sector that the exchange rates were misaligned. The intervention ‘signal’ may have indicated a preparedness on the part of the central banks to use other policy measures, like the manipulation of short-term interest rates, to move the exchange rates in the desired directions and by the desired magnitudes.

An issue that is conceptually distinct from the intervention objective is the effectiveness of the intervention. Effectiveness here refers to the ability of intervention to affect the exchange rate. The expected effectiveness of intervention to alter the exchange rate could also be expected to be a factor influencing the decision to intervene and, the extent and method of the intervention. A government may intervene in order to give the appearance of being seen to be doing something about a problem even when it believes the policy is likely to be ineffective.

The private sector and foreign central banks can both play important roles in influencing the effect of intervention. Consider the reaction of the private sector

\textsuperscript{14}France, Great Britain, Japan, the United States and West Germany constitute the G5 countries.
when an agreement is reached among the major central banks that the yen is undervalued and that a rate of 210 yen/dollar is more appropriate than a rate of 240 yen/dollar. This agreement together with supporting intervention may lead private investors to believe that an appreciation of the yen is an almost sure one way bet. To obtain the capital gains resulting from the expected appreciation of the yen, the private sector investors will seek to acquire yen assets and sell assets denominated in other currencies. These actions by private sector agents could be expected to reinforce the appreciation tendencies that the central banks sought to bring about by intervention. Where the private sector believes intervention is against market trends, it may step up its capital movements in a way that works against the movement desired by the central bank.

Foreign central bank reaction to the Bank of Japan’s intervention may be either passive or active. In the active case, its reaction could serve to strengthen the intervention by similar intervention or by altering monetary policy in a sympathetic way. Alternatively its reaction could be quite the opposite. These possibilities could be expected to lead to different outcomes. In a two country world, the intervention outcome is the result of intervention policies in both countries. Both countries may be intervening simultaneously or it may be that in the pursuit of other policy targets such as fighting inflation, the effect of domestic intervention may be strengthened or weakened by a foreign country’s policy initiatives. It is to be expected that there will be agreements and disagreements about what the overall intervention stance should be.

The importance of sterilized intervention from a policy perspective is that, if effective, sterilized intervention becomes an additional instrument of monetary policy for the central bank. It would provide the central bank with a means to influence the exchange rate without changing the stock of money. In the sixties, the Bank of Japan relied heavily on movements in the official discount rate, the amount it loaned to banks at the official discount rate and administrative guidance to achieve its monetary policy objectives. It was only in the seventies that the Bank of Japan could use the Bill Discount Market, the Call Market and the long-term bond market to carry out effective open market operations to influence domestic monetary conditions. It is well known that the simultaneous achievement of two policy objectives, like an independent monetary growth rule (or an interest rate target) and

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15 In a multi-currency, multi-country world, third country effects could also be of some importance. For example, intervention in the pound/dollar foreign exchange market has the potential to upset investors’ equilibrium portfolio holdings of yen assets vis-a-vis assets denominated in other currencies. Any changes in the holdings of yen caused by attempts to achieve portfolio equilibrium could lead to movements of the yen/dollar exchange rate.
an exchange rate target, is not possible if only one instrument, say open market operations, is available. In this case, for the sake of attaining monetary growth targets it may be necessary to forsake the achievement of exchange rate targets. The availability of another effective instrument, sterilized intervention, provides a situation of having two instruments (sterilized intervention and open market operations) to attain two goals. Open market operations could be directed to the achievement of the monetary targets and sterilized intervention to the achievement of the exchange rate target.

Evidence on the effectiveness of sterilized intervention provides an indication of the extent to which unsterilized intervention in the foreign exchange market can be considered to be different from an open market operation. If sterilized intervention is an effective instrument, an open market operation will lead to different impacts on the exchange rate and interest rates from unsterilized intervention. But if sterilized intervention is ineffective in that it causes no change in economic variables or expectations, the two policies, unsterilized intervention and an open market operation, do not differ at all in reality.

The effectiveness of sterilized intervention may also have important implications for the effect of private sector portfolio behaviour on the exchange rate. Earlier, bond substitution, private agents switching between bonds denominated in different currencies, was referred to as one of the ways that private agents could cause exchange rate changes. If sterilized intervention is ineffective and the reason for this ineffectiveness is that bonds denominated in different currencies are perfect substitutes then this will also mean that when private sector agents switch the currency denomination of their holdings of bonds there will not be any exchange rate movements.

Another important aspect of private sector portfolio behaviour is the extent to which private sector agents engage in currency substitution, that is shift their holdings of money between domestic and foreign monies. McKinnon (1982, 1983a) has stressed that large exchange rate changes are likely to be one important consequence of a high degree of currency substitution. Currency substitution is likely to be the major form of asset substitution when bonds denominated in different currencies are perfect substitutes.

On the basis of the alleged existence of significant degrees of currency substitution between the major traded currencies, McKinnon (1982) has suggested certain policies for the central banks of Japan, the United States and West Germany. These policies include a recommendation that the three central banks should seek to control the growth of the world money supply rather than the
growth of their individual money stocks. In addition, McKinnon argues that attempts by individual monetary authorities to adopt sterilized intervention policies in foreign exchange markets will not isolate them from international monetary disturbances in the form of currency substitution and that consequently the three central banks should adopt a policy of unsterilized intervention in response to portfolio shifts.

Private sector portfolio behaviour, whether it be bond, currency or another form of asset substitution, because it can cause large exchange rate movements, has created concern in government circles and capital controls have often been applied to inhibit or prevent undesired capital movements. The imposition or removal of impediments to certain capital flows can be viewed as an additional form of policy to affect the exchange rate. These impediments can inhibit private agents attaining their desired portfolios and so slow down (or speed up) exchange rate adjustments. Alternatively, the impediments may alter the view that investors have of assets denominated in different currencies by changing the characteristics of the assets.

Government and government related institutions may also be subject to regulations that restrict their choice and holdings of assets denominated in foreign currencies or issued abroad. The effectiveness of some capital controls is also dependent on the degree of substitutability between bonds denominated in different currencies, suggesting that the link between the effectiveness of sterilized intervention and the effectiveness of capital controls may be very strong.

Proposals have been put forward to limit the incentives for short-run capital mobility, either permanently or on an ad hoc basis\textsuperscript{16}. Some examples of these proposals would be suggestions to tax certain capital flows or to tax all spot conversions of one currency into another. The latter tax on all spot currency conversions would be aimed particularly at short-term financial round-trip excursions with an intention of moderating swings in the major exchange rates. The direction of capital control changes in Japan, with a general trend to liberalization and a lifting of capital controls, has been quite the opposite of these prescriptions.

Changes in the domestic financial structure that result from financial deregulation and innovation can also impact on the exchange rate. For example, the introduction of a more comprehensive deposit insurance system in Japan may lead to greater risk taking by Japanese financial institutions with the result that more of their portfolios is invested in non-yen-denominated assets. New assets, like Certificates of Deposits (introduced in 1979) and Money Market Certificates (1985),

\textsuperscript{16}For example, Tobin (1978) and Bergsten (1982).
have been introduced into the Japanese financial markets and have been attractive to both foreign and domestic investors. Purchases of these new assets by foreigners that lead to an increase in their net holdings of yen assets may influence the yen/dollar exchange rate.

Significant capital control changes and domestic financial deregulation have occurred in Japan since 1973. These changes include the introduction (and subsequent abolition) of a ban on foreign purchases of short- to medium-term Japanese assets, the introduction (and subsequent elimination) of high reserve ratios on additions to yen-denominated bank deposits held by non-residents, the reversal of the principal governing foreign exchange transactions and permitting unrestricted use of foreign-currency deposits with Japanese banks. These type of changes need to be considered when analyzing exchange rate determination.

Changes in capital controls have continued to the point where Japan has virtually eliminated capital controls. However, the Foreign Exchange and Foreign Trade Control Law that came into operation in December 1980 provides for the reintroduction of capital controls in emergency situations. Violent fluctuations in the exchange rate are specified as one situation where the Ministry of Finance is given the authority to reimpose capital controls. The expectation of future capital controls can also act as an inhibition to holding assets likely to be affected by the controls.

Japan stands out as being the one country that has been subject to substantial international public pressure to deregulate its financial system and to remove impediments to capital flows into and out of Japan. One of the arguments used to support this pressure has been that the nature of the Japanese financial system and capital controls leads to an undervalued yen. The suggestion is that capital controls and the financial system have been biased in a particular direction. Implicit in this argument is a view that deregulation of the Japanese financial market and elimination of Japanese capital controls will lead to an appreciation of the yen vis-a-vis other currencies in particular against the American dollar and that this will lead to a partial alleviation of the balance of trade problems between Japan and the United States.

In the time since the major Western countries moved to float their exchange rates, there has been an explosion of economics literature dealing with aspects of exchange rates and their determination. In the recent literature on exchange rate

determination, three major approaches, the monetary approach, the portfolio approach and the balance of payments approach, can be identified. The monetary approach concentrates on the determinants of the demand for money and the reasons for deviations from purchasing power parity\(^{18}\). The portfolio approach examines the determinants of the demand for various assets (money and bonds) and how changes in the demand and supply of these assets cause changes in the exchange rate\(^{19}\). The balance of payments approach focuses on the determinants of the items of the balance of payments like trade flows, capital flows and intervention, and how the exchange rate moves to achieve balance of payments equilibrium\(^{20}\). An important difference between the monetary approach on the one hand and the portfolio and balance of payments approaches on the other is the assumption made about the degree of substitutability between bonds denominated in different currencies. The monetary approach assumes that bonds denominated in different currencies are \textit{perfect} substitutes while the other two approaches assume that they are \textit{imperfect} substitutes. This means that apart from expectations effects, sterilized intervention has no effect on the exchange rate in monetary models.

Many attempts have been made to estimate exchange rate equations on the basis of the three approaches but they have met with varying degrees of success\(^{21}\). In contrast, fewer attempts have been made to test the \textit{assumptions} that underlie the approaches. An examination of the underlying assumptions of the models may provide useful insights into the strengths and weaknesses of each approach, and where financial change might have its strongest effect. An example of where the assumptions of a model and reality diverge is provided by both the monetary and portfolio approaches. For the derivation of reduced form equations for the exchange rate, typical models in the monetary and portfolio moulds assume \textit{static} money demand functions yet for at least ten years in most countries a consensus has existed that suggests that \textit{dynamic} money demand functions are more satisfactory. A second example would be a portfolio model which assumed that only one bond,

\(^{18}\)Frenkel (1976), Mussa (1976) and Bilson (1978) contain details of the flexible-price monetary model while Dornbusch (1976) provides an explanation of the sticky-price monetary model.

\(^{19}\)Girton and Henderson (1977) and Branson (1979) contain derivations of portfolio models in a small country framework.

\(^{20}\)Explanations of this approach can be found in Berner \textit{et al} (1977) and Amano (1980, 1981).

\(^{21}\)Frankel (1984a) provides a recent application and evaluation of the monetary and portfolio models for Canada, France, Japan, the United Kingdom and West Germany.
usually a dollar bond, was internationally traded. For Japan, there is significant investment by Japanese financial institutions in non-dollar foreign-currency bonds. As well, foreigners have important and sizeable holdings of yen-denominated assets. This thesis seeks to provide some evidence with respect to the substitutability of bonds denominated in different currencies, the substitutability of monies denominated in different currencies and the stability of some of the key relationships used to provide this evidence.

Previous exchange rate studies have typically sought to discover the degree to which evidence from a variety of countries and currencies supports a particular theory. An implicit assumption underlying these studies has been that a single theory should work well for different countries and currencies. As a result, potentially relevant institutional arrangements in any one country have tended to be ignored.

It is not only differing institutional arrangements that could be important but also changes in institutional arrangements in any one country that could have affected the extent to which the underlying assumptions of any theory were valid for that country. Rather than take many countries and one theory, here we focus on Japan and on one exchange rate, the yen/dollar rate. By doing so it is possible to take account of relevant administrative and legal changes that have occurred in Japan since 1973. Relevant changes in the regulatory structure in the United States will also be considered.

Much of the evidence in the thesis is provided by econometric techniques and these techniques presume a degree of stability in the underlying relationships being estimated. Given the many changes that have occurred in the Japanese financial system and regulations governing capital flows into and out of Japan, it is essential to investigate whether the estimated relationships have been stable over time. Investigations of stability are lacking in many of the previous exchange rate studies. While econometric techniques are used in the thesis to investigate the effects of structural change, it is recognized that these techniques will not be successful in detecting structural change in all cases. Hence it is necessary to discuss the effect of changes in qualitative terms as well as to provide a more comprehensive model for analyzing foreign exchange markets and exchange rate policy.
1.2 Structure of the Thesis

Chapter 2 uses a portfolio model to discuss aspects of sterilized intervention, currency substitution, and the potential impact of changes in the financial system. The major theoretical avenues and channels through which sterilized intervention is presumed to operate, principally involving private sector agents reshuffling their holdings of assets in their portfolios in response to sterilized intervention and the effect intervention may have on expectations about future exchange rates and future monetary policies are discussed and illustrated. The discussion also highlights the importance of taking account of the potential effects of financial reform on asset substitutability, on the speed of portfolio adjustment and on investor sensitivity to interest rates. Previous empirical studies of the effectiveness of intervention are also reviewed providing the context for the empirical work in Chapters 3-4. In the discussion of sterilized intervention, bond demand functions are the focus of attention. For currency substitution, it is money demand functions that are of interest and whether foreign interest rate or exchange rate expectations variables appear in these demand functions.

A critical question arising in Chapter 2 concerns the degree of substitutability between bonds denominated in different currencies: are bonds denominated in different currencies perfect substitutes or not? In a nutshell, are bonds just bonds? This is an important issue because it largely determines the effectiveness of sterilized intervention, whether bond substitution by private agents will be an important influence on the exchange rate and the effectiveness of some capital controls.

Perfect substitutability of bonds denominated in different currencies requires that the expected rates of return on the different bonds be equalised. One method of examining differences in expected rates of return is to model the stochastic behaviour of the exchange rate and interest rates using the vector autoregression technique. The hypothesis that expected rates of return on bonds denominated in different currencies are equal imposes certain testable restrictions on the coefficients of the vector autoregression. When there is imperfect asset substitutability, it is expected that the restrictions on the coefficients of the vector autoregression will be rejected. In Chapter 3, a vector autoregression using the yen/dollar exchange rate and interest rates on yen-denominated and foreign-currency denominated bonds is estimated and some evidence against the restrictions implied by perfect substitution is found. However, in the model developed there are a number of possible explanations for these rejections. Some explanations are

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22 Expected rates of return for foreign bonds include their nominal interest rate as well as the gains or losses arising from expected exchange rate changes.
consistent with the hypothesis that the monetary authorities are able to use sterilized intervention effectively and others are not.

An alternative method of examining differences in expected rates of return is developed in Chapter 4. This method uses a model which has imperfect bond substitutability and perfect bond substitutability as special cases. The focal question then becomes whether there is any systematic behaviour in the difference in the expected returns on bonds denominated in different currencies and whether this systematic behaviour can be related to variables over which the monetary authorities have some control. The model is estimated using American and Japanese financial data. The results from this model are also contrasted with the results based on a ‘market-efficiency’ model. These results provide some evidence supporting the view that bonds denominated in yen and dollars are imperfect substitutes.

Chapter 5 concentrates on estimating demand for money functions in Japan in the context of investigating the importance of currency substitution. The investigation centres on determining the appropriate specification of the resident demand for yen-denominated deposits. The extent to which foreign variables, like the foreign interest rate and the expected change of the exchange rate, play a significant role in determining the demand for money in Japan is fundamental to the empirical importance of currency substitution. Indirect evidence on this issue is also provided by the stability of the money demand equations.

Recently, substantial financial deregulation has occurred in Japan. Some of the deregulation relates to capital flows and some to the domestic money markets. While similar deregulation has occurred in other countries, the general focus of attention has been on its impact on definitions of monetary aggregates and the controllability of the money supply. Very little attention seems to have been given to the relevance of these changes for exchange rate determination and their potential effect on the exchange rate. To understand the importance of these changes it is necessary to describe the workings of the Japanese financial system. A quantitative assessment of a number of these changes using econometric methods is rather difficult given their recent nature, the lack of available data and the lack of power of econometric techniques to detect structural changes. In building the econometric models in Chapters 3-5, it was necessary to take account of some of the major structural changes that have occurred in the period 1973-84. This evidence is drawn on in Chapters 6 and 7 to suggest what the important changes have been and how they have affected the exchange rate. Chapter 6 focuses on the general arguments linking financial liberalization and the value of the yen while Chapter 7 attempts a qualitative analysis, that is, an assessment on the basis of economic theory, of some
of the recent changes is made. This study suggests some of the important characteristics of regulatory change that will be needed for a change to have an impact on the exchange rate.

Much of the evidence presented in this thesis is econometric in nature. Chapter 8 provides a discussion of some the new techniques that were developed as an aid to interpreting the data.

Chapter 9 contains concluding remarks regarding what can be said about the various channels through which asset substitution operates, the effectiveness of sterilized intervention and the effect of financial change on the yen/dollar exchange rate. In addition, the generalisations that might follow from this study of the yen/dollar exchange market are set out. The policy implications of this research and further avenues for research are also discussed.
CHAPTER 2

THE PORTFOLIO APPROACH TO EXCHANGE RATE DETERMINATION

Much of the recent work on macroeconomic theory for open economies has utilised a portfolio balance approach. The essence of this approach is that equilibrium in financial markets occurs when the stocks of national monies and other financial assets are equal to the stock demands for these assets based on current wealth. Financial variables like the nominal exchange rate and nominal interest rates are assumed to adjust to ensure that this asset equilibrium is achieved.

Portfolio models have been used by a number of authors to explain various aspects of Japanese interest rate behaviour and movements of the yen/dollar rate. One of these authors, Danker (1983), has even estimated a structural open economy portfolio model to explain simultaneously interest rate and exchange rate movements.

In a two country model, the relevant agents for portfolio balance models are usually the public and private sectors in each country. Depending on the purpose at hand, further disaggregation of the private sector into the financial and non-financial private sectors could be useful. The reason for this disaggregation is that since the agents typically differ in the assets they can hold and the legal constraints they face, it is likely that there will be differences in their portfolio behaviour.

As the stock of money and bonds in private hands is government determined and presumed to be exogenously given in most models, the fundamental core of portfolio balance models are the asset demand functions. The theoretical basis of these asset demand functions are the theories of portfolio selection and money demand, although some attempts have been made to derive asset demands from explicit utility maximizing behaviour. Typical arguments of the asset demand functions have been the rates of return on the own asset and competing assets, a

\[1^{1}\text{For example, Tobin (1980), Allen and Kenen (1983), Branson and Henderson (1985) and Frenkel and Mussa (1985).}\]

transaction variable and wealth. Investor wealth is assumed to include their holdings of securities issued by the government. Strict gross substitution is usually assumed so that when the rate of return on one asset rises, the demand for other assets are expected to fall.

Although the degree to which assets are disaggregated depends on the purpose at hand, they usually include at least home and foreign money, and home and foreign bonds. A separate, distinct and well-defined demand function is presumed to exist for each of these assets so that in a deterministic model, at any two points of time if the same rates of return, wealth and other variables were observed, the demands would be the same. The assets are a priori assumed to be substitutable for one another but the substitutability is assumed to be less than perfect.

For sterilized intervention to be effective, the assumption of imperfect substitutability of bonds denominated in different currencies is critical. Two other relevant assumptions are that investor wealth includes government issued securities and that sterilized intervention can influence expectations of variables. These three assumptions are discussed in 2.1. Japanese evidence on these issues is also reviewed. Extreme versions of the currency substitution hypothesis suggest that a separate and distinct demand for domestic money does not exist. Less extreme interpretations suggest that the traditional empirical specifications of the money demand function are incorrect and that these specifications need to be augmented by certain variables. Section 2.2 provides a brief discussion of these issues. The stability of the asset demand functions is a general presumption of portfolio models. In the face of major regulatory changes this assumption of stability is highly suspect. In section 2.3, the potential impact of regulatory changes on bond substitutability, currency substitution and the exchange rate generally are discussed.

2.1 Effectiveness of Sterilized Intervention

Arguments concerning the effectiveness of sterilized intervention usually focus on the degree of substitutability between bonds denominated in different currencies. In particular, whether these bonds are perfect substitutes. However there are circumstances where perfect substitutability between bonds denominated in different currencies is neither a necessary nor a sufficient condition for sterilized intervention to be effective. It is not a necessary condition if sterilized intervention policy can alter the exchange rate through expectational effects even when bonds denominated

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3 The domestic currency is presumed to be the yen and the foreign currency is presumed to be the dollar.
in different currencies are perfect substitutes\(^4\). It is not sufficient if, even when the two types of bonds are imperfect substitutes, private investors regard the claims and obligations of the government as their own\(^5\). This relates to the extent to which investors realise that a current increase in the outstanding stock of government bonds will lead to higher taxes in the future to repay these bonds and investors make their current plans based on the realization that the present value of their future tax liabilities has increased. Each of these issues: the importance of the degree of substitution between bonds denominated in different currencies; the informational content and impact on expectations of sterilized intervention and the extent to which outstanding government bonds are net worth are examined in turn.

**Substitutability of Bonds**

One of the assumptions of the portfolio approach was that 'well-defined' asset demands exist. Two bonds, yen-denominated bonds and dollar-denominated bonds, were distinguished. Portfolio models would presume that the two bonds are imperfect substitutes. For the effectiveness of sterilized intervention, one of the important questions is for what bonds do well-defined demands exist? Are there well-defined demands for say bonds denominated in each currency or is there only one well-defined demand for all bonds taken together? Well-defined demands for each type of bond are consistent with bonds denominated in different currencies being imperfect substitutes - so that even when the expected rates of return on the bonds denominated in the different currencies are equal there is likely to be an investor preference for one of them. A well-defined demand function for all bonds taken together but no well-defined demand functions for each type of bond is consistent with bonds denominated in different currencies being perfect substitutes - so that when the expected rates of return on the different bonds are equal, an investor is indifferent as to the bond he holds.

Portfolio theory suggests that existing stocks of assets denominated in different currencies will be willingly held if, given existing expected yields, wealth holders see no incentive to switch out of one asset or currency into another after balancing the return, risk and liquidity of the assets. When bonds denominated in different currencies are imperfect substitutes, it is possible that sterilized intervention matters because it alters the currency composition of the stock of bonds outstanding and that the changes in asset stocks would produce new holdings of stocks that would

\(^4\)Mussa (1981).

\(^5\)Obstfeld (1982a).
not be willingly held by private wealth holders at existing asset prices and wealth. Wealth holders would then proceed to buy or sell assets in order to achieve their desired level of holdings of stocks of the assets. This asset reshuffling has the potential to alter asset prices, that is, interest rates and exchange rates. This portfolio reshuffling argument forms the standard argument for why sterilized intervention matters.

An alternative possibility is that bonds denominated in different currencies are perfect substitutes which implies that investors are indifferent between holding a bond denominated in one currency and a bond denominated in another currency. In this case the new stock levels produced by sterilized intervention do not disturb asset equilibrium since investors are concerned with the total stock of bonds and not its currency composition. Since no portfolio reshuffling is induced, there is no need for any changes to interest rates or the exchange rate.

The preceding argument has focused attention on the importance of knowing something about the degree of substitutability of bonds and this motivates attempts to try to discover something about this substitutability. A number of studies have investigated the substitutability issue directly and some others provide direct or indirect evidence on the effect of sterilized intervention. The evidence of these studies is reviewed with a particular emphasis on the results that have been found for Japan.

The presence of nondiversifiable exchange risk could be a major reason for imperfect substitutability of bonds denominated in different currencies. An indication of the presence of imperfect substitutability is a deviation of the n-period forward exchange rate at time $t$ from the expected future spot rate at time $t+n$ where the expectations are formed at time $t$. Given that the expected future spot rate is unobservable, to test for this deviation it is always necessary to make some assumption about the formation of exchange rate expectations. It is usually assumed that exchange rate expectations are formed rationally. This implies that a test for the existence of a deviation between the two exchange rates is really testing a joint hypothesis that bonds denominated in different currencies are perfect substitutes and that expectations are formed rationally.

Under that joint hypothesis, the ex-post return (or risk premium) defined as the difference between the realized spot rate at time $t+n$ and the n-period forward rate at time $t$ on maturing contracts should be unrelated to any information available at the time the forward contract was made (time $t$). Alternatively, in the

\footnote{Frankel (1979).}
regression of the realized spot rate at time \( t+n \) on a constant, the \( n \)-period forward rate at time \( t \) and other information available at time \( t \), the only statistically significant parameter should be the forward rate and it should have a coefficient of unity. In estimation or the computation of the standard errors allowance must often be made for the possibility that the assumption of rational expectations will introduce a serially correlated disturbance even if the joint hypothesis is true\(^7\). Two types of testing procedures, that will be referred to as ‘single currency’ tests and ‘multi-currency’ tests, need to be distinguished. The single currency tests are concerned with whether information on that currency only like any lagged values of the risk premium available at the time the forward contract was made can explain movements of the risk premium. The multi-currency tests are conducted using information on any currency, for example, lagged risk premiums from other bilateral rates.

Recent studies using a variety of forward contract lengths, sampling periods and observation periods, and either single or multi-currency tests have found evidence for Japan that favour the rejection of the hypothesis that there is no systematic deviation between the realised spot rate at time \( t+n \) and the \( n \)-period forward rate at time \( t \). This suggests information available at time \( t \) is helpful in explaining fluctuations in the future spot rate\(^8\). In some studies, allowance was made for the possibility that the equation’s error might be heteroskedastic\(^9\). A problem in the interpretation of these rejections is that they can be used as evidence consistent with expectations not being formed rationally and/or as evidence consistent with the hypothesis that bonds denominated in different currencies are imperfect substitutes.

Even when a rejection is interpreted as evidence in favour of a variable risk premium and imperfect substitutability, it does not necessarily imply that the monetary authorities can alter the risk premium and so affect the exchange rate with intervention operations. This is because the variables that are found to have significant explanatory power, like the lagged risk premiums are not variables over which the monetary authorities have direct control like the stock of domestic currency or outstanding stock of foreign-currency bonds or the central bank discount.

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\(^7\)This occurs when the forecasting period is longer than the measurement period, that is \( n > 1 \): see Hansen and Hodrick (1980).


rate. These policy variables are not usually included in the equations estimated in these studies.

The alternative procedure is to test the substitutability hypothesis by using the ex-post return (or risk premium) defined as the difference between expected returns on the two bonds. The portfolio balance model implies that the outstanding stocks of 'outside' assets denominated in each currency as well as the distribution of wealth and the portfolio preferences of the residents of the two countries could be important explanatory variables of this ex-post return. Estimating equations are obtained by solving asset demand functions for the risk premium and then assuming exchange rate expectations are static or are formed rationally. Evidence from this approach has failed to find any significant relationship of the hypothesised type for Japan\(^\text{10}\). In Frankel's (1982) study, a system of five equations were jointly estimated with the ex-post returns for five different currencies (including the yen) vis-a-vis the American dollar as the dependent variables and the shares of wealth allocated to different currency bonds and the shares of production in each country that is allocated to consumption as the explanatory variables. In Danker et al's (1985) study, two different equations were estimated for Japan, one based on domestic demands for yen denominated bonds that included only domestic variables like the Bank of Japan's discount rate, rate of interest on yen time deposits, real stock of yen bonds in Japanese private sector hands, Japanese private sector wealth and the real disposable funds of the Japanese financial sector, and the other based on foreign demands for yen denominated bonds included only foreign variables, the real stock of yen bonds in foreign hands and real foreign wealth. For Japan, when expectations were assumed to be formed rationally, the null hypothesis that these variables jointly or individually had no explanatory power could not be rejected. When expectations were assumed to be static, the hypothesis that the variables had no explanatory power could be rejected.

For Germany, Danker et al (1985) found that there was evidence to favour a rejection of the joint hypothesis that bonds denominated in different currencies are perfect substitutes and that exchange rate expectations are formed rationally although the support for the portfolio balance model was mixed. These results are a little puzzling given an a priori expectation that the substitutability between dollar bonds and mark bonds would be higher than that between dollar bonds and yen bonds\(^\text{11}\). This expectation suggests that if mark and dollar bonds are found to be imperfect substitutes, a fortiori, yen and dollar bonds should be too.

\(^{10}\) Frankel (1982) and Danker et al (1985).

There are some situations where the tests based on deviations between spot rates and forward rates and those based on differences of expected returns are testing equivalent hypotheses. All the studies cited appear to presume that these conditions are satisfied for Japan.

It should be stressed that although substantial changes occurred in Japan’s capital controls over the estimation periods used in these studies, the effect these changes could have on the tests and how the changes might alter the interpretation of the outcomes is not usually considered. Ito (1985), who uses a vector autoregression to test the substitution hypothesis, is an exception in that he considers the effect of some capital changes and finds that some significant changes in the test outcomes result. This lack of a consideration of structural change partially reflects the fact that common evidence across countries is often sought without considering any of the important and potentially relevant institutional differences amongst countries.

While the primary motivation for estimating reduced form exchange rate equations is to explain exchange rate movements, these equations can be used to indicate whether variables associated with sterilized intervention, like bond stocks denominated in different currencies, are significant explanators of exchange rate movements. The explanatory power of these models and the extent to which the model’s theoretical predictions are supported empirically provide some indirect evidence on the bond substitution issue. Reduced form exchange rate equations are either derived under the perfect substitutability assumption - the so-called monetary models, or the imperfect substitutability assumption - the so-called portfolio models. In the monetary models, sterilized intervention will not influence the exchange rate unless it affects exchange rate expectations. If monetary models of the exchange rate explained exchange rate movements well the implication might well be drawn that bond stocks or portfolio variables associated with sterilized intervention are unimportant. Since monetary models have performed rather poorly on recent data one certainly could not draw that implication12.

Portfolio models suggest that the exchange rate will depend on not only the supplies of domestic and foreign monies but also on the supplies of domestic and foreign non-monetary bonds. In these estimated exchange rate models, the relative size of the coefficients on the stock of domestic and foreign bonds will indicate the effect of a purchase of foreign bonds for domestic bonds, that is, sterilized intervention. Overall the latest evidence for Japan would seem to provide little

support for the portfolio model in that the signs of the coefficients of some variables suggested by portfolio theory are not always consistent with those observed and the coefficients on the variables are often statistically insignificant\textsuperscript{13}. There is also evidence that the coefficients are structurally unstable\textsuperscript{14}. Thus the reduced form portfolio model provides little evidence to suggest that sterilized intervention is effective in Japan. This would be consistent with the findings for Germany stated in Genberg (1981) and Frankel (1983a).

Danker (1983) estimated a small model of the financial sector that included structural asset demand equations by currency of denomination and by asset holder\textsuperscript{15}. This model when simulated will determine the yen/dollar exchange rate and a domestic interest rate amongst other variables. The Danker study used monthly data over the period February 1974 to December 1980 and so avoided the period following the liberalization of the Japanese foreign exchange law in December 1980. The model was used to simulate transitory sterilized intervention operation of $2 billion to support the yen under the assumption that market participants had perfect foresight. The operation was reversed after six months. The immediate impact on the exchange rate of the sterilized intervention was very dependent on the model’s specification. The sterilized intervention could have an immediate impact of raising the yen/dollar exchange rate by almost ten percent in one case and by just over one percent in another. The difference was due to alternative ways of estimating one of the bond demand functions\textsuperscript{16}. The long run impact of these sterilized intervention operations was, by assumption, zero\textsuperscript{17}.

A consideration of the most recent evidence suggests that only the approaches based on the extent to which the current forward rate deviates systematically from the future spot rate and the small open economy portfolio model have provided evidence that would lend support to the proposition that sterilized intervention in the yen/dollar market could be effective.

\textsuperscript{13}Frankel (1984a) and McDermott and Spivack (1984).

\textsuperscript{14}McDermott and Spivack (1984).

\textsuperscript{15}Obstfeld (1983) is a similar study for Germany.

\textsuperscript{16}The effect of unsterilized intervention was also simulated and the immediate impact of the unsterilized intervention was to raise the exchange rate by about seven percent but again that effect could be significantly affected by altering the model’s specification.

\textsuperscript{17}In contrast, Obstfeld found that unsterilized intervention had a significant impact on the German exchange rate but that sterilized intervention had virtually no impact at all.
Expectations and Policy Announcements

It is now accepted that expectations of future policy can have significant effects on variables of current policy importance. The current value of the exchange rate is determined by current money and asset demand and supply factors and also by the expectations of the path that these variables will take in the future\(^{18}\). Agents' assumptions about the behaviour of exogenous variables, such as the domestic money supply and the domestic discount rate, critically influence the path of the expected exchange rate and hence the actual exchange rate.

Governments may desire to alter those expectations to achieve current (or future) policy targets. A possible avenue of influence is the announcement that a certain policy rule will be followed. For example, a government may announce that a ten per cent money growth rule will be implemented in twelve months time. To the extent that the policy announcement is credible and is believed, the signal of a future change in monetary policy could alter current expectations about the future equilibrium exchange rate. To the extent that the current spot rate is a function of expectations of the future equilibrium spot rate, the current spot rate will also be altered. Other economic variables like the expected rate of inflation may also be affected. When the time comes to implement the announced policy the government may decide to implement an alternative policy. The problem that the private investor faces is that he cannot completely believe government announcements about the future course of policy. As a result, private investors may be reluctant to expose themselves to risk concerning the future conduct of government policy by relying solely on monetary announcements.

Mussa (1981) argues that official intervention provides a partial solution to this moral hazard problem. The government by intervening in the foreign exchange market at the same time as its policy announcement does more than merely provide information about the future course of policy it can provide concrete evidence of its intention to follow that policy course by staking its money in support of the policy. Mussa argues that to the extent that the policy commitment is genuine, there is no reason to be secretive about the fact of intervention and it should be made as transparent as possible. It is not clear whether Mussa is referring to sterilized intervention in this context although Frenkel (1983) and Henderson (1984) interpret Mussa in this way. This interpretation of Mussa is followed here.

This argument would seem to have some substance when intervention is unsterilized or when assets denominated in different currencies are imperfect.

\(^{18}\) Bilson (1979) and Frenkel (1981).
substitutes. When intervention is unsterilized, the intervention will influence the exchange rate, if only because it disturbs money market equilibrium, and can back the policy. However, suppose the central bank does allow a purchase of foreign exchange to increase the domestic money supply in the short run so that monetary growth exceeds it target but the central bank is bound by a previously announced money supply growth in the longer run. If the monetary growth rule is to be maintained, at some time in the future an open market operation will be necessary to achieve this goal, an expectation of such a future event could work to potentially offset the effect of the current intervention. Hence an announced money growth rule can potentially negate the effect of intervention. When intervention is sterilized and assets denominated in different currencies are imperfect substitutes, the earlier arguments suggest it can influence the exchange rate and provide backing for the announced policy.

Suppose bonds denominated in different currencies are perfect substitutes and the government intervenes in the foreign exchange market and sterilizes this intervention, this intervention will have no short-run or long-run effects\(^\text{19}\). If the government makes a policy announcement about future money growth rates and backs the announcement with sterilized intervention, it is difficult to appreciate why agents do not see that the intervention will have no short-run or long-run effects and thus adds nothing to the announcement given. It may be that Mussa's argument was based on a mistaken belief that when foreign and domestic bonds are perfect substitutes, sterilized intervention could be effective in the short-run\(^\text{20}\). The sterilized intervention having no effect is not backing the policy at all.

This argument relating to agents 'seeing through' the intervention relies on agents knowing that the intervention is occurring and that it is being fully sterilized. Typically central banks do not indicate at the time of the intervention that they are intervening nor that the intervention is being sterilized. As intervention by the Bank of Japan is carried out by placing orders through the Bank of Tokyo and the large city banks\(^\text{21}\), information about whether the Bank of Japan is intervening usually quickly filters through to the market. Although the Bank of Japan has never published exact figures on intervention, some indication can be obtained from the monthly changes in the Foreign Exchange Fund Account

\(^{19}\)Kenen (1982).

\(^{20}\)A mistake pointed out by Kenen (1982).

and monthly changes in Japan’s foreign exchange reserves. Daily data can sometimes be obtained from market sources and quotes published by Reuters. For example, Taya (1983) publishes these sort of estimates from October 1977 to December 1979. However, even ex-post there are immense difficulties in determining the extent to which any intervention was sterilized. Hence it is not unreasonable to presume that at the time of the intervention that agents could have been confused about the nature of the intervention, that is, whether it is sterilized or not. Hence some agents may act as if the intervention was sterilized when it was in fact not, or vice versa. Agents acting on these (perhaps mistaken) beliefs could then by their actions alter the exchange rate. There will be an appearance that the government can influence the exchange rate although this influence is based on confusion only. This may give the appearance that sterilized intervention is effective. It is possible that on the basis of the confusion, the exchange rate may not even move in the direction desired by the government. Confusion however does not seem to be a reliable foundation for the implementation of government policy.

The expectations effect of intervention in providing information about future movements of policy instruments has not featured in empirical studies. This is because of the difficulty of specifying the sort of information being provided by the intervention and specifying how it might be interpreted by agents.

*Are Government Bonds Net Worth?*

In portfolio models, the wealth of the private sector is usually assumed to include their holdings of government bonds. There is a deal of theoretical and empirical literature concerning the issue of whether government bonds are net wealth or not and the implications of this for the standard effects of an expansionary fiscal policy on aggregate demand. Typically these papers have investigated this question in a closed economy context and indicated conditions where government bonds are not part of net wealth. This Ricardian argument has been generalised to the open economy situation by Obstfeld (1982a). He suggests that even if bonds denominated in different currencies are imperfect substitutes that sterilized intervention will not be effective if

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22One Japanese government official indicated that one of the Bank of Japan’s aims was to ensure that intervention did not affect the money supply and that he thought the Bank of Japan had been very effective in achieving this objective. Branson (1983) suggests an indication that the Japanese authorities have sought to neutralize the effect of intervention on the money supply is the observed lack of correlations between the M1 innovations and the reserve (or exchange rate) innovations in a vector autoregression model of Japan. For most countries, the published data does not permit a determination of whether intervention was sterilized or unsterilized: Hodgman and Resek (1985).

23For example, Barro (1974).
1. the domestic public fully anticipates and discounts future tax liabilities connected with government debt; and

2. the central bank's foreign exchange assets earn interest that is capitalized by the domestic public.

Obstfeld's argument suggests that the effectiveness of sterilized intervention depends not only on whether securities denominated in different currencies are perfect substitutes but also on the ability/ inability of private agents to see through government transactions.

Suppose the sterilized purchase of foreign exchange entails the purchase of interest-earning foreign assets from the public by the central bank in return for interest bearing domestic assets. This implies a rise in the public's holding of domestic government debt. Taxes in the future can be expected to rise to pay for this government debt so that there will be an equal rise in the net present value of future taxes. If all central bank earnings are returned to and capitalized by the public a change from public to private ownership (or vice versa) of foreign-currency bonds will be unimportant so that this operation will leave asset markets unperturbed. If the public fails to capitalize the relevant income and taxation streams it is possible that sterilized intervention will be effective. The ability of the public to capitalize correctly these income streams must be dependent on the knowledge the public has about the monetary authorities' holdings of foreign exchange reserves, for example the currency composition and maturity structure of foreign exchange reserves. In the case of Japan, this knowledge is certainly incomplete.

Carmichael (1982) provides an indication of the sort of stringent theoretical conditions that are required for the necessary anticipations and capitalizations to occur. One of typical assumptions is notwithstanding their finite life spans that households have infinite time horizons. Given the sort of conditions required for the Ricardian arguments to hold, it would seem to be more a theoretical nicety than of empirical relevance. Ueda (1985) has provided some recent evidence on the validity of this Ricardian proposition for Japan. His results suggest that consumers have very short time horizons and that they pay little attention to the prospect of future tax increases when the current fiscal deficit increases24.

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24The results in Ishikawa and Ueda (1984) also support the view that Japanese consumers are very myopic in their decision making.
2.2 The Substitutability between Money and Foreign Assets

A typical assumption of both monetary and portfolio models of exchange rate determination is that domestic and foreign monies are non-substitutable for one another. A consequence of this assumption is that the rate of return on foreign money does not appear in the domestic money demand function (and the rate of return on domestic money does not appear in the foreign money demand function). One reason for the assumed non-substitutability is an assumption that foreigners do not hold domestic money and domestic residents do not hold foreign money.

A second common assumption is that for domestic residents, domestic money and foreign bonds (and for foreigners, foreign money and domestic bonds) are nonsubstitutable. This implies that the rate of return on foreign bonds does not appear in the domestic money demand function and the rate of return on domestic bonds does not appear in the foreign money demand function.

These assumptions are reflected in the typically estimated money demand functions since the variables included in the functions are limited to domestic factors like domestic income, domestic interest rates and domestic inflation. There have been a small number of attempts to estimate money demand functions incorporating foreign influences.25

The concern with exclusion of foreign variables from the money demand function is not new. One of the points stressed by Brainard and Tobin (1968) was that asset demands should include the rates of return on all relevant assets, with ‘relevant’ being determined by the investment opportunities of the investor. These relevant variables may include the rates of return on foreign money and foreign bonds. The less extreme versions of currency substitution seem to be doing nothing more than stressing the importance of these variables.26 Although one difference between portfolio theory and currency substitution that has been suggested is that domestic money and foreign bonds are likely to appear as complements rather than substitutes.27 There is also the possibility that domestic and foreign money will be complementary.28

Of more fundamental importance is the claim that domestic and foreign monies

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25 For example, Hamburger (1977) for Germany and the United Kingdom; Arango and Nadiri (1981) for Canada, Germany, the United Kingdom and the United States; and Traa (1985) for Canada, Germany, the Netherlands, Switzerland and the United States.


28 Brillembourg and Schadler (1979).
are so highly substitutable that the demand for domestic money is highly unstable\textsuperscript{29}. The claim is made that the demand for world money is stable. This is the opposite extreme of the traditional non-substitutability argument and suggests that it will not be possible to obtain sensible estimates of the demand for domestic money.

Another possibility that has been raised is that significant switching has and will occur between monies denominated in different currencies in response to non-quantifiable political events\textsuperscript{30}. It is argued that these events have occurred sufficiently often and have been of a sufficiently large size that the demand for domestic money has become unstable.

Boughton (1979) would appear to be the only study that investigates these issues for Japan by including a Euro-dollar interest rate and the rate of change of Japan's effective trade-weighted exchange rate. In a study that included both data on the fixed and floating exchange rate periods, neither of these variables were found to be statistically significant.

\section*{2.3 Financial Liberalization and the Stability of Asset Demands}

Econometric models will be used to investigate the degree of substitutability between assets, both money and bonds, denominated in different currencies. An important presumption of the econometric work is that the relationships being estimated are stable, that is, the relevant variables do not change over time, the coefficients are constant and the variances associated with the error in each equation are constant.

An important determinant of the stability of these relationships will be the degree of stability (or change) in the administrative, institutional, legal and political environment within which investors operate. This environment relates not only to the exchange rate regime in operation but includes, for example, the degree of stability and credibility of government policy, the taxation system as it applies to interest income and capital gains income, and the stability of the world economic and political system.

For some countries, the regulatory environment affecting financial markets and international capital transactions has undergone very little change since 1973. While for other countries, major changes have occurred. Japan falls into the latter category as indicated in Appendix B where the important Japanese policy changes from 1973 to 1984 that are likely to impact on capital flows are listed. The elimination of

\textsuperscript{29} McKinnon (1982, 1983a).

\textsuperscript{30} McKinnon (1983a).
capital controls in the United States in 1974, implied that little change in this area was likely and this is reflected in Appendix C which lists the corresponding policy changes in the United States over the period 1973-1984.

There are a number of possible avenues for regulatory changes to affect the effectiveness of sterilized intervention. By changing the characteristics of either yen-denominated bonds or foreign-currency denominated bonds, investor perceptions of their substitutability could change. The elasticity of bond demand functions with respect to interest rate changes or expected changes of the exchange rate could be altered. Tests of the hypothesis that bonds denominated in different currencies are perfect substitutes presume that capital can move freely between domestic and foreign markets. The extent to which arbitrage can occur between domestic and foreign markets is influenced by capital controls and so changes in capital controls may affect the interpretation of these tests of the perfect substitutability hypothesis.

The ability of Japanese agents to engage in currency substitution is potentially influenced by rules governing the acquisition and use of foreign-currency deposits, whether issued by Japanese banks or foreign banks; regulations governing the interest rates payable on foreign-currency deposits and the reserve ratios that are applicable to these deposits. Similarly the ability of non-residents to engage in currency substitution or the extent to which they use non-resident yen deposits with Japanese banks to engage in currency substitution is potentially influenced by the regulations governing the terms and conditions on which Japanese banks can accept these deposits. This type of regulation may determine whether foreign-currency deposits (or yen deposits) are a relevant investment opportunity for the investor.

The type of assets available, their currency of denomination, their interest rates and the quantities of assets issued are just some of the variables over which the Japanese government has exercised control and which potentially affect asset demands. Changes in some of these controls could potentially induce exchange rate effects. For example, changes in the capital inflow/outflow controls; changes in the interest rates payable on time deposits and changes in the tax treatment of interest receipts are three changes that could alter investor holdings of yen-denominated assets as opposed to dollar-denominated assets and therefore alter the exchange rate.

2.4 Conclusion

The analytic starting point in this Chapter was the portfolio approach to exchange rate determination. The Chapter was concerned with developing arguments relating to the effectiveness of sterilized intervention, the potential impact of currency substitution and the possible effect of regulatory changes.
The discussion of the effectiveness of sterilized intervention proceeded by examining the importance of the substitutability between bonds denominated in different currencies, the expectations effects that intervention might induce, and the possibility that a Ricardian proposition with respect to government debt might inhibit the effect of sterilized intervention. Of these issues, the most important would seem to be the degree of bond substitution and this is certainly reflected in the empirical studies. The empirical studies that examined the substitution issue directly suggest that there is a degree of substitution between yen bonds and bonds denominated in foreign currencies but that the government is not likely to be able to employ this substitution to use sterilized intervention effectively. Danker (1983) stands out as a study that suggests sterilized intervention will be effective. The validity of Danker's results on a post-1980 sample that includes regulatory change is questionable. The potential effect of regulatory change has not been investigated in most of these studies.

A number of alternative implications of currency substitution were discussed. These were: that the traditionally estimated money demand functions were misspecified by their exclusion of foreign variables; that it is likely that a the money demand function will exhibit a high degree of instability in the face of economic and political events; or that estimation of a demand for domestic money function is not sensible. There does not appear to be a study of Japanese money demand in the floating exchange rate period that has attempted to investigate these issues nor attempted to assess the impact of regulatory change over the 1970s on the degree of currency substitution that has occurred.

Given the changes that have occurred in the Japanese financial system and the regulations governing capital flows into and out of Japan, testing the stability of any estimated economic relationship will be quite important. There are other independent channels for regulatory change to impact on the exchange rate besides its impact on asset substitutability. For example, regulatory change may influence the exchange rate by altering savings behaviour.
CHAPTER 3
BOND SUBSTITUTION, CAPITAL CONTROLS
AND THE JAPANESE EXPERIENCE

The degree of substitutability between bonds denominated in different currencies was one of the issues identified in Chapter 2 as being important for the effectiveness of sterilized intervention. In the next two chapters, three alternative methods that can be used to investigate this substitutability issue are presented. One method is based on a vector autoregressive model, another is based on ‘market efficiency’ arguments and the third is based on a structural form bond demand equation. These methods are used to investigate the degree of substitutability between short-term (one- and three-month) onshore yen-denominated and offshore dollar-denominated assets.

Although different methods of analysis are used in the two Chapters, there are a number of issues and concepts relevant to the interpretation of the evidence in both Chapters. These common issues relating to the meaning of covered and uncovered interest rate parity and the relevance of deviations from covered interest rate parity for uncovered interest rate parity are discussed in section 3.1. The remaining parts of the Chapter lay out the way a vector autoregressive model can be used to provide evidence on the substitutability issue and apply it to yen and dollar bond data.

3.1 Covered Interest Rate Parity, Uncovered Interest Rate Parity and Capital Controls

If bonds denominated in different currencies are considered by economic agents to be perfect substitutes, investors view the bonds denominated in the different currencies as identical assets and will prefer the bond with the higher expected return. In the absence of restrictions on the use of domestic and foreign money and currency markets, this will lead to a movement of funds from the bonds with low expected returns to those with high expected returns. This resulting movement of funds can be expected to lead to the expected rates of return on the bonds being equalised. In international macroeconomics, this hypothesis goes under the name of
Uncovered interest rate parity (UCIRP) or Fisher hypothesis. Uncovered interest rate parity is a hypothesis that suggests the difference between the interest rates on two bonds denominated in different currencies is equal to the difference between the expected (log) future exchange rate and the current spot (log) exchange rate. For yen and dollar securities, that is:

$$s_{t+n/t} - s_t = n(RJ_{t,n} - RF_{t,n})/100,$$

(3.1)

where $s_{t+n/t}$ is the expectation formed at time $t$ of the log of the yen/dollar exchange rate at time $t+n$, $s_t$ is the log of the yen/dollar exchange rate at time $t$, $RJ_{t,n}$ is the interest rate per period on an $n$-period yen-denominated bond at time $t$, and $RF_{t,n}$ is the interest rate per period on an $n$-period dollar-denominated bond at time $t^4$. As can be seen from (3.1), uncovered interest rate parity is concerned with the relationship between expected rates of return on bonds of identical maturities in different currencies where the "risk" arising from exchange rate changes has not been eliminated. Should bonds denominated in different currencies be imperfect substitutes there is no expectation that the relationship between the interest rates and exchange rates specified in (3.1) will hold. Equation (3.1) contains an unobserved variable in the form of $s_{t+n/t}$, the expected value of the log of the exchange rate, which prevents easy verification of the relationship. In the fixed exchange rate regime, where for most time periods there is little expectation of

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1A number of additional qualifications that relate to the taxing of domestic and foreign sourced income, the taxing of interest and other income and the maturity of the assets are required.

2The hypothesis is sometimes stated in terms of the interest rates in two countries. However the hypothesis is concerned with the currency of denomination not the location of issue, although often these two concepts will be equivalent.

3If 1 yen of an $n$-period domestic bond is purchased then after $n$ periods there will be $(1+RJ_{t,n}/100)^n$ yen while if the 1 yen is invested in an $n$-period dollar bond after $n$ periods this will realise $(1+RF_{t,n}/100)^n(S_{t+n/t}/S_t)$ yen where $S_t$ is the yen/dollar rate and $S_{t+n/t}$ is the expected value of the exchange rate at time $t+n$ formed at time $t$. Taking logs of these two quantities gives $n\log(1+RJ_{t,n}/100)$ and $n\log(1+RF_{t,n}/100) + \log(S_{t+n/t}/S_t)$. For small $x$, $\log(1+x) \approx x$ so that the two quantities can be written as $nRJ_{t,n}/100$ and $(nRF_{t,n}/100) + \log S_{t+n/t}/\log S_t$. Equating these two quantities gives:

$$n(RJ_{t,n} - RF_{t,n})/100 = \log S_{t+n/t}/\log S_t$$

$$s_{t+n/t} - s_t = n(RJ_{t,n} - RF_{t,n})/100.$$ 

The last line assumes that $\log S_{t+n/t}$ (the expectation of the log of the exchange rate) is a good approximation for $\log S_{t+n/t}$ (the log of the expected value of the exchange rate) even though for any function $f$ and a random variable $X$, $E(f(X)) \neq f(E(X))$. Although this a mathematical inconvenience, the magnitude of the difference does not seem to be a matter of economic or empirical significance: Siegel (1972).

4Both interest rates are measured in percentage terms.
an exchange rate change, the hypothesis suggests that interest rates on bonds of identical maturity denominated in different currencies will be equalised.

Uncovered interest rate parity needs to be contrasted with another important arbitrage condition in international macroeconomics, covered interest rate parity. Covered interest rate parity (CIRP) is a hypothesis that the current difference between the interest rate on two bonds denominated in different currencies is equal to the difference between the forward (log) exchange rate and the current spot (log) spot rate. That is:

\[
f_{t,n} - s_t = n(R_{t,n} - RF_{t,n})/100,
\]

where \( f_{t,n} \) is the log of the n-period forward exchange rate at time t. As can be seen from (3.2), covered interest rate parity is concerned with the relationship between rates of return on bonds of identical maturities denominated in different currencies where the "risk" arising from exchange rate changes has been eliminated by appropriate transactions in the forward exchange market.

Uncovered and covered interest rate parity are two arbitrage conditions that often form the basis of the theoretical models used in the exchange rate and international macroeconomics literature. The combination of covered interest rate parity and uncovered interest rate parity imply that that the n-period forward rate will be an unbiased predictor for the spot rate n periods ahead. The extent to which the n-period forward rate is an unbiased predictor for the spot rate n periods ahead has formed the basis of one of the methods to test for the extent to which uncovered interest rate parity holds. This method will only be equivalent to tests based on (3.1) when covered interest rate parity holds.

For tests of the covered and uncovered interest rate parity conditions, it is necessary that the bonds being compared are similar in all respects except their currency of denomination. The similarity includes the maturity of the bond, for example, one-month yen-denominated bonds and one-month dollar-denominated bonds. To argue as is implicitly done in Danker et al (1985) that expected rates of return on bonds of different maturities will be equalised, for example, the Japanese

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5 The derivation of this equation is similar to the derivation of (3.1).

6 The rate of return for the bond denominated in the foreign currency includes the capital gain/loss that arises because of the difference between the spot exchange rate and the forward exchange rate.

7 For example, Hansen and Hodrick (1980, 1983) and Cumby and Obstfeld (1984).
call rate (an overnight rate)\(^8\) and the one-month Euro-dollar rate, requires additional assumptions about the term structure of interest rates. Namely, that at least over the short-term, the term structure of interest rates is flat. The Fisher hypothesis, that expected rates of return on bonds of identical maturity denominated in different currencies will be equalised, contains no implications for the relationship between expected rates of return on bonds denominated in different currencies and different maturities.

Information about whether covered interest rate parity holds is an important aid in interpreting deviations from uncovered interest rate parity. When bonds of identical maturity denominated in different currencies are treated as perfect substitutes by economic agents, arbitrage by investors in the bond and foreign exchange markets could be expected to ensure that their expected returns would be equalised so that uncovered interest rate parity held. Covered interest rate parity suggests funds will move whenever the rate of return on one bond differs from the covered return on another bond and these funds will continue to flow until these rates of return are equalised. However capital controls could prevent the movement of arbitrage funds in both cases and a divergence between the rates of return in the two cases could occur. If capital controls were such that they prevented covered interest rate parity from holding it seems likely to follow that arbitrage that sought to eliminate divergences from uncovered interest rate parity could also be inhibited. Restrictions on capital flows preventing covered interest rate parity from holding could also prevent uncovered interest rate parity from holding. Therefore it is possible with effective capital controls that even if bonds of the same maturity denominated in different currencies were treated as perfect substitutes by economic agents that uncovered interest rate parity would not necessarily hold. It may be unreasonable to expect uncovered interest rate parity to hold if covered interest rate parity does not. Therefore a finding that uncovered interest rate parity does not hold does not necessarily imply that the bonds are imperfect substitutes unless something is known about the extent to which capital can flow to eliminate profitable trading possibilities. This information can be obtained by examining whether covered interest rate parity holds. A paradoxical result is possible. Covered interest rate parity may not hold whereas uncovered interest rate parity may. The covered interest rate parity result may be suggesting that arbitrage funds may be being inhibited and the other suggesting that arbitrage funds are not being inhibited. This sort of result may be useful in shedding some further light on the

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\(^8\) Danker et al. used the call rate as a substitute for the one-month Gensaki rate in the mistaken belief that data on the one-month Gensaki rate was not publicly available.
arguments as to when covered interest rate parity held in Japan and the power of the tests to detect deviations from uncovered interest rate parity.

The extent to which covered interest rate parity holds between the returns on yen-denominated assets and the returns on assets denominated in other currencies has been investigated by a number of authors\(^9\). Otani and Tiwari (1981) and Ito (1983, 1985) have investigated whether covered interest rate parity held between onshore yen-denominated assets and offshore dollar-denominated deposits of three months maturity taking into account some of the transactions costs and the bid/ask spread\(^{10}\). Prior to 1979, arbitrage possibilities on a covered basis were found to exist between the Japanese and Euro-dollar interest rates. Illustrating this are Ito’s (1985) findings that covered interest rate parity is “strongly rejected” in the period 1973:01-1977:03\(^{11}\) and “rejected” in the period 1977:04-1980:12. Following changes to capital controls in May 1979 and December 1980\(^{12}\), it was found that these arbitrage possibilities seem to have been eliminated. For example, Ito (1985) finds covered interest rate parity “accepted” in the period 1981:1-1985:3. The extent to which covered interest rate parity held between May 1979 and December 1980 however seems to have been a matter of dispute\(^{13}\).

A number of reasons have been advanced for why covered interest rate parity does not hold\(^{14}\):

1. default risk - investors may perceive that foreign bonds are more subject to the risk of default;
2. transactions costs and the spread between buying and selling prices for foreign exchange and securities;


\(^{10}\)Otani and Tiwari, and Ito (1985) compare the three-month Gensaki rate with covered three-month Euro-dollar rates. Ito (1983) compares the three-month Gensaki rate with covered three-month Euro-dollar and covered three-month U.S. prime industrial paper rates. He also compares the three-month Gensaki rate with an offshore yen-denominated rate, the three-month Euro-yen rate.


\(^{12}\)The change in May 1979 was that foreigners were permitted to transact in the Gensaki and the Certificates of Deposit market. The change in December 1980 was the reversal of rules governing foreign exchange transactions from prohibition in principle to freedom in principle and the elimination of restrictive rules governing the operation of foreign-currency deposits by Japanese residents with Japanese foreign exchange banks. The changes in 1980 were due to the Foreign Exchange and Foreign Trade Control Law of that year. Both of these changes are discussed in more detail in Chapters 6 and 7.

\(^{13}\)Compare the results in Otani and Tiwari (1981), Ito (1983, 1985) and Mutoh and Hamada (1984).

\(^{14}\)see Officer and Willett (1970) and Levich (1985).
arguments as to when covered interest rate parity held in Japan and the power of the tests to detect deviations from uncovered interest rate parity.

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14 see Officer and Willett (1970) and Levich (1985).
3. differing tax treatment of interest and other income;
4. less than infinite elasticities for foreign exchange and securities;
5. actual capital controls; and
6. political risk - the threat of the introduction of exchange and capital controls at some time in the future.

These arguments could also be used to suggest why uncovered interest rate parity does not hold. An additional reason why uncovered interest rate parity may not hold is the absence of risk neutral investors or the presence of a "risk premium".

In the Japanese context, capital controls are seen by Otani and Tiwari (1981) and Ito (1983, 1985) to be the most important reason why CIRP has not held. For example, the arbitrage possibilities existing prior to 1979 were attributed to various capital controls imposed by the Japanese authorities. A conclusion suggesting that, in contrast to the experience in other countries, Japanese capital controls were effective\(^\text{15}\).

Komiya and Suda (1980) reject the arguments that Japanese capital controls have been effective. They ascribe the seeming presence of arbitrage possibilities to measurement problems. These measurement problems relate particularly to the choice of interest rate used in the covered interest rate parity calculations. For example, the Japanese Gensaki rate\(^\text{16}\) is often used in the covered interest rate parity calculations but this market was not open to foreigners until 1979\(^\text{17}\). Komiya and Suda claim that covered interest rate parity has held since 1975. Taking all these arguments together suggests at least three possible points from which covered interest rate parity held between short-term onshore yen assets and short-term offshore dollar assets: from January 1975, from May 1979 and from December 1980.

Given these arguments about the validity of the covered interest rate parity hypothesis, and its relevance for tests of UCIRP based on forward rates and the interpretation of evidence on the uncovered interest rate parity hypothesis, it is interesting to examine some of the previous studies of uncovered interest rate parity

\(^\text{15}\) The effectiveness of American, Australian and German capital controls are discussed in Hewson and Sakakibara (1975), Campbell (1981) and Hewson and Sakakibara (1977) respectively.

\(^\text{16}\) Transactions in the Gensaki market involve a conditional purchase (or sale) of a government bond, a corporate bond or a Certificate of Deposit for a fixed price with a resale (or repurchase) at a specified price and date. Since June 22, 1984, trading in foreign-currency bonds in the Gensaki market has also been permitted.

\(^\text{17}\) The ability of Japanese agents to invest in Euro-currency deposits is restricted by rules generally prohibiting the opening of such accounts for "investment" purposes.
that use bonds denominated in yen. Danker et al. (1985) in their study of whether uncovered interest rate parity held between Japanese onshore yen bonds and offshore dollar bonds estimate their equations over the sample period 1974:02-1980:12. The evidence cited previously suggests covered interest rate parity did not hold for some (and possibly all) of the sample period so one would need to be sceptical about the interpretation of their results. Danker et al. find that uncovered interest rate parity was supported by the evidence. This is rather surprising given that covered interest rate parity did not hold for some of the sample period. If arbitrage to eliminate deviations from covered interest parity was inhibited by capital controls it is difficult to see why arbitrage to eliminate deviations from uncovered interest rate parity was not also inhibited.

A number of studies, for example, Hansen and Hodrick (1980, 1983), Longworth et al. (1983), Ueda (1983, p.176), Cumby and Obstfeld (1984), Hsieh (1984) and Mutoh (1985), have investigated uncovered interest rate parity for currencies including the yen. Data used in these seven studies includes the period prior to May 1979. Since these studies investigate the predictability of future spot rates by forward rates, there is an ambiguity in the interpretation of the results. This ambiguity arises because the hypothesis that the forward rate is an unbiased predictor for the future spot rate (tested in these studies) is not equivalent to the uncovered interest rate parity hypothesis when covered interest rate parity does not hold. Frankel (1982) in a multi-currency study that includes the yen, using data from June 1973 to August 1980, finds no evidence of deviations from uncovered interest rate parity for Japan. He used for rates of return the log of the one-month forward rate minus the log of the next month’s spot rate presuming this would be equivalent to examining the interest differential in excess of depreciation, given covered interest parity holds. But the evidence cited earlier suggests that for at least some of the observations he used this will not be the case.

In the context of covered interest rate parity, Frenkel and Levich (1977)
introduce the notion that there are "tranquil" and "turbulent" periods in foreign exchange markets, that is periods of low exchange rate volatility and high exchange rate volatility. Extending this argument to the present context, it could be argued that in the tranquil periods, there is less risk attached to foreign-currency bonds than in the turbulent periods so that uncovered interest rate parity may hold in the "relative risk free" periods but not in the relative risky periods. This argument suggests that uncovered interest rate parity may hold in some periods but not in others. In addition, during the transition between these periods the variance of the exchange rate may change and this should be incorporated into our econometric work. In addition, in October 1979, the Federal Reserve Bank switched from interest rate targeting to monetary growth targeting - a move that has led to increased volatility of U.S. domestic interest rates.

The technique used to test for uncovered interest rate parity outlined in this paper does not require that the forward rate be an observable quantity or even that the forward market exists. It can therefore, in theory, be used to investigate uncovered interest rate parity for assets where forward contracts typically do not exist, that is maturities greater than one year. In Japan, prior to November 1973, forward contracts were available only to exporters/importers. Between November 1973 and April 1984, access to the forward market was based on the "real demand rule", that is, it was necessary to show the existence of an export/import contract or the holding of a foreign currency asset or liability before forward contracts could be obtained. From April 1984, the "real demand" rule was abolished. Hence the forward market was not totally open until April 1984.

Ito (1984) tests whether uncovered interest rate parity holds for Japanese and Euro-dollar three-month interest rates over the period 1972-1984. He finds the hypothesis accepted if data for 1975-1984 or 1972-1980 is used but is rejected if data for 1972-1984 is used. In comparing the results for 1975-1984 and 1972-1984, Ito finds no paradox because significant deviations from covered interest parity are observed in 1972-1974 and so it is expected deviations from uncovered interest rate parity will be observed over the period 1972-1974 so that using 1972-1984 data will lead to a rejection. However, the results for 1972-1980 do not fit this story and Ito in fact makes no comment on them. According to Ito's explanation, a deviation would be expected to show up in the 1972-80 period as well.


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20 These arguments are reinforced by the findings of heteroskedasticity in the studies by Cumby and Obstfeld (1984) and Domowitz and Hakkio (1985).
interest rate parity is "strongly rejected" in period I, "rejected" in period II and "accepted" in period III. In contrast, uncovered interest rate parity is rejected in period I but accepted in periods II and III. Ito finds the concurrent acceptance of UCIRP and rejection of CIRP in period II puzzling. Ito's rationalization of this puzzle relates to distortions in the Japanese forward exchange market prior to April 1984. He claims that after December 1980 it was much easier to avoid these controls.

An alternative interpretation put forward here is that structural change is a potential explanation for this puzzle. Estimation of relationships that are subject to structural change may lead to acceptance (rejection) of an hypothesis when that hypothesis is false (true). Some of the structural changes may be closely related to known changes in capital controls while others may be associated with one off political events.

3.2 Vector Autoregressions and the Restrictions implied by UCIRP

Ito's (1983, 1985) approach of using a vector autoregression to model the relationship between the exchange rate and the interest rates and then using that model to derive and test the restrictions implied by UCIRP is followed. Rather than using Ito's method to derive the restrictions imposed on the coefficients of the vector autoregression, the method used here (called the "Sargent" approach) is the way that similar restrictions have been derived in other situations to test: rational expectations models of the term structure of interest rates\(^\text{21}\); whether the forward exchange rate is an unbiased predictor of the future spot rate\(^\text{22}\); and rational expectations models of the term structure of the forward premium\(^\text{23}\). By following the "Sargent" approach, the similarities in the derivations of the cross equation restrictions suggested by the term structure models and uncovered interest rate parity are indicated\(^\text{24}\). Stating the restrictions implied by uncovered interest rate parity for bonds of any maturity and for different lags of the variables in the vector autoregression also becomes easier. Another advantage of the "Sargent" approach is that calculation of the analytic derivatives of the restrictions with respect to the parameters is easier, especially when the lag length is subject to variation.

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\(^{21}\)Sargent (1979) and Baillie and McMahon (1982a).


\(^{23}\)Baillie and McMahon (1985).

\(^{24}\)Compare Ito (1985, pp.5,19,20) who claims they are quite different.
Some of the claimed attractions of the vector autoregressions are that they make no assumption as to the exogeneity of particular variables\(^{25}\) nor impose what some have called incredible identifying restrictions. However it is necessary to make assumptions about what variables appear in the autoregression and to assume that the variables are linear jointly covariant stationary so that a multivariate analogue of the Wald Decomposition Theorem applies\(^{26}\). The assumption that the variables are linear jointly covariant stationary implies the variables will have a multivariate moving average representation. Assuming that the moving average representation is invertible, means a vector autoregressive representation can be written for the variables. Here the variables included in the system are the log of the yen/dollar exchange rate, an \(n\)-month yen interest rate and an \(n\)-month dollar interest rate which will be denoted \(s_t\), \(R_{J_t}^{t,n}\) and \(R_{F_t}^{t,n}\) respectively\(^{27}\).

The vector autoregression is assumed to be:

\[
\begin{bmatrix}
1-a_1(L) & -b_1(L) & -c_1(L) \\
-a_2(L) & 1-b_2(L) & -c_2(L) \\
-a_3(L) & -b_3(L) & 1-c_3(L)
\end{bmatrix}
\begin{bmatrix}
s_t \\
R_{J_t}^{t,n} \\
R_{F_t}^{t,n}
\end{bmatrix}
= 
\begin{bmatrix}
u_{1,t} \\
u_{2,t} \\
u_{3,t}
\end{bmatrix}
\]

\(\text{where } a_j(L)=\sum_{i=1}^{p} a_{ji}L^i, b_j(L)=\sum_{i=1}^{p} b_{ji}L^i \text{ and } c_j(L)=\sum_{i=1}^{p} c_{ji}L^i, \quad j=1,2,3.\)

Letting \(u_t^*=[u_{1,t},u_{2,t},u_{3,t}]\), it is assumed that \(E(u_t)=0, E(u_t'u_t')=V\) and \(E(u_t'u_{t,j'})=0\) \(j\neq 0\).\(^{28}\) It is important that \(u_t\) be serially uncorrelated so that the expectation of \(u_t\) conditional on an information set prior to time \(t\) is always zero. Let \(a_j=[a_{j,1},\ldots,a_{j,p}],\)
\(b_j=[b_{j,1},\ldots,b_{j,p}],\)
\(c_j=[c_{j,1},\ldots,c_{j,p}]\)
\(j=1,2,3\) and \(\tau=[a_{1,1},b_{1,1},c_{1,1},a_{1,2},b_{2,2},c_{2,2},a_{3,1},b_{3,1},c_{3,1}]\). On the assumption that none of the parameters in \(\tau\) are set equal to zero, asymptotically efficient estimates of the parameters can be obtained by applying ordinary least squares to each equation. These estimates denoted \(\hat{\tau}\) will have the asymptotic distribution

\[
\sqrt{T}(\hat{\tau} - \tau) \sim N(0,V^{-1} \otimes M),
\]

\(\text{In the context of UCIRP, this is particularly important as the hypothesis contains no assumption about either the pattern of causality between the variables or their exogeneity.}\)

\(\text{Covariance stationarity requires that the variances and covariances of each variable be independent of time.}\)

\(\text{Some obvious other candidates might be other exchange rates, interest rates on assets denominated in other currencies and money supplies.}\)

\(\text{It should be noted that the UCIRP hypothesis and the rational expectations hypothesis do not imply the restriction that } V \text{ is constant over time. This is because both are only concerned with the properties of the first moments of the data.}\)
where \( M = \text{plim}(X'X/T) \), \( T \) is the number of observations and \( X \) a \( T \) by \( 3p \) matrix whose \( t \)-th row contains observations on the variables 

\[
[s_{t-1}, \ldots, s_{t-p}, RJ_{t-1,n}, \ldots, RJ_{t-p,n}, RF_{t-1,n}, \ldots, RF_{t-p,n}].
\]

To derive the restrictions implied by uncovered interest rate parity it is convenient to rewrite the system in (3.3) as a first order system:

\[
\begin{bmatrix}
  s_t \\
  s_{t-1} \\
  \vdots \\
  s_{t-p+1} \\
  RJ_{t,n} \\
  RJ_{t-1,n} \\
  \vdots \\
  RJ_{t-p+1,n} \\
  RF_{t,n} \\
  RF_{t-1,n} \\
  \vdots \\
  RF_{t-p+1,n}
\end{bmatrix}
= \begin{bmatrix}
a_1 & b_1 & c_1 \\
I_{p-1} & 0 & 0 \\
a_2 & b_2 & c_2 \\
0 & I_{p-1} & 0 \\
a_3 & b_3 & c_3 \\
0 & 0 & I_{p-1}
\end{bmatrix}
\begin{bmatrix}
s_{t-1} \\
 sl_{t-2} \\
\vdots \\
s_{t-p} \\
RJ_{t-1,n} \\
RJ_{t-2,n} \\
\vdots \\
RJ_{t-p,n} \\
RF_{t-1,n} \\
RF_{t-2,n} \\
\vdots \\
RF_{t-p,n}
\end{bmatrix}
+ \begin{bmatrix}
u_{1,t} \\
u_{2,t} \\
\vdots \\
u_{3,t} \\
u_{2,t} \\
\vdots \\
u_{3,t}
\end{bmatrix}
\]

which can be written as:

\[
Y_t = AY_{t-1} + v_t,
\]

where \( Y_t \), \( A \) and \( v_t \) are obviously defined. In (3.4), it is necessary condition for the vector \( Y_t \) to be stationary that the eigen-values of \( A \) be less than one in modulus.

Here the rational expectations assumption is invoked to provide a method to forecast values for \( s_t \) based on past information. For economic agents to be able to make these forecasts it is necessary to make the very strong assumptions that they know the data generating process for \( s_t, RJ_{t,n}, RF_{t,n} \) summarised in (3.4) and the coefficient matrix \( A \), and that they calculate their expectations on the basis of the model. Calculating the expected value of \( Y_{t+n} \) conditional on information up to and including time \( t \) gives:

\[
Y_{t+n|t} = E_t(A^nY_t + A^{n-1}v_{t+1} + \ldots + A^1v_{t+n-1} + v_{t+n}) = A^nY_t,
\]

(3.5)
where \( E_t(.) \) defines the expectation of a variable conditional on the information available at time \( t \). Here the information set at time \( t \) is assumed to contain current (dated at time \( t \)) and lagged values of the exchange rate and the two interest rates. Defining \( e, f \) and \( g \) to be \( 3p \) by \( 1 \) vectors with unity in the \( 1 \), \( p + 1 \) and \( 2p + 1 \) positions and zeros everywhere else respectively, then

\[
s_{t+n/t} = e'Y_{t+n/t} = e'A^nY_t, \quad RJ_{t,n} = f'Y_t \quad \text{and} \quad RF_{t,n} = g'Y_t.
\]

Equation (3.1) can be rewritten as:

\[
e'A^nY_t - e'Y_t = n(f'Y_t - g'Y_t)/1200
\]

Hence the restrictions implied by uncovered interest rate parity under rational expectations are\(^{29}\):

\[
r(r) = e'A^n - e' - n(f' - g')/1200 = 0.
\]

The hypothesis of uncovered interest rate parity under rational expectations implies \( r(r) = 0 \). When \( n = 1 \), the maturity of bonds is equal to the sampling period, \( r(r) \) is a function of \( a_1, b_1, \) and \( c_1 \), so it is only necessary to estimate an equation for \( s_t \) in order to test the validity of the restrictions. For \( n > 1 \), \( r(r) \) is a non-linear function of the coefficients in each equation and it is necessary to estimate all the equations of the system in order to test the restrictions.

The test of this restriction can be performed by estimating the unrestricted model (equation (3.3)) and computing a Wald test. The results in Baillie et al (1983) can be used to derive the analytic derivatives of the vector of restrictions.

\(^{29}\) In equation (3.1), the interest rates refer to the rate of return over one period and this coincides with the measurement period. In (3.3), the interest rates refer to the rate of return over twelve months not the measurement period of one month. The divisor of 1200 rather than 100 is take account of this difference.

If the information set at time \( t \) did not include the values of the exchange rate and the interest rates at time \( t \) then the restrictions would be:

\[
r'(r) = e'A^{n+1} - (e' + n(f' - g'))/1200)A = 0.
\]
with respect to the estimated parameters\textsuperscript{30}. When a constant is included in each equation an additional restriction arises and some additional differentiation results derived in Balestra (1980) are required\textsuperscript{31}.

### 3.3 Uncovered Interest Rate Parity and the Japanese Experience

The data used here are monthly data with bonds having maturities of one and three months. The estimation period spans from March 1973 to December 1984. In the examination of UCIRP, it seems sensible not to include observations prior to March 1973. Prior to August 1971, Japan was on a fixed exchange rate system with the exchange rate set by the Bank of Japan and the period from August 1971 to March 1973 was the transition period from fixed to floating exchange rates\textsuperscript{32}. Two reasons can be advanced for excluding the pre March 1973 points: the data generating process for the exchange rate and the interest rates can be expected to have changed in the switch from fixed to floating exchange rates; and the way exchange rate expectations are formed can be expected to differ.

The yen-denominated interest rate used are the one- and three-month Gensaki rates and the offshore dollar-denominated rates are the one- and three-month Euro-dollar rates\textsuperscript{33}. The reason for using Euro-dollar rates as the appropriate dollar denominated rates of return is that Euro-dollar deposits are not subject to reserve

\textsuperscript{30}For the restrictions in equation (3.6), the derivatives are:

\[
\frac{\delta r(t)}{\delta r} = \begin{bmatrix}
\sum_{j=0}^{p-1} (e'A^j)eA^{n-1-j} \\
\sum_{j=0}^{p-1} (f'A^j)eA^{n-1-j} \\
\sum_{j=0}^{p-1} (g'A^j)eA^{n-1-j}
\end{bmatrix}
\]

\textsuperscript{31}If the model contains a constant, the model can be written as \(Y_t = AY_{t-1} + d + v_t\) with \(d\) containing the constant for each equation in the first, \(p+1\) and \(2p+1\) positions and zeros everywhere else. Then \(Y_{t+n/t} = A^NY_t + (I+A+...+A^{n-1})d\) so that an additional restriction \(e'(I+A+...+A^{n-1})d=0\) is imposed.

If the model is estimated with the exchange rate in difference form with \(D_{t+n/t} = s_{t+n/t} - s_{t-1}\) then uncovered interest rate parity can be written as:

\[
D_{t+n/t} + D_{t+n-1/t} + ... + D_{t+1/t} = n[R_{t+n/t} - R_{t,n}]/1200.
\]

That is:

\[
e'(A^n + ... + A)Y_t = n(f'g')Y_t/1200
\]

so the restriction imposed is \(e'(A^n + ... + A) = n(f'g')/1200\).

\textsuperscript{32}Ito (1984) includes observations for 1972 while Ito (1985) includes observations for January and February 1983.

\textsuperscript{33}Detail of data sources are given in Appendix A on page 192.
controls or regulation Q type effects and may consequently be more attractive than American rates. An additional reason is that other studies of both covered and uncovered interest rate parity have tended to use Euro-dollar rates.\(^\text{34}\)

Results for three-month bonds are presented first. Five issues are investigated: the choice of estimating period; the choice of \(p\), the lag length; the stationarity of the model; the degree of homoskedasticity present and the tests of the UCIRP restrictions.

Tables 3-1, 3-2, 3-3 and 3-4 on pages 54 and 55 contain the results for bonds of three-month maturity where each of the variables in the vector autoregression appear in undifferenced form and a constant was included in every equation. Detailed explanations of the meaning of the items in the Tables is contained on page 56. In section 3.1, the importance of covered interest rate parity for interpreting deviations from uncovered interest rate parity was emphasised. The discussion suggested that it was only after December 1980, that there was agreement in the literature that covered interest rate parity held. There was some suggestion that it may hold from as early as 1975. Given the major changes in capital inflow and outflow restrictions that have occurred in Japan, structural change could also affect the data generating process. Two important changes are focused on (i) in May 1979 when foreigners were first permitted to transact in the Gensaki and Certificate of Deposits markets and (ii) in December 1980 when a new foreign exchange law commenced operation reversing the rules governing foreign exchange transactions from prohibition in principle to freedom in principle.\(^\text{35}\) The estimation periods used in Tables 3-1 and 3-2 reflect the two structural changes as well as the periods for when covered interest rate parity is suggested to hold.\(^\text{36}\) The regressions summarised in Tables 3-3 and 3-4, labelled "rolling regressions", are based on blocks of 36 observations (or 31 observations in the case of the first regression). The idea behind these regressions was to test the sensitivity of the results to the choice of time period and to attempt to alleviate any problems that may arise due to changes in the parameters or the variances over time.

In section 3.2, the value of \(p\), the lag length, was assumed to be given but in

\(^{34}\)For example, Otani and Tiwari (1981), Ito (1983, 1985) and Danker et al (1985).

\(^{35}\)In addition, the change from interest rate targeting to monetary growth targeting by the FRB could have caused a change in the data generating process for the Euro-dollar interest rate and possibly the other variables as well. Even though we use Euro-dollar rates, a policy change which affects US domestic rates can also be expected to influence Euro-dollar rates.

\(^{36}\)The beginning of each sample period in Table 3-1 were chosen to ensure that all lagged values of the variables appearing in the vector autoregression occur after the regulatory change.
empirical work it must be determined. The choice can be critical. Too high a value of $p$ could lead to inefficient estimates of the parameters with a consequent tendency to accept the hypothesis that the UCIRP restrictions are valid. Too low a value of $p$ will not only lead to inconsistent parameter estimates but would also imply that the residuals are not white noise. If the residuals are not white noise then the forecast of $Y_{t+n}$ formed at time $t$, $Y_{t+n}/t'$ would not be as stated in equation (3.5). Ito (1985, p.12) argues that when the interest rates are for three-month instruments, a value of $p$ greater than or equal to three must be chosen. Ito provides no reason for why this is so but he suggests that overspecifying the value of $p$ is likely to increase the likelihood of falsely accepting the null hypothesis of UCIRP. Ito's (1985) choice of a lower bound of three for the lag length can possibly have the same effect. In the results presented here it will be seen that the chosen lag length is quite often less than three.

Results on the choice of lag length in the vector autoregressions for different time periods are presented in Tables 3-1 and 3-3. Four criterion were used as aids in choosing the lag lengths: the Akaike (A) criterion, the Schwartz (S) criterion, the Hannan (H) criterion and a testing sequence based on a series of likelihood ratio tests (L). The MAXLAG package of programs developed by Terrell and Penm implementing the Akaike, Hannan and Schwartz criteria was used to determine the "best" value of $p$ for each of these criteria. The series of likelihood ratio tests started off from an assumed maximum lag length, the lag length was reduced by one lag at a time and a likelihood ratio test for the validity of the restrictions of excluding the variables associated with the higher lag was calculated. This process of reducing the lag length by one and testing the validity of the exclusion restrictions was continued until the hypothesis of a shorter lag length was rejected. The significance level for each individual test in the likelihood ratio testing sequence was chosen to take account of the fact that the overall significance level of the testing procedure is related to the significance level of each of the individual tests.

With the exception of three time periods (73:05-84:12 and 75:07-84:12 in Table 3-1 and 78:01-80:12 in Table 3-3), it will be seen that the use of the Akaike,

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37 Ito (1985) used a lag length of four (and sometimes five) without explaining how this lag length was chosen.


39 This assumed maximum lag length varied from three to eight depending on the number of observations in the sample.
Hannan and Schwartz criteria lead to the very parsimonious lag choice of $p=1$. The use of the likelihood ratio testing procedure to choose the lag length typically leads to longer lag lengths than chosen by the other criteria. In particular, where models chosen by the other criteria differ from the model chosen by the likelihood ratio criterion, the former models are always rejected in favour of the latter model when compared using likelihood ratio tests.

The white noise nature of the estimated residuals was checked in two ways. First, Hosking's multivariate portmanteau test, a test based on the residuals of the system, was calculated. Second, the residuals of each equation were checked using a single equation lagrange multiplier test to test jointly for up to fourth order serial correlation. On the basis of these tests, in most cases the residuals seem to be white noise. There are however a few models even with quite long lags where there is significant serial correlation at the one per cent level. It seems to be more of a problem for the regressions summarised in Table 3-1 than for those in Table 3-3.

As mentioned previously, the assumption that the series are jointly covariant stationary is rather important. To check on the stationarity of the series under investigation, the modulus of the largest eigen value of the matrix $A$ was calculated and this appears in the column labelled $E$ in Tables 3-2 and 3-4. The modulus of the largest eigen value being close to one in most cases indicates the possibility of at least one unit root. Two possibilities are open: (a) to use those results and carry out the tests of the UCIRP hypothesis; or (b) to test for unit roots. The justification for (a) is an argument of Sims (1978). He has shown that it is still valid to carry out hypothesis testing in a second order univariate autoregression with one unit root provided the hypothesis being tested does not test for unit roots. He argues but does not prove that the results will extend to higher order lags and multivariate systems. The problem with (b) is that it is well known in the univariate case that even asymptotically the usual $t$ and $F$ tests for unit roots do not have their usual distributions and it is necessary to make use of special tables of critical values. Similar problems will occur in the multivariate case. The modulus of the eigen values are of course random variables and it is possible to

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40 Hosking (1980).

41 Pagan and Hall (1983) contains a discussion of this test.

42 There are a number of cases where the absolute value actually exceeds one.

43 See Fuller (1976) and Hasza and Fuller (1979).
calculate standard errors for them. It has been pointed out, however, that the distribution of the estimated eigen values is in question when the model is unstable, that is, the dominant eigen value has a modulus greater than or equal to one in absolute value.

Here we carry out tests of the UCIRP hypothesis using the equations that potentially have unit roots. Two tests of the restrictions are presented. Tests labelled R are based on a variance-covariance matrix that assumes homoskedasticity and those labelled RH are based on a hetroskedastic consistent estimate of the variance-covariance matrix. There are a number of cases where there is a conflict between the test outcomes using the two test statistics. The tests for hetroskedasticity, HE(1), HE(2) and HE(3) in Table 3-2 indicate that in all but one time period (79:10-84:12, p=5) significant (at the one per cent level) hetroskedasticity in at least one equation is present. The use of tests based on RH is therefore warranted and these indicate that except in two cases (73:04-80:11, p=1 and 73:05-84:12, p=2) the restrictions implied by uncovered interest rate parity are rejected at at least the five per cent level. For one of the exceptions, the model is rejected against a model with longer lags (73:04-80:11). Tests of UCIRP on subsets of the data included in the two exceptions suggest that the restrictions are rejected. This conflict between results based on a set of data and subsets of that data set is suggestive of structural change.

In Table 3-4, there are only two conflicts between the test outcomes based on R and RH (73:06-75:12, p=1 and 76:01-78:12, p=1). In one case, 76:01-78:12, the conflict can be resolved by examining the tests for hetroskedasticity. Significant hetroskedasticity is found and this justifies the use of RH. The other is on the border line between accepting or rejecting the restrictions at the five per cent level. For all the results in Table 3-4, at the five per cent level, the restrictions would only be accepted for two periods (73:06-75:12, p=2 and 78:01-80:12, p=1). The result for time periods 73:06-75:12 is somewhat surprising as this might have been where uncovered interest rate parity was least expected to hold since this is the period where capital controls were heaviest.

In summary, the evidence would seem to favour the rejection of the UCIRP restrictions on the coefficients of the vector autoregression that are suggested for

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44 Theil and Boot (1962) and Oberhofer and Kmenta (1973).


46 RH was calculated using the OLS option in the Two-Step Two-Stage Least Squares package described in Cumby and Huizinga (1984).
three-month bonds for all but the earliest observations of the floating exchange rate period.

Turning to one-month bonds, since the maturity length corresponds to the sampling period, in order to test the UCIRP restrictions it is only necessary to estimate an equation for the exchange rate. Equations were estimated with the differenced exchange rate as the dependent variable. Equations with the exchange rate in undifferenced form were not used because one of the restrictions suggested by uncovered interest rate parity is the restriction of a unit root. Since testing that unit root would cause problems concerning the appropriate critical value to use, a unit root was imposed\textsuperscript{47}.

As with three-month assets, two sets of results are presented - one set where the sample period is chosen on the basis of certain structural changes (Table 3-5) and the other based on arbitrary groupings of the observations (Table 3-6). An explanation of the meaning of the items in Tables 3-5 and 3-6 is contained on page 59. In both tables, a model with no lags is chosen by all the criteria in most time periods. That is a random walk model with drift, although the constant was usually not significant. This is consistent with the findings of other investigators of exchange rate behaviour\textsuperscript{48}. The tests for serial correlation ($LM_1$, $LM_2$, $LM_3$) in nearly all cases suggest no further serial correlation and the likelihood ratio tests do not indicate that any further lags of the variables should be included.

In the random walk model, it is not possible to test the uncovered interest rate parity restrictions. For those cases where a model with one lag of each variable is chosen by one of the criteria (73:05-79:04 in Table 3-5 and 7:01-79:12 and 79:01-81:12 in Table 3-6), given the lack of significant heteroskedasticity, only results for 79:01-81:12 in Table 3-6 would lead to a rejection of the null hypothesis. For completeness, tests of UCIRP in models based on one lag of each variable for each time period are also presented\textsuperscript{49}.

The random walk model might be interpreted as evidence against the uncovered interest rate parity restrictions. However, it is easily illustrated that the hypothesis of a random walk for the exchange rate and the hypothesis of UCIRP for bonds of one month maturity are two similar hypotheses. Consider the model:

\textsuperscript{47} When the models were estimated in undifferenced form, one of the roots was typically very close to unity.

\textsuperscript{48} For example, Meese and Singleton (1982) and Meese and Rogoff (1983).

\textsuperscript{49} In this case, the restrictions are that all variables except the interest differential should have a zero coefficient while the coefficient on the interest differential should be unity.
\[
\Delta s_{t+1} = b(RJ_t - RF_t)/1200 + u_{t+1}.
\]

(3.7)

The random walk model suggests that the coefficient in equation (3.7) will be zero while UCIRP suggests it should be unity. Equation (3.7) was estimated by Ordinary Least Squares (OLS) without a constant and ninety-five per cent confidence intervals for b were calculated using both the standard OLS covariance matrix and a heteroskedastic consistent covariance matrix\(^{50}\). These confidence intervals are presented in Table 3-7. As might be expected given the results in Tables 3-5 and 3-6, zero is contained in every confidence interval. Unity is not contained in any confidence interval that includes data after December 1982. For samples based solely on information prior to December 1980, unity is contained in the confidence intervals.

That is, for one-month bonds prior to December 1980, the restrictions suggested by uncovered interest rate parity are accepted and after December 1982, the restrictions are rejected.

3.4 Yen Bonds and Dollar Bonds: Any Difference?

This chapter has sought to set out a method for testing the UCIRP hypothesis for bonds with a maturity equal to or longer than (but an integral multiple of) the period of observation. The method was used to investigate the uncovered interest rate parity hypothesis for bonds of one- and three-months maturity denominated in yen and dollars.

The results supporting a departure from UCIRP are much stronger for bonds of three-months maturity than they are for bonds of one-month maturity. For three-month bonds, once account has been taken of heteroskedasticity where it appears to be present, the restrictions on the coefficients of the vector autoregression suggested by uncovered interest rate parity are in general rejected. Only in the early part of the floating exchange rate period is there any evidence to support the restrictions. Different results are obtained for one-month bonds. For results based only on data prior to December 1980, the UCIRP restrictions are accepted. For results based on a sample period that includes data after December 1982, the UCIRP restrictions are rejected.

The results also indicate that it can be potentially misleading to use the vector autoregression method with coefficients estimated over long time horizons to test UCIRP. Structural instabilities are suggested as the cause of these differences. This is illustrated by the different results produced by estimating over a long time.

\(^{50}\)The constant was insignificant in every case.
period and then over shorter time periods. For one-month bonds, using data on the full sample gives rise to results consistent with the rejection of the uncovered interest rate parity hypothesis (Table 3-7). For three-month bonds, after allowance for heteroskedasticity, the evidence from the full sample is consistent with acceptance of the uncovered interest rate parity hypothesis. These results are not however robust to changes in the sample period. Segmenting the sample in either of two ways can produce substantially different results. One segmentation was based on the effect that important regulatory changes had on covered interest rate parity (January 1975, May 1979 and December 1980). The other segmentation of the sample was essentially arbitrary. Results on these segmented samples tended to be very different from those on the full sample. For three-month bonds, using segmented samples, uncovered interest rate parity is generally rejected. A result in stark contrast to the acceptance on the full sample. For one month bonds, limiting the sample period to prior to December 1980 produces evidence that is consistent with the uncovered interest rate parity hypothesis but is inconsistent with the results based on the full sample. If the sample includes data after December 1982, the evidence is consistent with the results for the full sample. In addition, the importance of the assumption of homoskedasticity of the equations’ errors as to whether UCIRP is accepted or not has also been illustrated.

The interpretation of the rejections of the UCIRP restrictions is a little difficult. As mentioned earlier tests of this kind usually are testing a joint hypothesis that bonds denominated in different currencies are perfect substitutes and that expectations are formed rationally. Should either of these hypotheses be incorrect, a rejection could be expected. The assumption of rational expectations that was invoked to generate the testable restrictions presupposes that agents know the data generating process for the exchange rate and the interest rate and that they calculate their expectations on the basis of that model. These are extremely strong assumptions especially given the apparent confusion amongst economists concerning the determinants of exchange rate movements. An additional complicating factor is whether regulations on capital flows caused deviations from covered and uncovered interest rate parity. This last factor can only be conclusively excluded after December 1980. In the post-1980 periods, there would seem to be strong support for the rejection of the restrictions. The strongest statement that can perhaps be made is that at least in the post-1980 period, the evidence is certainly consistent with both one- and three-month bonds denominated in yen and dollars being imperfect substitutes.
### Table 3-1: Three-Month Bonds: Choice of Lag Length

<table>
<thead>
<tr>
<th>Period</th>
<th>C</th>
<th>p</th>
<th>H/s</th>
<th>LME</th>
<th>LMRJ</th>
<th>LMRF</th>
<th>l_2</th>
<th>l_1</th>
<th>l_1</th>
<th>l_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>73:04-79:04</td>
<td>AHS</td>
<td>1</td>
<td>86.1 b/8</td>
<td>3.9</td>
<td>5.3</td>
<td>3.5</td>
<td>-</td>
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<td>-</td>
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### Table 3-2: Three-Month Bonds: Testing UCIRP

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Table 3-3: Lag Length Choice in Rolling Regressions

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Table 3-4: Testing UCIRP in Rolling Regressions

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</table>
Notes on Table 3-1, 3-2, 3-3 and 3-4

1. C denotes the criterion choosing that model, "A", "H" and "S" for Akaike, Hannan and Schwartz respectively. "L" indicates the lag length chosen when a likelihood ratio testing procedure is used.

2. p is the number of lags included.

3. H/s is Hosking's portmanteau statistic, where s is the number of lags included in the calculations. This statistic is distributed asymptotically under the null hypothesis of no significant lags of any of the variables up to lag s, as a chi-square with \( g^2(s-p) \) degrees of freedom, where \( g \) is the number of equations. s was chosen to be roughly \( T^{1/2} \), where \( T \) is the number of observations.

4. LME, LMRJ and LMRF are the Lagrange Multiplier tests for serial correlation of the form \( u_t = \sum_{i=1}^{p} \theta_i u_{t-i} + \epsilon_t \), where \( \epsilon_t \) is white-noise, in the exchange rate, yen-denominated interest rate and dollar-denominated interest rate equations. The tests test whether all the \( \theta_i \) are jointly zero and are each distributed as a chi-square with four degrees of freedom.

5. \( l_{r}^r \) is the likelihood ratio test that the model should contain \( p-r \) (p+1) lags of all variables instead of p lags. It is distributed, under the null hypothesis, as a chi-square with \( 9.r \) degrees of freedom.

6. HE(1), HE(2) and HE(3) denote tests of heteroskedasticity in the exchange rate, yen-denominated interest rate and dollar-denominated interest rate equations respectively. The test is derived in Pagan et al (1981) and is designed to test whether \( \alpha=0 \) in \( \sigma_t^2 = \sigma^2 (E(y_t))^\alpha \), where \( y_t \) is the dependent variable in the regression and \( \sigma_t^2 \) is the variance of t-th disturbance.

7. R is the Wald test of the restrictions implied by UCIRP assuming the error term is homoskedastic. As a constant is included in each equation, the number of restrictions being tested is \( p.g+1 \).

8. RH is the Wald test of the restrictions implied by UCIRP assuming the error term is heteroskedastic and a White (1980) type adjustment is made to compute a consistent estimate of the variance covariance matrix of the parameters.

9. Superscripts a, b and c indicate that the statistic is significant at the 10 per cent, 5 per cent and 1 per cent levels respectively.
Table 3-5: Evaluation of Models for One-Month Maturity

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Notes on Table 3-5 and 3-6

1. C denotes the criterion choosing that model, "A", "H" and "S" for Akaike, Hannan and Schwartz respectively. "L" indicates the lag length chosen when a likelihood ratio testing procedure is used.

2. p is the number of lags included.

3. LM₁ is the LM test for serial correlation of the form $u_t = p_j u_{t-j} + e_{t-j}$ and tests the null hypothesis of whether $p_j$ is zero. It has a standard normal distribution, under the null hypothesis.

4. $L_r (L_r + r)$ is the likelihood ratio test that the model should contain $p-r$ (p+r) lags of all variables instead of p lags. It is distributed, under the null hypothesis, as a chi-square with 3r degrees of freedom.

5. HET is a test of heteroskedasticity obtained as $T.R^2$ from the regression of the squared residuals on the predictions of the equation, where $T$ is the number of observations and $R^2$ is the coefficient of determination.

6. R is the Wald test of the restrictions implied by UCIRP assuming the error term is homoskedastic. As each equation is estimated with a constant included, the number of restrictions being tested is $3.p+1$.

7. RH is the Wald test of the restrictions implied by UCIRP assuming the error term is heteroskedastic and a White (1980) type adjustment is made to compute a consistent estimate of the variance covariance matrix of the parameters.

8. Superscripts a, b and c indicate that the statistic is significant at the 10 per cent, 5 per cent and 1 per cent levels respectively.

9. A "***" indicates that the test value cannot be calculated in that model.
Table 3-7: Confidence Intervals for Coefficient of Equation (3.7)

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CHAPTER 4
THE BEHAVIOUR OF THE RISK PREMIUM

In Chapter 3, a vector autoregressive model was used to both derive the restrictions suggested by uncovered interest rate parity and to test them. These restrictions were generally rejected for three-month bonds while for one-month bonds they were only rejected when the sample period included data after December 1982. However, the method using a vector autoregressive model provides no positive evidence that the monetary authority will be able to alter the extent of deviations from uncovered interest rate parity or that financial variables can assist in explaining the deviations.

Two alternative approaches used in the literature to test for uncovered interest rate parity are discussed. One approach seeks to find any information available at a particular time that is correlated with deviations from uncovered interest rate parity. The second approach uses a bond demand equation from a portfolio model to suggest what variables might influence the deviations from uncovered interest rate parity and in what direction. The latter approach does suggest an explicit link between deviations from uncovered interest rate parity and changes in monetary policy instruments. Versions of both tests are used with the focus of attention being tests based on a bond demand function. This bond demand approach is used to derive an equation that contains perfect substitutability and imperfect substitutability of bonds as special cases.

As in Chapter 3, the tests are applied to one- and three-month bonds. In the models based on the portfolio approach, the dependent variable of the equation to be estimated contains an unobserved variable, the expected value of the log of the future exchange rate. When this expected value is replaced by its realised value some estimation problems arise. These problems and their solutions are discussed. The results in this Chapter are also compared and contrasted with those in the previous Chapter.
4.1 Tests of Uncovered Interest Rate Parity

Tests of uncovered interest rate parity have focused on either the relationship between spot and forward exchange rates; and/or the relationship between expected rates of return on bonds denominated in different currencies. The first type of test typically involves a regression of the log of the exchange rate at time \( t+j \), \( \log s_{t+j} \), on the log of the \( j \)-period forward rate at time \( t \), \( \log f_{t+j} \) and tests whether the constant is significantly different from zero; and whether the coefficient on the forward rate is significantly different from one. The ability of other information available at time \( t \), denoted by \( I_t \), like lagged values of the spot exchange rate, the forward rate or interest rates, to assist in explaining the future exchange rate may also be investigated. In regression notation, this testing procedure may be written as:

\[
s_{t+j} = a + bf_{t+j} + c'Z_t + u_{t+j}, \quad (4.1)
\]

where \( Z_t \) is vector of information available at time \( t \), that is, \( Z_t \in I_t \) and \( u_{t+j} \) is an error term. In equation (4.1), the focus of interest are tests of the hypotheses \( a=0, b=1 \) and \( c=0 \). An alternative is to impose \( b=1 \) in equation (4.1) to obtain:

\[
s_{t+j} - f_{t+j} = a + c'Z_t + u_{t+j}, \quad (4.2)
\]

In equation (4.2), the hypotheses of interest are \( a=0 \) and \( c=0 \). Rejection of these hypotheses in (4.1) and (4.2) are subject to two interpretations: the forward market is inefficient in reflecting exchange rate expectations and expected profit opportunities exist; and/or the profit earned from forward speculation is a return offsetting the risk taken in holding an open position. The latter interpretation is consistent with bonds denominated in different currencies being imperfect substitutes.

Many articles have been written on this type of strategy and the recent literature has focused on estimation problems. The problems associated with estimating these models arise when the forecast period is longer than the observation period (\( j > 1 \)) and are due to the possibility that the error can no longer be guaranteed to be white-noise even under the hypothesis that \( s_{t+j} - f_{t+j} \) is unrelated to any information at time \( t \). According to this argument, in equations (4.1) and (4.2), \( u_{t+j} \) likely to be a moving average of order \( j-1 \).

---

1. Levich (1985) contains a recent survey of this work.

A number of articles\(^3\) have sought to derive from microeconomic foundations, conditions for the divergence of the forward exchange rate and the expected future spot rate. The typical method is to solve a representative consumer’s consumption-asset investment optimization problem and use the resulting first order conditions to obtain a relationship between the forward rate and the expected future spot rate. For example, in the Grauer et al (1976) case, the important condition relates to the covariance between the future spot rate and a function of a world commodity price deflator and other variables. This sort of result would seem to be of little empirical use since no indication is given as to what causes changes in that covariance term and therefore changes in the extent of the divergence between the two rates. The papers also typically rely on the assumption that the agent is “representative” of agents in both countries in a two country model. But it is well known that consumption and asset investment patterns differ amongst countries so that this assumption would seem to be unreasonable. Given that consumption bundles in different countries do differ it is not obvious that the arbitrage conditions relied upon in these models will hold.

Given the discussion in section 3.1 about the validity of covered interest rate parity, tests based on (4.1) and (4.2) are not necessarily measuring deviations from uncovered interest rate parity. An alternative strategy to (4.2) would be to use \(RP_{t,j} = (s_{t+j} - s_t) + j(RF_{t,j} - RJ_{t,j}) / 100\) as the dependent variable. This variable is derived directly from the statement of uncovered interest rate parity in Chapter 3 (equation (3.1), where \(s_{t+j}/t\) is replaced by \(s_{t+j}\). \(RP_{t,j}\) is the ex-post difference in the nominal returns on \(j\)-period bonds denominated in yen and dollars and has sometimes been referred to as the \(j\)-period risk premium. When investors are risk averse, the risk premium acts as an incentive to investors to bear the risk of holding foreign currency denominated assets. Replacing \(s_{t+j} - t_{t,j}\) by \(RP_{t,j}\), equation (4.2) becomes:

\[
RP_{t,j} = a + c'Z_t + w_{t+j}
\]

(4.3)

where \(w_{t+j}\) is an error term and is likely to be an MA(j-1). The information set that is sometimes used in \(Z_t\) is \(RP_{t,j}, RP_{t,j-1,j}, \ldots\) for the currency being investigated and the \(j\)-period ex-post risk premiums on other currencies\(^4\). There is

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\(^3\)For example, Grauer et al (1976), Frankel (1979), Hansen and Hodrick (1983) and Hodrick and Srivastava (1984).

\(^4\)Obstfeld (1982b) contains a brief description of this method.
no reason to limit the information set to risk premia only. The null hypothesis of market efficiency and risk neutral investors suggests that no information available at time $t$ should be correlated with $RP_{t,j}$.

An alternative test involves regressions of the difference of expected returns on bonds of the same maturity denominated in different currencies on variables suggested by portfolio theory, for example, wealth in each country and the outstanding stock of bonds in a particular currency. Alternatively, it has been argued that the rate of return differential will be a function of the relative supply of assets denominated in different currencies\(^5\). The usual justification for this approach is not based on microeconomic foundations but rather on a somewhat arbitrarily specified demand function for bonds denominated in one currency. This function is then inverted so that the dependent variable becomes the expected rate of return differential and the equation appears very similar to (4.3). The testing procedure is also similar in that the question of what variables, if any, significantly explain the risk premium is investigated\(^6\). Some attempts have been made to justify from microeconomic foundations the demand functions used in such exercises\(^7\). However, these do not take account of the existence of financial intermediaries and assets besides bonds (for example, time deposits) that might be available to the investor. A trade-off between reality and the micro-foundations of the approach is necessary.

### 4.2 Testing Uncovered Interest Rate Parity

As argued in Chapter 3, tests based on the extent to which the forward rate is unbiased predictor of the future spot rate only provide information relevant to the uncovered interest rate parity hypothesis when covered interest rate parity also holds. Given the Japanese evidence discussed in Chapter 3, the use of forward rates could only be justified on data after December 1980. Instead, here tests using the j-period ex-post risk premia as defined in section 4.1 are used. This risk premium is derived directly from the statement of uncovered interest rate parity in equation (3.1) and is a more direct test of the hypothesis. Information about covered interest rate parity will be relevant for the interpretation of deviations from uncovered interest rate parity. In addition to these information based tests, the


\(^6\)For example, Dooley and Isard (1983) and Danker et al (1985).

approach of specifying an aggregate demand function for bonds which is then inverted to give the difference of the expected returns on the two bonds as the dependent variable is used. Both approaches are used to provide evidence of whether uncovered interest rate parity holds between bonds denominated in yen and those denominated in dollars.

It is sometimes argued that the degree of substitution between bonds denominated in different currencies can be investigated by estimating bond demand equations and examining the size of the estimated coefficient of the expected rate of return differential. If this coefficient is very large, in absolute value, it is argued that the bonds are close to being perfect substitutes and uncovered interest rate parity is close to holding. However when bonds denominated in different currencies are perfect substitutes, separate demand functions for the two types of bonds are not defined and therefore separate demand functions cannot be sensibly estimated. Separate bond demand functions are not defined under both the perfect substitution hypothesis and the imperfect substitution hypothesis. Hence estimates from bond demand functions cannot provide any information about whether bonds are perfect substitutes.

Consistent with the definition of the ex-post nominal return differential discussed in section 4.1, the expected nominal return differential on j-period bonds is

\[ r_{t,j}^e = (s_{t,j}^e - s_t) + j(RF_{t,j} - RJ_{t,j})/100. \]

If uncovered interest rate parity holds, expected rates of return will be equalised and this expected risk premium will be driven to zero. A slightly less rigorous statement of uncovered interest rate parity would be to say the difference of the expected rates of return is random and is best represented by a white noise process. As a result, deviations from uncovered interest rate parity should not be serially correlated and should not be correlated with any past information.

A bond demand equation is used to determine what variables might be related to movements in the risk premium. The risk premium is then regressed on these variables and the joint significance of these variables determines whether the evidence is consistent with uncovered interest rate parity or not. In this Chapter, the demand equation that is examined is one for yen-denominated bonds. That demand function is specified as an aggregate of demands for Japanese yen-denominated bonds by four sectors - the Japanese private non-financial sector, the

\[ \text{Danker et al (1985).} \]

\[ \text{Yen-denominated bonds of all maturities are presumed to be perfect substitutes for one another. A similar assumption is made with respect to dollar-denominated bonds.} \]
Japanese private financial sector, the rest of the world’s private non-financial sector and the rest of the world’s private financial sector\(^{10}\). Data is not publicly available on holdings of yen-denominated bonds disaggregated by holder\(^{11}\). Notwithstanding this, the theoretical disaggregation of bond demands by economic agents is useful in that it provides some insights into the variables to which different economic agents respond. It is postulated that these variables differ amongst the agents because the legal and other constraints they face differ.

The Japanese private sector real demand for yen-denominated securities, \(B/P\), is obtained by aggregating the Japanese financial sector’s demand for yen securities and the Japanese private non-financial sector’s demand for yen securities. The variable deemed to be of relevance to Japanese agents is the real value (in yen) of their holdings of yen securities.

The Japanese financial sector’s demand for yen securities is presumed to be influenced by the expected risk premium\(^{12}\), \(\text{RP}^e_n\), the real amount of funds that financial institutions have available for investment after meeting their reserve requirements (that is, demand and time deposits minus reserves), \(\text{ND}/P\), and the rate of interest charged by the Bank of Japan on central bank loans to the banks, \(\text{RD}^3\). It is assumed that an increase in \(\text{RP}^e_n\) (an increase in the expected rate of return on dollar bonds relative to yen bonds) will lead to a decrease in the demand for yen bonds, an increase in the disposable funds of financial institutions will lead to an increase in the demand for yen bonds while an increase in the Bank of Japan’s discount rate will mean less borrowing from the central bank and more yen borrowing so leading to a reduction in the demand for yen bonds.

The Japanese private non-financial sector’s real demand for yen-denominated

\(^{10}\)The financial sector in Japan and the rest of the world are limited to the banking sector.

\(^{11}\)The study by Danker et al (1985) used confidential monthly data made available by the Bank of International Settlements and the Bank of Japan. This enabled approximate disaggregation of the aggregate stock of yen-denominated bonds into Japanese and rest of the world holdings. An unsuccessful attempt was made to obtain that data from the Federal Reserve. The data used by Danker et al, the external assets and liabilities of Japanese foreign exchange banks, is available on a quarterly basis from the Annual Reports of the Bank of International Settlements but the usefulness of this data set diminishes after December 1980, because the new Japanese Foreign Exchange Law undermines some of the key assumptions made by Danker et al in the construction of their series on domestic and foreign holdings of yen-denominated bonds. This is the reason why Danker et al’s estimation period finishes in December 1980: Danker et al (1985, p.7). Hence a different data set is used here.

\(^{12}\)At this stage, it is presumed to be the \(n\)-period expected risk premium. The assumption that bonds of any maturity denominated in one currency are perfect substitutes suggests the choice is unimportant. Should bonds denominated in the same currency but with different maturities be imperfect substitutes, then the specification of the bond demand function will be incorrect.

\(^{13}\)Implicitsly it is being assumed that the absolute size of reactions in bond demands to changes in the interest rate on dollar-denominated bonds, yen-denominated bonds and the expected rate of change of the exchange rate are identical. A similar assumption is made for all other demand functions.
bonds is presumed to depend negatively on the risk premium, positively on the 
private sector's real wealth, \( W/P \) and negatively on the rate of interest on time 
deposits, \( RT \), since time deposits are a substitute for yen securities. Real income, \( Y \), 
is included because the transaction demand for money must be offset elsewhere in 
the private sector's portfolio. However the sign of real income effects in the demand 
for yen (and dollar) bonds is unclear, Equation (4.4) represents the sum of the 
Japanese financial and non-financial sectors' demands for yen-denominated bonds:\textsuperscript{14}:

\[
B/P = a_0 + a_1 R P^e_n + a_2 RT + a_3 RD + a_4 Y + a_5 N D/P + a_6 W/P + u_1 
\tag{4.4}
\]
\( a_1, a_2, a_3 < 0 \) and \( a_5, a_6 > 0, \)

where \( ND \) is the nominal disposable funds of the Japanese financial institutions, \( W \)
is the Japanese private non-financial sector's nominal wealth, \( P \) is the Japanese 
price level and \( u_j \) in equations (4.4)-(4.7) are error terms. The expected signs of the 
coefficients appear under the equation.

Based on identical arguments, a similar equation can be derived for the rest of 
the world private sector's demand (in dollars) for yen securities, \( B^*/P^*S \). The only 
difference is that the variable deemed to be of relevance to the rest of the world's 
agents is the real value (in dollars) of their holdings of yen-denominated bonds.\textsuperscript{15} The rest of the world private sector's demand for yen securities is assumed to be:

\[
B^*/P^*S = b_0 + b_1 R P^e_n + b_2 R T^* + b_3 R D^* + b_4 Y^* + b_5 N D^*/P^* 
+ b_6 W^*/P^* + u_2 
\tag{4.5}
\]
\( b_1, b_2, b_3 < 0 \) and \( b_5, b_6 > 0, \)

where variables with a '*' are the rest of the world equivalents to the Japanese 
unstarred variables\textsuperscript{15} and \( S \) is the yen/dollar exchange rate. Danker \textit{et al} (1985) 
used equations similar to (4.4) and (4.5) to derive separate equations for the risk 
premium based on the domestic demand for yen-denominated bonds and the foreign 
demand for yen-denominated bonds\textsuperscript{16}.

Data is not available on a monthly basis for \( B \) and \( B^* \) separately but is

\textsuperscript{14} Time subscripts are excluded for ease of exposition.

\textsuperscript{15} \( N D^* \) and \( W^* \) are measured in dollars and \( B^* \) is measured in yen.

\textsuperscript{16} Their foreign bond demand equation set \( b_2 = b_3 = b_4 = b_5 = 0. \)
available for the aggregate $BAGG = B + B^*$. Hence it is useful to derive an aggregate world demand for yen securities that is obtained as a linear approximation of the sum of equations (4.4) and (4.5):

$$BAGG/P = c_0 + c_1RP_n + c_2RT + c_3RT^* + c_4RD + c_5RD^* + c_6Y$$
$$+ c_7Y^* + c_8ND/P + c_9ND^*/P^* + c_{10}W/P$$
$$+ c_{11}W^*/P^* + c_{12}SP^*/P + u_3$$

(4.6)

This equation is rather similar to the aggregate bond demand equation derived by Danker et al. (1985, p.10) for Canada, although here the domestic and foreign countries are treated symmetrically.

Since this equation is assumed to be a part of a simultaneous equation system, the normalization restriction is arbitrary and the equation can be rewritten with the risk premium as the dependent variable:

$$RP_n = d_0 + d_1RT + d_2RT^* + d_3RD + d_4RD^* + d_5Y + d_6Y^*$$
$$+ d_7ND/P + d_8ND^*/P^* + d_9W/P + d_{10}W^*/P^* + d_{11}SP^*/P$$
$$+ d_{12}BAGG/P + u_4$$

(4.7)

There are of course relationships between the coefficients of equations (4.6) and (4.7), for example, $d_j = -c_{j+1}/c_1$, $j = 1, \ldots, 11$, and $d_{12} = 1/c_1$. When dollar and yen bonds

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17Foreign official holdings of Japanese government securities were assumed to be zero. As Japan opens its financial markets and liberalizes controls on foreign government holdings of these assets, this assumption becomes less and less realistic. Unfortunately, breakdowns of central bank holdings of foreign exchange reserves by currency and by asset (jointly) are not available. For example, foreign central banks hold yen deposits with the Bank of Japan and Japanese banks, in addition to yen-denominated bonds.

18It is assumed that there is some substitution between yen- and dollar-denominated bonds. This new normalization will be invalid if $c_1 = 0$ since all the coefficients of equation (4.6) would be being divided by zero. The situation when $c_1 = 0$ is where the demand for yen-denominated bonds is not responsive to movements in the expected risk premium, that is, there is no substitution between yen- and dollar-denominated bonds.

It is well-known that while the normalization restriction is arbitrary, with most instrumental variable estimation methods different normalization restrictions will lead to different estimates of the underlying parameters. In small samples, the estimation methods will also lead to different results when testing the same hypotheses on the underlying parameters. A similar renormalization of a bond demand equation has been applied in Frankel (1983b) and Danker et al. (1985). In Frankel (1982), a system of asset demands that depend on rates of return is renormalized making the rates of return the dependent variables.

As Frankel (1982, 1983b) notes should any of the quantity variables be measured inexactly or any relevant explanatory variable be excluded from the demand function, estimated coefficients and standard errors from equation (4.7) may be inconsistent.
become closer and closer substitutes, \( c_1 \) gets larger in absolute value. In the perfect substitution case, \( c_1 \) becomes infinite and hence all the \( d_j \)'s can be expected to be zero. In this case, the risk premium is not related systematically to any variables on the right hand side of (4.7). In the imperfect substitution case, at least some of the \( d_j \)'s would be expected to be non-zero.

The test of the perfect substitution hypothesis derived from (4.3) and (4.7) appear to be very similar. Including all the variables on the right hand side of (4.7) into \( Z_t \) would give rise to an apparently identical testing procedure. In (4.3), it is presumed that the elements of \( Z_t \) are not correlated with \( u_{t+j} \), since \( u_{t+j} \) is a forecast error that is not correlated, by definition, with information at time \( t \). However, the assumptions made in the derivation of (4.7) imply at the very least that \( (\text{BAGG}/P)_t \) is correlated with the error \( u_{4,t} \). There is good reason to believe that other variables will also be correlated with the error.

One of the matters left unspecified is how the expected value of the log of the future exchange rate given a certain information set is formed. The expected value of the log of the exchange rate at time \( t+n \) given only information at time \( t \) is determined using McCallum’s (1976) method. That is, the expected value is replaced by its realised value. It is easily illustrated that the use of this method introduces the possibility that the equation’s error will be serially correlated.

The McCallum rational expectations solution relies on the following relationship:

\[
S_{t+j} = S_{t+j/t} + e_{t,j} \tag{4.8}
\]

where \( S_{t+j} \) is the log of the observed exchange rate at time \( t+j \), \( S_{t+j/t} \) is the expected value, formed at time \( t \), of the log of the exchange rate at time \( t+j \) and \( e_{t,j} \) is a disturbance that is uncorrelated with any information available at time \( t \), that is \( E(e_{t,j}/I_t)=0 \) and \( I_t \) is information available at time \( t \). Making the McCallum substitution into (4.7) implies the error will be \( w_t = u_{4,t} + e_{t,j} \). Even when \( E(u_{4,t}/I_{t-1})=0 \), there is no way, a priori, to eliminate the possibility of correlation between the \( j \)-month forecast error \( e_{t,j} \) revealed at time \( t \) and the innovation, \( u_{4,t} \), which also occurs at time \( t \). This suggests that \( w_t \) and \( w_{t+j} \) are potentially correlated. Similarly the possibility of a correlation between \( e_{t-k,j} \), \( 0 < k < j \) revealed at time \( t-k+j \) and the innovation \( u_{4,t} \) cannot be eliminated so that \( w_t \) and \( w_{t+k} \), \( 0 < k < j \) are potentially correlated. By itself this argument suggests that \( w_t \) the

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19 This implies that \( u_{4,t} \) is not an autoregression.

20 This is a generalization of the argument contained in Example 1 of Cumby et al (1983, p.337).
error of the j-month risk premium equation, will potentially but not necessarily have a structure like that of a moving average of order j, since \( w_{t+k} \) and \( w_t \) are potentially correlated \((0 < k \leq j)\). The argument for correlation amongst the \( w_t \)'s is even stronger when the forecast period is longer than the sampling period \((j > 1)\). In this case, it can only be verified that \( E(e_{t,j}e_{t+h,j}) \) is zero for \( h \geq j \) suggesting that \( e_{t,j} \) has a moving average of order \( j-1 \) structure. However, it is possible that it will be a moving average of a lower order, or even a moving average of order zero, namely a white-noise process. Combining these results with respect to the possible correlation between \( e_{t-k,j} \) and \( u_{t,t} \), \( 0 < k \leq j \) and the possible correlation between \( e_{t,j} \) and \( e_{t+h,j} \), \( h < j \) and \( j > 1 \), suggests that \( w_t \) will have a moving average structure of up to order \( j \). It is still possible that \( w_t \) will be white-noise process. These results suggest that even when one-month bonds are used together with monthly data that the error term in equation (4.7) after replacement of the expected value of the log of the exchange rate by its realised value could possibly be serially correlated and be a moving average of order one. It should be stressed that these correlations are only possibilities and not necessities suggesting that it may be sensible to test for the existence of the serial correlation first and then if significant serial correlation is detected to estimate the equation using an appropriate estimation technique.


Risk premium equations based on equations (4.3) and (4.7) were estimated using the monthly data defined in Appendix A. Two dependent variables were used: RP1, the one-month risk premium, that is, the difference between the rates of return on one-month dollar bonds and one-month yen bonds, and RP3, the three-month risk premium, that is, the difference between the rates of return on three-

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21 Hansen and Hodrick (1980).

22 Suppose the data generating process for \( s_t \) was

\[
s_t = \epsilon_t + \phi_1 \epsilon_{t-1} + \phi_2 \epsilon_{t-2} + \ldots
\]

where \( \epsilon_t \)'s are independently distributed white-noise errors. Taking expectations at time \( t \) of \( s_{t+n} \) gives

\[
s_{t+n} = \epsilon_{t+n} + \phi_1 \epsilon_{t+n-1} + \phi_2 \epsilon_{t+n-2} + \ldots
\]

The forecast error, \( e_{t,n} \), is therefore

\[
e_{t,n} = \epsilon_{t+n} + \phi_1 \epsilon_{t+n-1} + \phi_2 \epsilon_{t+n-2} + \ldots + \phi_{n-1} \epsilon_{t+1}
\]

This last equation indicates that \( e_{t,n} \) is in general an MA(n-1). But if \( \phi_1 = \ldots = \phi_{n-1} = 0 \) then it would be an MA(0).
month dollar bonds and three-month yen bonds.

The discussion in Chapter 3 indicated that a sample period where covered interest rate parity holds will enable a clearer interpretation of the results. The results in Chapter 3 indicate that using data after December 1980, the evidence is consistent with one- and three-month bonds being imperfect substitutes. For these two reasons, in this Chapter, the period following December 1980 is focused on, but results are also presented for similar periods to those in Chapter 3 for purposes of comparison. An additional reason for focusing on the period following December 1980 was that this period was not considered by Danker et al. (1985).

Private sector wealth in Japan is defined as the sum of cumulated Japanese Government deficit (proxied by the stock of Japanese Government bonds, in all currencies) and the cumulated Japanese current account surplus. The cumulated Japanese current account surplus is used as the rest of the world's cumulated current account deficit. This figure is subtracted from the outstanding stock of United States government bonds in private hands (a proxy for rest of the world's cumulated government deficit) to obtain figures for private sector wealth in the rest of the world. Other rest of the world variables were proxied by their United States' equivalents with the exception of RT*. RT* does not appear in the estimated equations because there was little variation in the rates of interest on time deposits in the U.S. over the sample period.

**Information Approach**

The first issue examined is whether there is any information available at time \( t \) that is correlated with the one-month and three-month ex-post risk premia. Three information sets are used and these are labelled A, B and C. Information set A

23 Rates of return include the actual capital gain associated with exchange rate changes.

24 For the current account surplus, cumulation starts in January 1972. Base figures for Japan's asset position vis a vis the rest of the world in December 1971 are taken from Bisignano and Hoover (1980).

25 A number of alternatives to this measure are possible. For example, using the cumulated United States' current account position instead of the negative of the Japanese current account position. However, for the United States monthly values of the current account surplus are not available but figures on the trade balance are. Alternatively monthly current account figures could be obtained by the method of interpolation using quarterly figures as was attempted in Bisignano and Hoover (1980). For the cumulated government deficits of the rest of the world, deficits for countries other than the United States could have been used.

26 A number of alternatives to this proxy for the rest of the world readily come to mind, for example, using weighted sums of variables of a number of foreign countries (including the United States) or using weighted sums of variables of a number of countries (excluding the United States) and the variables for the United States as well. In both cases the choice of weights is problematic. Danker et al (1985) recognize this problem but impose zero coefficients on most of the foreign variables.
contains \([RP_{t-j}, RP_{t-j-1}]\), information set B contains \([BAGG/P, SP'/P, ND/P, ND'P, WP/P, WP'/P', RD, RD', RT, Y, Y']\). Information set C contains all the information in sets A and B. The arguments in section 4.1 concerning the form of the error in equation (4.3) suggest that for the one-month risk premium equation the error should be white-noise, while the error in the three-month risk premium equation should be a moving average of order 2. Given the assumptions of this approach\(^{27}\), OLS estimates are consistent but some adjustment of the estimated covariance matrix may be necessary for heteroskedasticity and, in the case of the three-month risk premium, serial correlation\(^{28}\).

Table 4-1 contains the results for the one-month risk premium equations. In Table 4-1, \(LM_j\) are Lagrange Multiplier tests to test if the error are white-noise as opposed to simple autoregressions or moving averages of order \(j\). \(LM_{HI}\) denotes a test of heteroskedasticity based on regressing the square of the OLS residuals on the information set\(^{29}\). OLS indicates the usual F-test for the significance of all coefficients except the constant using the usual OLS variance-covariance matrix and OLS(H) is a similar test except that it uses a heteroskedastic consistent estimate of the variance-covariance matrix\(^{30}\). The OLS(H) test is, under the null hypothesis, distributed as chi-square with degrees of freedom determined by the number of coefficients being tested equal to zero\(^{31}\). Throughout this Chapter, superscripts a, b, and c indicate that a statistic is significant at the 10, 5 and 1 per cent levels respectively. In general, little serial correlation is indicated which is consistent with the assumptions of the hypothesis under test. When the information set is limited to lagged values of the dependent variable (set A), the risk premium appears to be uncorrelated with that information set whether an OLS or heteroskedastic-adjusted variance-covariance matrix is used. This is true for all sample periods indicated.

However whenever either information sets B or C are used, that is variables suggested by the portfolio model are included, using an OLS covariance matrix indicates that the hypothesis that the coefficients on all the elements of the

\(^{27}\)In particular, the assumption that the regressors are strictly exogenous.


\(^{29}\)Pagan and Hall (1983). As a result, for information sets A, B and C these tests are distributed as \(\chi^2(2)\), \(\chi^2(11)\) and \(\chi^2(13)\) respectively under the null hypothesis of homoskedasticity.

\(^{30}\)For OLS, the relevant critical values are derived from the tables for the F distribution.

\(^{31}\)For information sets A, B and C, the degrees of freedom are 2, 11 and 13 respectively. OLS(H) was computed using the OLS option in the Two-Step Two-Stage Least Squares program described in Cumby and Huizinga (1984).
Table 4-1: One-Month Risk Premium Equations: OLS Estimates

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<th>Info</th>
<th>Estimation</th>
<th>Period</th>
<th>LM₁</th>
<th>LM₂</th>
<th>LM₃</th>
<th>LM₄</th>
<th>OLS</th>
<th>OLS(H)</th>
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information set are zero can be rejected at the five per cent level in all but three periods (information set C and periods: 73:03-80:11, 73:03-84:12 and 75:01-79:04). For those three periods, significant hetroskedasticity is detected and a hetroskedastic consistent variance-covariance matrix should be used. Making this adjustment indicates rejection of the hypothesis that no variable is a significant explanator of the risk premium. Hence for all time periods when information sets B and C, the hypothesis that no variable is a significant explanator is rejected. For information sets B and C, depending on the estimation period, a number of variables (ND, ND*, RD, RD*, SP*/P and WP/P) appeared to be individually significant at the five per cent level but there was no variable that was consistently individually significant across all estimation periods for a given information set.

Table 4-2 contains the corresponding results for the three-month risk premium. For the three-month risk premium, it is expected that the errors will be up to a moving average of order 2. Consistent with this hypothesis, significant serial correlation is detected in the errors across all time periods. Given the significant serial correlation, the application of generalized least squares (GLS) in this situation might appear to be an obvious solution. However, the consistency of GLS estimates requires the assumption that the regressors are predetermined whereas in these rational expectations models, it can only be shown that the regressors will be strictly exogenous and under this assumption GLS estimates are inconsistent. In Chapter 8, a test of whether the regressors are predetermined or strictly exogenous based on Hausman’s (1978) procedure is developed. This test is labelled HA in Table 4-2 and is distributed, under the null hypothesis that all the regressors are predetermined, as a chi-square with the degrees of freedom being determined by the number of coefficients (including the constant) being estimated.

For all periods on information set A, the hypothesis of predeterminedness is accepted suggesting that it would be valid to use GLS estimates for the hypothesis tests. This may merely reflect the fact that the variables in A tend to be insignificant explanators whether OLS or GLS estimates are used. For information sets B and C, the hypothesis of predeterminedness is generally rejected. For the samples where the hypothesis of predeterminedness is accepted, there is always a sub-period when it is rejected. To err on the side of caution, the use of OLS estimates would seem to be appropriate. In any case, the hypothesis that the information in informations sets B or C is of no use in predicting the three-month risk premium is rejected at at least the five

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32 Hansen and Hodrick (1980).

33 So for information sets A, B and C, the degrees of freedom are 3, 12 and 14 respectively.
### Table 4-2: Three-Month Risk Premium Equations: OLS Estimates

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<th>Info</th>
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<th>LM₃</th>
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percent level whether GLS estimates (denoted GLS), OLS estimates with the variance covariance matrix corrected for MA(2) errors (denoted MA(2)) or OLS estimates with the variance covariance matrix corrected for MA(2) and heteroskedastic errors (denoted MA(2)+H) for all but one case\textsuperscript{34}. For both one-month and three-month risk premia equations these results would seem to provide quite strong evidence suggesting that the risk-premia is correlated with some information available at time t. This result holds provided the information set includes portfolio model based variables rather than just lagged values of the risk premia available at time t.

**Bond Demand Approach**

In the light of these results it is useful to examine the results based on the portfolio approach. For the purposes of estimating equation (4.7), private sector real wealth in both countries, W/P and W'/P', the real available funds of the financial institutions in both countries, ND/P and ND'/P', and the current exchange rate, S are treated as endogenous so that an instrumental variable estimation method is used. Given the short-run nature of portfolio models of the exchange rate, income in both countries is presumed to be predetermined. Policy variables like the discount rates (RD and RD') and the Japanese time deposit rate (RT) are also treated as predetermined. The assumption that these variables are in fact predetermined is tested later. It is necessary to use an instrumental variable technique not because the variables dated at time t are not presumed to be contained in the information set at time t but because of the possibility of endogeneity\textsuperscript{35}. Earlier arguments suggested that for the one-month risk premium equation the error could be an MA(1) and for the three-month risk premium equation it could be up to an MA(3). The equations are estimated by an instrumental variable method and I.M. is one of the tests for jth order serial correlation discussed in Pagan and Hall (1983). It is constructed so that it will be valid when the equation is estimated by an instrumental variable method. It tests the hypothesis that \( \pi_j \) is zero in either \( u_t = \pi_j u_{t-j} + \epsilon_t \) or \( u_t = \epsilon_t + \pi_j e_{t-j} \), where \( \epsilon_t \) is white noise and the test is distributed as a standard normal under the null

\textsuperscript{34}The exception is for information set B, 75:01-80:11 and GLS estimates. The HA test indicates that GLS estimates are likely to be inapplicable in any case. Tests denoted MA(2) and MA(2)+H were computed using the OLS option in the Two-Step Two-Stage Least Squares program described in Cumby and Huizinga (1984).

\textsuperscript{35}Except where otherwise stated, for both risk premia equations, the, instrument set used was: BAGG/P,-1', SP'/P,-1', ND/P,-1', ND'/P,-1', WP/P,-1', WP'/P,-1', RD, RD', Y, Y', RT, Y,-1', Y,-1', (P/P),-1 and a time trend.
hypothesis of $r_j = 0$. In Chapter 8, the validity of this test in this type of rational expectations model is demonstrated. $LM_{HI}$ is a test for heteroskedasticity based on a regression of the squared residuals from an instrumental variable regression on the instrument set.$^{36}$

Results for the one-month premia are contained in Table 4-3. None of the tests for first order serial correlation ($LM_1$) indicate the presence of serial correlation while for two periods (75:01-84:12 and 79:05-84:12) significant second order serial correlation ($LM_2$) is observed. Four tests of the hypothesis that the coefficients on the variables except the constant are zero are used. The tests are based on different estimation techniques: the standard instrumental variable estimator (IV); the Two-Step Two-Stage Least Squares estimator with an MA(1) correction (2S2SLS MA(1)); the Two-Step Two-Stage Least Squares estimator with an allowance for heteroskedasticity (2S2SLS H) and the Two-Step Two-Stage Least Squares estimator with an allowance for MA(1) and heteroskedastic errors (2S2SLS MA(1)+H)$^{37}$. Considering the periods where no significant serial correlation is observed, the test of all the parameters (except the constant) being zero is accepted at the five percent level using the usual instrumental variable variance covariance matrix. The test of heteroskedasticity does not indicate any heteroskedasticity. It is only for the two periods where significant serial correlation is observed that there is any evidence supporting a rejection of the null hypothesis that the coefficients on the portfolio variables are zero. However, results on subsamples within these two periods suggest acceptance of the hypothesis.

Earlier the variables $Y$, $Y^*$, $RD$, $RD^*$ and $RT$ were presumed to be predetermined and therefore valid instruments for these regressions.$^{38}$. Should any of these variables be invalid instruments, the consistency of the estimated coefficients and the validity of the hypothesis tests would be questionable. END denotes a test of whether these variables are valid instruments, and is distributed, under the null hypothesis that the variables being tested are predetermined, as a chi-square with

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$^{36}$Pagan and Hall (1983) contains a discussion of this test.


$^{38}$When $RD$, $RD^*$, $RT$, $Y$ and $Y^*$ are treated as invalid instruments (and therefore deleted from the instrument set) and are replaced by $RD_{-1}^*$, $RD_{-1}$ and $RT_{-1}$, the tendency to accept the hypothesis that the coefficients on all the portfolio variables are zero is much stronger. In this case they are accepted (at the five per cent level) for all periods when IV estimation is used; for six out of eight periods when 2S2SLS MA(1) is used; for four out of eight periods when 2S2SLS MA(1)+H is used and for three out of eight periods when 2S2SLS H is used.
Table 4-3: One-Month Risk Premium Equations: Portfolio Approach

<table>
<thead>
<tr>
<th>Estimation Period</th>
<th>LM₁</th>
<th>LM₂</th>
<th>END</th>
<th>LM₁₁</th>
<th>IV</th>
<th>2S2SLS</th>
<th>2S2SLS</th>
<th>2S2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>73:03-79:04</td>
<td>-0.45</td>
<td>-0.48</td>
<td>5.1</td>
<td>18.6</td>
<td>17.7ᵃ</td>
<td>22.1ᵇ</td>
<td>41.0ᶜ</td>
<td>83.5ᶜ</td>
</tr>
<tr>
<td>73:03-80:11</td>
<td>-0.67</td>
<td>-1.77ᵇ</td>
<td>2.9</td>
<td>18.3</td>
<td>19.5ᵃ</td>
<td>26.5ᵇ</td>
<td>29.8ᶜ</td>
<td>32.5ᶜ</td>
</tr>
<tr>
<td>73:03-84:12</td>
<td>0.41</td>
<td>-1.68ᵃ</td>
<td>11.2ᵇ</td>
<td>22.7ᵃ</td>
<td>19.0ᵃ</td>
<td>21.2ᵇ</td>
<td>40.6ᶜ</td>
<td>56.3ᶜ</td>
</tr>
<tr>
<td>73:03-84:12A</td>
<td>0.80</td>
<td>-1.18</td>
<td>0.4</td>
<td>22.5ᵃ</td>
<td>21.1ᵇ</td>
<td>20.3ᵇ</td>
<td>39.1ᶜ</td>
<td>44.1ᶜ</td>
</tr>
<tr>
<td>75:01-79:04</td>
<td>-0.04</td>
<td>-1.02</td>
<td>2.3</td>
<td>14.4</td>
<td>13.7</td>
<td>39.3ᶜ</td>
<td>34.8ᶜ</td>
<td>116.2ᶜ</td>
</tr>
<tr>
<td>75:01-80:11</td>
<td>-0.54</td>
<td>-1.59</td>
<td>6.4</td>
<td>16.3</td>
<td>16.2</td>
<td>25.6ᶜ</td>
<td>32.7ᶜ</td>
<td>38.4ᶜ</td>
</tr>
<tr>
<td>75:01-84:12</td>
<td>-0.08</td>
<td>-2.48ᵇ</td>
<td>9.1</td>
<td>19.4</td>
<td>22.2ᵇ</td>
<td>26.2ᶜ</td>
<td>39.9ᶜ</td>
<td>42.5ᶜ</td>
</tr>
<tr>
<td>79:05-84:12</td>
<td>0.45</td>
<td>-2.23ᵇ</td>
<td>4.1</td>
<td>12.9</td>
<td>13.1</td>
<td>20.3ᵇ</td>
<td>27.4ᶜ</td>
<td>28.4ᶜ</td>
</tr>
<tr>
<td>80:12-84:12</td>
<td>-1.01</td>
<td>-0.91</td>
<td>6.2</td>
<td>12.6</td>
<td>8.4</td>
<td>18.3ᵃ</td>
<td>15.4</td>
<td>60.2ᶜ</td>
</tr>
</tbody>
</table>

The degrees of freedom determined by the number of variables being tested. ³⁹ Acceptance of the null hypothesis suggests that the variables are valid instruments and that the tests based on that assumption would be valid. Should the null hypothesis be rejected, some (or all) of those variables are invalid instruments and so should be removed from the instrument set and be replaced by a variable that is more likely to be a valid instrument, for example, the variable lagged one period. For only one period (73:03-84:12), a value of END significant at the five per cent level found. That test seemed to indicate that RT and Y’ were invalid as instruments. A test that RT and Y’ were valid instruments given the assumed validity of Y, RD and RD’ as instruments gave a test statistic of 10.7 (critical value X²(2)(0.01) = 9.21). In 73:03-84:12A, RT and Y’ are treated as endogenous and the figure for END is a test of whether Y, RD and RD’ are valid instruments. They seem to be valid instruments. For this time period, the null hypothesis that the coefficients are all zero is rejected although for some subsets of observations they are not.⁴⁰

Table 4-4 contains the parameter estimates for the one-month risk premium equation for the period December 1980 to December 1984. Consistent with the joint test based on a instrumental variable variance covariance matrix, none of the

³⁹ A number of forms of this test are available: Spencer and Berk (1981, 1982), Hausman and Taylor (1981) and Smith (1983). The LM₂S version of the test discussed in Smith (1983, p.9) was used. In order to carry out this test, instruments in addition to those specified on page 76 were required. These were: RD₋₁, RD₋₁ and RT₋₁.

⁴⁰ In the regressions for 1973:03-84:12A, the instrument set on page 76 was altered by deleting RT and Y’ and adding RT₋₁.
<table>
<thead>
<tr>
<th>Estimation</th>
<th>IV</th>
<th>2S2SLS MA(1)</th>
<th>2S2SLS H</th>
<th>2S2SLS MA(1) H</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAGG/P</td>
<td>-189.7</td>
<td>-205.1</td>
<td>-192.4</td>
<td>-183.2</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(1.76)</td>
<td>(1.49)</td>
<td>(3.28)</td>
</tr>
<tr>
<td>SP'/P</td>
<td>-1.39</td>
<td>-1.52</td>
<td>-1.29</td>
<td>-1.23</td>
</tr>
<tr>
<td></td>
<td>(0.82)</td>
<td>(1.18)</td>
<td>(1.06)</td>
<td>(1.73)</td>
</tr>
<tr>
<td>ND/P</td>
<td>248.0</td>
<td>198.2</td>
<td>202.1</td>
<td>190.6</td>
</tr>
<tr>
<td></td>
<td>(1.56)</td>
<td>(1.88)</td>
<td>(1.96)</td>
<td>(2.84)</td>
</tr>
<tr>
<td>ND'/P'</td>
<td>-7.95</td>
<td>-5.73</td>
<td>-3.55</td>
<td>3.01</td>
</tr>
<tr>
<td></td>
<td>(0.43)</td>
<td>(0.40)</td>
<td>(0.25)</td>
<td>(0.27)</td>
</tr>
<tr>
<td>WP/P</td>
<td>-7.70</td>
<td>23.9</td>
<td>-5.04</td>
<td>-21.7</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.25)</td>
<td>(0.05)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>WP'/P'</td>
<td>178.3</td>
<td>174.2</td>
<td>205.6</td>
<td>224.2</td>
</tr>
<tr>
<td></td>
<td>(0.71)</td>
<td>(0.84)</td>
<td>(0.96)</td>
<td>(1.50)</td>
</tr>
<tr>
<td>RD</td>
<td>-124.5</td>
<td>-121.18</td>
<td>-111.1</td>
<td>-108.7</td>
</tr>
<tr>
<td></td>
<td>(1.75)</td>
<td>(2.11)</td>
<td>(2.11)</td>
<td>(3.45)</td>
</tr>
<tr>
<td>RD'</td>
<td>60.4</td>
<td>52.0</td>
<td>54.3</td>
<td>51.7</td>
</tr>
<tr>
<td></td>
<td>(1.00)</td>
<td>(1.18)</td>
<td>(1.14)</td>
<td>(1.17)</td>
</tr>
<tr>
<td>RT</td>
<td>118.4</td>
<td>87.8</td>
<td>76.3</td>
<td>51.9</td>
</tr>
<tr>
<td></td>
<td>(1.13)</td>
<td>(1.32)</td>
<td>(1.25)</td>
<td>(1.16)</td>
</tr>
<tr>
<td>Y</td>
<td>-8.69</td>
<td>-7.57</td>
<td>-5.71</td>
<td>-3.96</td>
</tr>
<tr>
<td></td>
<td>(1.29)</td>
<td>(1.61)</td>
<td>(0.97)</td>
<td>(0.67)</td>
</tr>
<tr>
<td>Y'</td>
<td>-4.82</td>
<td>-4.69</td>
<td>-5.76</td>
<td>-5.00</td>
</tr>
<tr>
<td></td>
<td>(0.57)</td>
<td>(0.80)</td>
<td>(0.84)</td>
<td>(0.84)</td>
</tr>
</tbody>
</table>
coefficients (based on IV estimates) are individually significant. For other estimation methods, some of the coefficients are significant. For this period and for all four estimation techniques, BAGG/P, ND/P, WP*/P* and RD have signs that are consistent with those predicted. RT and RD* have signs consistently opposite to those predicted. The signs of ND*/P* and WP/P are dependent on the estimation technique used. Using an IV technique, both have signs that are inconsistent with those predicted.

For the three-month risk premia, Tables 4-6 and 4-5 contain the tests of the hypothesis that all the coefficients on the portfolio variables are zero and an evaluation of the models. Four estimation techniques, an instrumental variable estimator (IV); the Two-Step Two-Stage Least Squares estimator with an allowance for MA(3) errors (2S2SLS MA(3)); the Two-Step Two-Stage Least Squares estimator with an allowance for heteroskedasticity (2S2SLS H) and Two-Step Two-Stage Least Squares estimator with an allowance for both MA(3) and heteroskedastic errors (2S2SLS MA(3) H), were used. The null hypothesis that the portfolio variables have no explanatory power is consistently rejected at the five per cent level regardless of the estimation method used and regardless of the estimation period (see Table 4-5).

Table 4-5: Three-Month Risk Premium Equations: Tests of Restrictions

<table>
<thead>
<tr>
<th>Estimation</th>
<th>IV</th>
<th>2S2SLS MA(3)</th>
<th>2S2SLS H</th>
<th>2S2SLS MA(3) + H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73:03-79:04</td>
<td>44.3c</td>
<td>43.2c</td>
<td>63.4c</td>
<td>129.9c</td>
</tr>
<tr>
<td>73:03-80:11</td>
<td>81.0c</td>
<td>65.2c</td>
<td>127.9c</td>
<td>91.6c</td>
</tr>
<tr>
<td>73:03-84:12</td>
<td>61.8c</td>
<td>24.8c</td>
<td>123.5c</td>
<td>76.0c</td>
</tr>
<tr>
<td>75:01-79:04</td>
<td>42.8c</td>
<td>60.6c</td>
<td>86.6c</td>
<td>117.1c</td>
</tr>
<tr>
<td>75:01-80:11</td>
<td>58.0c</td>
<td>38.5c</td>
<td>83.6c</td>
<td>52.3c</td>
</tr>
<tr>
<td>75:01-84:12</td>
<td>68.4c</td>
<td>45.5c</td>
<td>104.1c</td>
<td>80.9c</td>
</tr>
<tr>
<td>79:05-84:12</td>
<td>55.7c</td>
<td>56.1c</td>
<td>95.1c</td>
<td>106.5c</td>
</tr>
<tr>
<td>80:12-84:12</td>
<td>29.0c</td>
<td>52.3c</td>
<td>84.2c</td>
<td>580.4c</td>
</tr>
<tr>
<td>80:12-84:12A</td>
<td>21.7b</td>
<td>45.1c</td>
<td>91.8c</td>
<td>428.2c</td>
</tr>
</tbody>
</table>

In Table 4-6, LM₁ is a test that \( π₁=π₂=π₃=0 \) in \( uₜ=π₁uₜ₋₁+π₂uₜ₋₂+π₃uₜ₋₃+eₜ \) or \( uₜ=eₜ+π₁eₜ₋₁+π₂eₜ₋₂+π₃eₜ₋₃ \) (\( eₜ \) is white-noise) and is distributed as a chi-square with

\[ 41 \] It should be noted that in some other periods, 73:03-79:04, 73:03-80:11, 73:03-84:12, 75:01-84:12 and 79:05-84:12, some of the coefficients are individually significant even though the joint tests are insignificant. There is no variable that is however consistently individually significant in even these time periods when IV variance covariance matrix estimates are used.
Table 4-6: Three-Month Risk Premium Equations: Model Evaluation

<table>
<thead>
<tr>
<th>Estimation</th>
<th>LM₁</th>
<th>LM₂</th>
<th>LM₃</th>
<th>LM₄</th>
<th>LM₅</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>73:03-79:04</td>
<td>0.57</td>
<td>-1.17</td>
<td>0.96</td>
<td>7.5ᵃ</td>
<td>9.2</td>
<td>8.2</td>
</tr>
<tr>
<td>73:03-80:11</td>
<td>2.78ᶜ</td>
<td>0.11</td>
<td>-0.50</td>
<td>8.8ᵇ</td>
<td>18.3</td>
<td>4.8</td>
</tr>
<tr>
<td>73:03-84:12</td>
<td>9.17ᶜ</td>
<td>3.42ᶜ</td>
<td>0.22</td>
<td>89.7ᶜ</td>
<td>31.9ᶜ</td>
<td>9.0</td>
</tr>
<tr>
<td>75:01-79:04</td>
<td>1.92ᵃ</td>
<td>-0.30</td>
<td>-1.45</td>
<td>4.9</td>
<td>17.0</td>
<td>9.8</td>
</tr>
<tr>
<td>75:01-80:11</td>
<td>2.21ᵇ</td>
<td>1.01</td>
<td>-0.17</td>
<td>9.8ᵇ</td>
<td>12.0</td>
<td>10.3</td>
</tr>
<tr>
<td>75:01-84:12</td>
<td>3.80ᶜ</td>
<td>0.46</td>
<td>-0.21</td>
<td>19.3ᶜ</td>
<td>24.8ᵇ</td>
<td>5.7</td>
</tr>
<tr>
<td>79:05-84:12</td>
<td>1.58</td>
<td>-0.95</td>
<td>0.34</td>
<td>3.6</td>
<td>18.7</td>
<td>1.4</td>
</tr>
<tr>
<td>80:12-84:12</td>
<td>-0.28</td>
<td>-1.04</td>
<td>0.59</td>
<td>1.2</td>
<td>21.8</td>
<td>13.1ᵇ</td>
</tr>
<tr>
<td>80:12-84:12A</td>
<td>-0.98</td>
<td>-0.87</td>
<td>0.44</td>
<td>3.0</td>
<td>25.9ᵇ</td>
<td>4.0</td>
</tr>
</tbody>
</table>

three degrees of freedom, under the null hypothesis of white noise errors. Significant serial correlation is detected in four of the eight periods, in contrast to the OLS equations (Table 4-2) where it is found in all cases⁴². Significant heteroskedasticity using LM₅ is found in only one case. END again tests whether RD, RD', RT, Y and Y' are valid instruments⁴³. In only one case, 80:12-84:12 is the hypothesis that these variables are valid instruments rejected. The test suggested that RD' and Y' were endogenous and therefore invalid as instruments. Testing the endogeneity of RD' and Y', given the assumption that Y, RD and RT are valid instruments, gave a test statistic of 8.2 (critical value $\chi^2_{(2)}(0.05) = 5.99$). In the regression 80:12-84:12A, RD' and Y' are treated as endogenous and END in this case tests whether RT, RD and Y are valid instruments⁴⁴.

Table 4-7 contains the parameter estimates for the three-month risk premium equations for December 1980 to December 1984 under the assumption that RD' and Y' are endogenous. As with the one-month equations a number of variables have signs consistent with predictions (BAGG/P, ND/P, WP'/P', RD) and a number have signs that are inconsistent with those predicted (ND'/P', WP/P, RD' and

---

⁴²This may indicate that these IV based tests for serial correlation may lack power to detect serial correlation in these sample sizes.

⁴³Even when RD, RD', RT, Y and Y' are treated as invalid instruments and are replaced by RD₋₁, RD₋₂ and RT₋₁, the restriction that the coefficients are all zero is generally rejected across all time periods and all estimation techniques at the five per cent level. Three acceptances occur. Two are when the IV technique is used and the estimation periods were: 75:01-79:04 and 80:12-84:12. The other was when 2S2SLS MA(3) was used and the estimation period was 75:01-79:04.

⁴⁴The instrument set specified on page 76 in this regression is altered by deleting RD' and Y' and adding RD₋₁.
Across all four estimation techniques the signs are the same. There seems to be a consistency between the "problem variables" (incorrectly signed) for the one-month and three-month equations. For the IV technique, no variable was individually significant. For other estimation periods, the variables that were individually significant depended on the sample period and the estimation technique.

4.4 Are Bonds Just Bonds?

For three-month bonds, the evidence from both methods used in this Chapter suggested acceptance of the hypothesis that there is some systematic behaviour of the ex-post risk premia. This was regardless of whether the test was based on an information approach (provided the information set was not limited to lagged values of the risk premia) or a portfolio model. The evidence supporting the rejection of the null hypothesis is quite strong even from the portfolio approach. The evidence from the portfolio model is weakened by the fact that most of the variables had coefficients that were individually statistically insignificant from zero and by the fact that the signs of the estimated coefficients on a number of variables differed from those predicted by theory. Although the evidence presented is consistent with three-month dollar bonds and three-month yen bonds being imperfect substitutes, the variable that would be affected by sterilized intervention, the outstanding stock of yen denominated bonds in private hands, is not a significant explanator of movements of the ex-post risk premium. Nor are the interest rates on central bank lending or the time deposit rate significant explanators. These results provide no evidence to suggest that the central bank will be able to significantly influence the risk premium through changing these policy instruments.

For one-month bonds, the evidence is a little inconsistent. Using the information based approach the hypothesis that none of the variables are significant explanators is rejected in all periods when the information set included portfolio variables. The evidence tended to support the hypothesis that none of the variables were significant explanators when the portfolio approach was used. The latter results are consistent with those obtained by Danker et al (1985) over the period 1974-80.

The evidence from both Chapters 3 and 4 is consistent with three-month bonds denominated in different currencies being imperfect substitutes. For three-month bonds, the joint hypothesis that assets denominated in different currencies are perfect substitutes and exchange rate expectations are rational can be rejected for the period December 1980 to December 1984. For earlier periods, it is not clear whether the rejections are due to capital controls inhibiting arbitrage flows,
<table>
<thead>
<tr>
<th>Estimation</th>
<th>IV</th>
<th>2S2SLS MA(3)</th>
<th>2S2SLS H</th>
<th>2S2SLS MA(3) H</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAGG/P</td>
<td>-58.5</td>
<td>-57.5</td>
<td>-16.8</td>
<td>-45.3</td>
</tr>
<tr>
<td></td>
<td>(0.78)</td>
<td>(0.89)</td>
<td>(0.23)</td>
<td>(0.88)</td>
</tr>
<tr>
<td>SP*/P</td>
<td>-0.96</td>
<td>-0.89</td>
<td>-0.91</td>
<td>-0.91</td>
</tr>
<tr>
<td></td>
<td>(0.75)</td>
<td>(0.79)</td>
<td>(0.99)</td>
<td>(1.32)</td>
</tr>
<tr>
<td>ND/P</td>
<td>85.8</td>
<td>92.3</td>
<td>59.6</td>
<td>73.5</td>
</tr>
<tr>
<td></td>
<td>(0.76)</td>
<td>(0.93)</td>
<td>(0.73)</td>
<td>(0.97)</td>
</tr>
<tr>
<td>ND*/P*</td>
<td>-6.57</td>
<td>-6.22</td>
<td>-7.78</td>
<td>-7.39</td>
</tr>
<tr>
<td></td>
<td>(0.70)</td>
<td>(0.85)</td>
<td>(0.97)</td>
<td>(0.68)</td>
</tr>
<tr>
<td>WP/P</td>
<td>-7.71</td>
<td>-14.3</td>
<td>-15.7</td>
<td>-6.38</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.18)</td>
<td>(0.26)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>WP*/P*</td>
<td>227.7</td>
<td>240.3</td>
<td>217.3</td>
<td>234.1</td>
</tr>
<tr>
<td></td>
<td>(0.99)</td>
<td>(1.22)</td>
<td>(1.40)</td>
<td>(1.91)</td>
</tr>
<tr>
<td>RD</td>
<td>-63.2</td>
<td>-66.9</td>
<td>-48.8</td>
<td>-59.1</td>
</tr>
<tr>
<td></td>
<td>(1.32)</td>
<td>(1.61)</td>
<td>(1.44)</td>
<td>(1.87)</td>
</tr>
<tr>
<td>RD*/</td>
<td>85.3</td>
<td>89.4</td>
<td>87.2</td>
<td>89.9</td>
</tr>
<tr>
<td></td>
<td>(1.19)</td>
<td>(1.47)</td>
<td>(1.96)</td>
<td>(2.38)</td>
</tr>
<tr>
<td>RT</td>
<td>90.0</td>
<td>95.0</td>
<td>91.0</td>
<td>97.5</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(1.28)</td>
<td>(1.50)</td>
<td>(1.47)</td>
</tr>
<tr>
<td>Y</td>
<td>-5.12</td>
<td>-5.34</td>
<td>-4.46</td>
<td>-5.61</td>
</tr>
<tr>
<td></td>
<td>(0.91)</td>
<td>(1.14)</td>
<td>(1.09)</td>
<td>(1.22)</td>
</tr>
<tr>
<td>Y*/</td>
<td>-14.2</td>
<td>-14.5</td>
<td>-15.6</td>
<td>-15.1</td>
</tr>
<tr>
<td></td>
<td>(1.60)</td>
<td>(1.97)</td>
<td>(2.58)</td>
<td>(3.36)</td>
</tr>
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</table>
imperfect substitution or expectations not being rational (or some combination of these possibilities).

For one-month bonds, different approaches lead to different results. The information approach produced evidence consistent with imperfect substitution, the evidence from the vector autoregression approach was only consistent with imperfect substitution if data after December 1982 was included and the evidence from the portfolio approach was generally consistent with perfect substitution. It may be that the substantial differences obtained in results for one-month bonds between the information and portfolio approach are due to the use of instrumental variables technique. There is a time separation of up to two months between the instruments and the risk premium variable. This could also be expected to be a problem for three-month maturities but one possible reason for different outcomes is that the ex-post risk premium for one-month bonds is dominated by the exchange rate change component to a much larger extent than the three-month risk premium.

The different outcomes for bonds of one- and three-month maturities may be indicative of the possibility that bonds denominated in the same currency but of different maturities are imperfect substitutes. This would undermine one of the assumptions that was made for the portfolio approach, that all bonds denominated in one currency regardless of their maturity are perfect substitutes.

One of the general problems with portfolio models used in the open economy is that the stock of outstanding bonds denominated in the domestic currency and domestic wealth tend to be highly correlated. This reflects the fact that changes in domestic private sector wealth are dominated by changes in the government surplus rather than changes in the current account surplus. As a result the stock of outstanding bonds denominated in the domestic currency and the estimate of domestic wealth tend to be highly correlated and this collinearity may be the cause of the individual insignificance of some of the variables in the risk premia equations whether based on the information or portfolio approach. A reflection of this high correlation between the bond stocks and wealth is that when demand equations for domestic bonds are estimated, the coefficient on domestic wealth is close to one and highly significant 45.

In Chapter 3 and this Chapter, the focus has been on whether bonds denominated in yen and dollars are perfect substitutes. While there is some evidence consistent with imperfect substitution, the evidence supporting the portfolio model which is the basis for sterilized intervention is not strong. The focus in the next

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45 See, for example, the domestic demand functions estimated for Germany and Japan in Danker et al (1985, p.14-15).
Chapter switches to currency substitution, substitution between monies denominated in different currencies.
CHAPTER 5
CURRENCY SUBSTITUTION

'Currency substitution' is a term that usually covers shifts or substitution by investors between monies denominated in different currencies. Its practical importance, for domestic policy making and for international policy co-ordination, has been the subject of much debate in the recent economics literature\(^\text{1}\). These portfolio shifts between different monies may be in response to either economic or political events. The economic events could be events like an expected depreciation of the domestic currency vis-a-vis other currencies\(^\text{2}\); or an unbalanced financial liberalization that could cause exchange rate changes\(^\text{3}\). The political events could be incidents like the threat of a Russian invasion of Poland\(^\text{4}\); or incidents that cause an investor suddenly to desire a 'safe haven' for his assets. These events if they cause large enough flows of funds through the foreign exchange market may cause the exchange rate to move substantially. Similar economic and political events could also form the basis for 'bond substitution' namely demand shifts between bonds denominated in different currencies.

In this Chapter, an attempt is made to determine the quantitative importance of currency substitution for yen-denominated monies issued in Japan. As a number of types of currency substitution have been identified and a number of different definitions of currency substitution have been used in the literature, the meaning of currency substitution and, in particular, the meaning of money is discussed in 5.1.

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\(^{3}\)McKinnon (1983a).

\(^{4}\)McKinnon (1983a).
Currency substitution arguments suggest that money demand equations derived in a closed economy context are likely to be misspecified. The specification of the money demand function in an open economy with particular emphasis on the need to consider the rate of return on foreign-currency assets, and to disaggregate money by currency denomination and the residence of the holder is elaborated on in section 5.2. Using Japanese data on the holdings of M1 and resident holdings of yen-denominated M2 with Japanese banks, estimated equations for these demands are presented in section 5.3. These estimated equations are used to determine the quantitative impact of currency substitution for Japan in the floating exchange rate period and the impact of the Foreign Exchange and Foreign Trade Control Law of 1980 on currency substitution. Section 5.4 contains some concluding remarks.

5.1 A Consistent Definition

Suppose that there are three financial assets: demand deposits paying no interest; term deposits paying a non-market-related rate of interest; and an asset, called a bond, whose rate of return is market determined. It is assumed that each asset is available in either yen or dollar denominations, so that the investor can diversify his wealth amongst six different assets. Between these six assets, there are many substitution possibilities both between assets denominated in the same currency and between those assets denominated in different currencies. Here the interest is on those possibilities that involve a switch from either domestic demand or time deposits to any of the three foreign-currency assets.

Currency substitution usually refers to an investor's swapping some of his wealth between demand deposits in the two currencies or between time deposits in the two currencies and this type of currency substitution is sometimes referred to as direct currency substitution. As mentioned earlier, currency substitution may be in response to economic events that have actually occurred or that are anticipated to occur.

As financial liberalization proceeds and interest rates on time deposits become more market related, this classification of assets into demand deposits, time deposits and bonds will become less appropriate.

Although only assets denominated in two currencies are considered here, currency substitution applies to a potentially much wider range of currencies. However, the points made here will only be reinforced by a consideration of more monies and bonds denominated in different currencies.

For example, McKinnon (1982). Although McKinnon (1983a, p.46) acknowledges that direct currency substitution between demand deposits is not likely to be a significant source of monetary instability for advanced industrialised countries. He argues that such substitution may be important for Southern and Central American countries where American Dollar notes and travellers cheques circulate alongside the home currency. Given the restrictions on items of legal tender and the requirements that payment of government taxes and purchases of government securities be made with certain types of money, usually base money, perfect substitution between base monies is highly unlikely.
By treating the returns on some assets as fixed, it is possible to aggregate assets into composite assets. For example, assuming that the rate of interest payable on both of the term deposits does not change it is possible, applying Hick's composite good theorem\textsuperscript{8}, to aggregate the demand and term deposits in one currency and those in the other and refer to currency substitution as switching between these two groups of deposits\textsuperscript{9}. Similarly if, in addition, the rates of interest on the two bonds were assumed to be fixed it would be possible to aggregate all the yen assets together and all the dollar assets together and refer to currency substitution as portfolio shifts between those two groups of assets\textsuperscript{10}. If the interest rate on the foreign currency bond only could be treated as fixed (a small country assumption), then currency substitution would refer to switching from yen deposits to any foreign currency assets. An example of this type of substitution in the Japanese case might be the switch from deposits in the postal savings system to zero-coupon foreign-currency denominated bonds in response to the proposed introduction of a ‘Green Card’ identification system for opening postal savings accounts\textsuperscript{11}.

Obviously what currency substitution refers to is very dependent on the assumptions made about the interest rates and assets available. Treating some returns as fixed and others as flexible, and aggregating assets is only useful empirically if it is more likely in practice that the prices that are left flexible will change compared to those that are assumed to be fixed. Since in practice all these returns have changed over the floating exchange rate period, none of the asset returns are treated as fixed. Here the focus is on currency substitution that takes the form of shifts out of either an M1 or an M2 type asset into any foreign asset that is shifts from the domestic-currency-denominated demand and time deposits to foreign-currency-denominated demand deposits, time deposits and bonds.

\textsuperscript{8}Hicks (1948, p.33) and Green (1976, p.111).

\textsuperscript{9}For example, Branson and Henderson (1985, p.754).

\textsuperscript{10}For example, Kareken and Wallace (1981) show in a world where there the only two assets are monies in different currencies that in the situation where ‘monies’ are perfectly substitutable and governments do not intervene in the foreign exchange markets and do not threaten the imposition of exchange controls the exchange rate will be fixed. The exchange rate is indeterminate in such a model and any exchange rate can be termed an ‘equilibrium’ exchange rate. The threat of capital controls, even when the probability of their imposition approaches zero, is sufficient to give rise to a determinate exchange rate: Lapan and Enders (1983). An obvious result that follows from the Kareken and Wallace proposition is that when monies are perfectly substitutable, a policy of unsterilized intervention, the selling of one currency in exchange for another, will be completely ineffective. If monies are not substitutable at all and bonds denominated in different currencies are perfect substitutes then the monetary approach to the exchange rate will be applicable: Lapan and Enders (1983).

\textsuperscript{11}See, for example, Hamada and Hayashi (1983). This issue is discussed further in Chapter 6.
The stress given to currency substitution by some commentators reflects a belief that shifts in money demands between domestic and foreign monies are as important if not more important than shifts in bond demands between domestic and foreign bonds. Alternatively it reflects an assumption that bonds denominated in the two currencies are perfect substitutes since this implies that a change in an investor’s preference towards yen bonds away from dollar bonds will not affect the exchange rate, portfolio shifts on the basis of changes in exchange rate expectations will then only appear as shifts in money demand.

The direct deposit-deposit type shifts require that some investors, either residents or non-residents, hold both domestic-currency-denominated and foreign-currency-denominated deposits, and that their holdings of these deposits respond to either political events or changes in some economic variables like the expected rate of change of the exchange rate. For these shifts to occur it is not required that all agents hold both types of deposits but only that some agents hold both types of deposits. Regulations may of course exist to prevent the uninhibited acquisition/disposal of foreign-currency deposits by residents and/or of yen deposits by non-residents. Alternatively the central bank may discourage domestic banks from soliciting foreign-currency deposits from residents as the American Federal Reserve has done.

Some commentators have made another ‘small country assumption’ that domestic residents hold foreign as well as domestic-currency balances while foreigners do not hold domestic balances. From the Japanese data, it is known that non-residents hold some yen deposits so that this may not be a valid assumption.

12Miles (1978b, p.429) and Cuddington (1983, p.111). In many theoretical macroeconomic models, it is assumed that the residents of each country do not hold the other country’s money and that in each country residents’ demand for money is independent of the rate of return on the security denominated in the other country’s currency: for example, Branson and Henderson (1985, p.754-755) and Fukao and Okubo (1984, p.195). Such assumptions have important implications for the relationship between the foreign interest rate elasticities of the two bond demands namely that they are equal and opposite, and for the interdependence of interest rate and exchange rate movements. On the other hand, Daniel (1985) presents a two country model, for the purpose of analyzing the international transmission of international monetary disturbances under flexible exchange rates, where the only assets are monies.

13For example, in the 1970’s Japan had restrictions on opening new foreign-currency accounts as well as ceilings on the outstanding balances that could be held in such accounts. One of the motivations for these regulations might have been to prevent currency substitution by Japanese residents. As discussed in Chapter 6, regulations still exist to prevent some Japanese agents from operating overseas bank accounts for ‘investment purposes’. While the initial motivation for this rule might have been to prevent currency substitution by Japanese residents, one of its justifications now must be to prevent Japanese residents taking advantage of the higher returns on Euro-yen deposits, thereby undermining the domestic financial system.


15Data on non-resident yen-denominated deposits with Japanese banks is available since December 1980 in the Bank of Japan’s Keizai Tokei Geppo (Economic Statistics Monthly).
When the money demand functions are estimated in section 5.3, account is taken of these non-resident deposits. In addition, non-residents can also hold Euro-yen deposits. If foreign-currency balances are held by domestic residents for portfolio diversification reasons, there is no a priori reason why a similar portfolio diversification argument would not apply to foreigners. This suggests that two agents, residents and non-residents, with potentially different portfolio behaviour are involved in holdings of domestic money.

It is often argued that because the rate of return on foreign-currency bonds dominates the rate of return on foreign-currency deposits, given a fixed and known rate of return on bonds, that foreign-currency deposits will never be held\(^\text{16}\). This argument ignores some of the other characteristics of assets (liquidity, country risk, issuer risk, transactions costs) that influence holdings of those assets as well as ignoring the possibility that the return on the bonds is not fixed. The latter combined with investor risk averseness suggests that money may be held in optimal portfolios\(^\text{17}\). When Levy and Sarnat (1978) calculated optimal portfolios assuming that an investor can invest in non-interest bearing deposits and common stock in a number of currencies, non-interest bearing deposits were not always dominated by the common stock. In fact, both Japanese stock and Japanese money appeared in a number of the calculated optimal portfolios.

McKinnon (1982, 1983a) has identified a further type of currency substitution that he calls ‘indirect currency substitution’. He assumes that there are three types of transactors, ‘domestic’ transactors who hold only domestic money and domestic bonds, ‘foreign’ transactors who hold only foreign money and foreign bonds, and ‘international’ transactors who hold domestic and foreign-currency bonds. Suppose for some exogenously given reason, the international transactors engage in bond substitution by switching some of their portfolio from domestic currency bonds to foreign currency bonds, McKinnon argues that the effect of this is likely to be similar to the effect of the demand for domestic money falling in the case of currency substitution. According to this argument, the domestic exchange rate will tend to depreciate as the demand for foreign currency rises, the foreign interest rate will tend to fall because the demand for foreign-currency bonds has risen and the domestic interest rate will tend to rise as the demand for domestic bonds has fallen.

\(^{16}\)The rates of return referred to here do not include the expected rate of appreciation which would be a component of the return common to both assets.

\(^{17}\)The dominance of bonds over money will occur for example if investors are risk neutral and bonds have a higher expected return when compared to money. The assumptions that are made about an investor’s attitude towards risk, risk loving, risk neutrality and risk aversion, have important implications for what assets will be found in the agent’s portfolio.
This implies that domestic (foreign) transactors will want to switch from domestic money (foreign bonds) to domestic bonds (foreign money). It appears that there is a reduced demand for domestic money and an increased demand for foreign money, so this phenomena appears to be like currency substitution. The implication of this argument is that domestic currency and foreign bonds could behave ex-post like complements. According to this argument, domestic money and the foreign interest rate will appear to be positively correlated. Traa (1985) argues that this will result in a money demand function where the foreign interest rate will appear and that an increase in the foreign interest rate will have a positive influence on domestic money demand.

5.2 Money Demand in an Open Economy

A number of authors have sought to test for currency substitution effects by examining the extent to which the world money supply explains price movements in the United States better than the United States money supply. The appropriate test of the currency substitution hypothesis would however seem to involve its potential effects on the demand for money and this investigation follows that line of argument.

In the economics literature, much attention has been paid to the demand for money in a closed economy with the demand for money being based on a transaction demand and a demand based on portfolio diversification considerations, where the portfolio is limited to domestic assets. In contrast, little attention seems to have been given to open economy effects. For example, Laidler (1985), in one of the latest surveys of money demand studies, makes no reference to the demand for money in an open economy.

Following this closed economy tradition, money demand functions for either M1 or M2 estimated for Japan have been of the form:

\[
\log m = b_0 + b_1 \log m_{-1} + b_2 \log y + b_3 \log r_1 + b_4 \log r_2 + b_5 \dot{p} + e \tag{5.1}
\]

For M1: \( b_2 > 0 \) and \( b_3, b_4, b_5 < 0 \)

For M2: \( b_2, b_3 > 0 \) and \( b_4, b_5 < 0 \)

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where \( m \) is the real money stock, \( y \) is a transactions variable like real Gross National Product (GNP), \( r_1 \) is an own rate of return like the one year time deposit rate, \( r_2 \) is the rate of return on alternative asset like the call rate and \( \dot{p} \) is the inflation rate. The expected signs of the coefficients for the two money stocks appear under the equation. Illustrations of studies that are encompassed by equation (5.1) are Tsutsui and Hatanaka (1982) who set \( b_3 = b_5 = 0.21 \); Hamada and Hayashi (1983) who set \( b_5 = 0 \) and Boughton (1979) who sets \( b_3 = 0.22 \). Shinkai (1984) includes a moving standard deviation of the inflation rate but does not find it to be a significant explanatory variable. One notable feature of all these studies is their simple treatment of dynamic behaviour by only including a lagged dependent variable. The variables suggested by Boughton (1979), Tsutsui and Hatanaka (1982) and Hamada and Hayashi (1983) are used in the study undertaken in the next section.

Japanese money demand studies typically do not contain any reference to money demand in an open economy and to how open economy effects might influence the specification of the demand for money function. An exception is Boughton (1979). He found in his study of the demand for money in the major OECD countries that external factors like the Euro-dollar deposit rate and the rate of change of the effective (trade weighted) exchange rate did not have any significant influence on the demand for money (M1 or M2) in Japan.

Secondly, no attention is paid to the currency composition of the components making up the M1 and M2 figures. The definition of Japanese M1 excludes both non-residents' holdings of yen and foreign-currency deposits with Japanese banks. However, figures for Japanese M2 include both yen-denominated and foreign currency deposits. In addition, the yen-denominated deposits are deposits held by both residents and non-residents.

The currency substitution arguments of section 5.1 suggest that the expected rate of change of the exchange rate and the foreign interest rate may be relevant explanatory variables for money demand. To the extent that these variables are important and have been excluded from the money demand functions estimated to date, it could be expected that the money demand functions would exhibit some

\[21\] Tsutsui and Hatanaka also use either \( r_2 \) or \( \log r_2 \) as the representative interest rate.

\[22\] Often serial correlation has been found in these equations.

\[23\] Shinkai (1984) uses an expected inflation variable rather than the actual inflation rate.
instability. Given the difficulties involved in quantifying one-off political events an alternative method of testing for currency substitution induced by these changes is again to test for the stability of the money demand function.

It would seem the influences on money demands arising in an open economy are potentially important. The variety of assets available for portfolio diversification is wider - foreign-currency denominated assets are now available. In the general Tobin type model where all relevant asset returns are included in every asset demand, the demand for money will be influenced by the rate of return on foreign assets, that is the assets’ nominal returns plus the expected return resulting from exchange rate changes. If foreign bonds are a relevant investment alternative then their rate of return plus the expected rate of exchange rate appreciation could be expected to appear in the money demand function. With foreign money a relevant investment alternative, the expected rate of the exchange rate could be expected to appear. The expected exchange rate change is the focus variable in the direct currency substitution literature while the foreign interest rate is the focus variable in the indirect currency substitution literature. It is not necessary for agents to hold both of the monies for those variables to appear in the money demand function. For agents holding domestic money, domestic bonds and foreign bonds, portfolio arguments suggest the demand for each of these assets will be a function of the rate of return on domestic bonds and the rate of return on the foreign bonds (foreign interest rate and expected rate of exchange rate appreciation). With currency substitution based on holdings of both money demands, the rates of return appearing in the demand for money function will still be quantitatively the same. It is for this reason that Cuddington (1983) argues that the notion of currency substitution is of limited relevance to macroeconomic modelling since the variables to be included in asset demand functions based on portfolio considerations are the same with and without currency substitution. The currency substitution debate does however focus attention on the appropriate specification of the money demand function in an open economy.

The second difference arising in the open economy is that non-residents may hold yen deposits. A number of reasons for this can be suggested. Firstly, these deposits may be used by non-residents to diversify their portfolios. Given the interest ceilings on yen time deposits with Japanese banks, time deposits are likely to be dominated by Gensaki and Euro-yen deposits. Secondly, central banks may

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24 See, for example, Swoboda (1968, p.6), and Chrystal (1977). Swoboda has shown that the application of the Baumol cash inventory model in the international context leads to the result that foreign-currency balances will on average be proportional to the square root of the transactions made in that currency.
wish to diversify their portfolios. Central bank motives for holding and changing their holdings of time deposits are likely to differ from the motives of private sector investors. In addition, agreements between central banks aim to prevent central banks using their holdings in the same way as private investors. Thirdly, traders may wish to use them to pay for Japanese exports by acquiring yen now as a hedge against exchange rate movements. Fourthly, traders may use them to deposit the proceeds of export contracts to Japan, that is the yen has been acquired and is held as yen pending expected favourable movements of the exchange rate. This last sort of activity is likely to be small given that the proportion of Japanese imports denominated in yen has been very small at around 3%. Therefore, the influences on holdings of yen deposits by non-residents could differ substantially from those of residents.

The reasons why Japanese residents would want to hold foreign currency deposits are very similar. Private individuals and corporations may wish to diversify their portfolios. Japanese importers who have to pay for imports in foreign currency may use foreign-currency deposits for hedging purposes. Japanese exporters may use them to deposit the proceeds of export contracts for the purpose of hedging.

Given the possibility of differing investor portfolio behaviour, between residents and non-residents, it may be important to disaggregate money demand by (a) the residence of the investor; and (b) the currency of denomination. This is consistent with Goldfeld (1973, 1976, p.708) argument for disaggregation of money demand by the type of money and the type of individuals involved. Not only may lag structures and response sizes differ but the response of different types of money to changes in say domestic interest rates may differ. For example, the responses of the demand for dollar time deposits to changes in yen and dollar time deposit interest rates are expected to be the opposite of the responses of yen time deposits to changes in the same variables. The transactions variable driving residents and non-residents could also be expected to differ.

25Goldfeld (1976) has examined briefly the demand by the rest of the world for dollar money and found that that demand can be adequately explained by US GNP (a proxy for world GNP). Mussa (1979, p.46-7) argues that the definition of money appropriate for monetary growth targeting and exchange rate determination may differ. In particular, he suggests that it might be the demand for money by large corporations that is of importance for exchange rate determination. The importance of disaggregating money demands by the type of investor in the context of the demand for money by business has been stressed in Maddala and Vogel (1969), Nadiri (1969) and Ben-Zion (1974).

26Mussa (1979, pp.46-47) suggests the response of demands to changes in exchange rate expectations can potentially differ.
5.3 Demand for Monies Issued Domestically

Data on foreign currency deposits held with Japanese foreign exchange banks and non-resident yen deposits held with Japanese banks is available separately on a monthly basis since December 1980. Aggregated data on these two series is available before 1973 so that data on resident demand for yen deposits can be derived since 1973.

The existence of currency substitution is investigated for two money stocks, M1 and resident holdings of M2. M1 is examined because McKinnon (1982, 1983a, 1985) focused on the demand for M1 while M2 is included because of the possibility that holdings of time deposits are more likely to be subject to portfolio influences. Given the Japanese definition of M2 includes both yen-denominated and foreign-currency denominated deposits and since the response of yen-denominated deposits and foreign-currency deposits to changes in expected rate of change of the exchange rate would be expected to be opposite, the foreign currency deposits have been excluded from the figures for M2. Since currency substitution is the focus of this Chapter, considering figures for M2 that include foreign-currency deposits would mask any currency substitution that occurred between yen-denominated deposits and foreign-currency-denominated deposits held with Japanese banks. If foreign currency deposits are to be excluded, the aggregation of foreign currency deposits and non-resident yen deposits prior to December 1980, also requires the exclusion of non-resident holdings of yen deposits. In any case, the arguments presented in the previous section with regard to the motives that non-residents are likely to have for holding these non-resident yen deposits provide additional reasons for their exclusion.

Certificates of Deposit (CDs) were not added to M2 to form a broad monetary aggregate. When estimating the demand for a broad monetary aggregate for Japan, some authors have estimated an equation for M2+Certificates of Deposit. However, the characteristics of the assets in M2 and the characteristics of CDs are likely to differ significantly. Interest rates on the deposits contained in M2 are either zero or fixed at a government determined rate whereas the rates on CDs are market determined. CDs are also negotiable instruments. CDs are likely to be more similar to bonds than money. Aggregation of these different assets is likely to mask responses both between M2 assets and CDs, and between M2 and foreign assets. Disaggregation may permit a clearer identification of these responses.

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27 Certificates of Deposit were introduced in May 1979.

28 For example, Tsutsui and Hatanaka (1982) and Hamada and Hayashi (1983).
The equations for M1 and resident holdings of yen-denominated M2 (hereafter denoted M2) are estimated on quarterly data from 1973:II-1984:IV\(^{29}\). The estimation period is chosen to include only observations on the floating exchange rate period. As this is the period where currency substitution is likely to be most important, the estimation period is chosen to favour the currency substitution hypothesis as much as possible. The limitation of the data to the floating exchange rate period would seem to follow from McKinnon and Tan’s (1983, p.474) claim that it is only in a period of volatile exchange rates and price instability that hard currencies like the yen or the mark become competitive stores of value and units of account for the dollar.

McAleer et al (1985) have recently stressed the importance of dynamics in the specification of econometric models and of starting off from a general model and working towards a specific model by the application of testable restrictions. Here the short sample of 47 observations prevents the consideration of long lags for each variable and a strict application of the general to specific modelling methodology. Instead, the modelling procedure adopted here was to attempt to find a satisfactory equation for the money demands based on wholly domestic influences and then determine if the variables suggested by currency substitution arguments, the expected change of the exchange rate or a foreign interest rate, added significantly to the explanatory power of the closed economy model.

The variables included in the model were taken from those selected by other investigators\(^ {30}\). Following the tradition of equation (5.1), four domestic variables, the three-month Gensaki rate (R3)\(^ {31}\) as a rate of return on competing assets, the three-month bank deposit rate (RT) as a rate of return on competing assets for M1 and as an own rate of return for M2, the inflation rate (INF) as another rate of return on competing assets and real Japanese gross national product (GNP) as a transactions variable, were considered as potential explanatory variables of M1 and

\(^{29}\)1973:II indicates the second quarter of 1973. Attempts were made to estimate equations for M1 and M2 on monthly data from March 1973 to December 1984 using industrial production and the real value of retail sales as proxies for real income. Satisfactory equations could not be obtained and this reflects to some extent the inadequacy of industrial production and the real value of retail sales as proxies for income. With only 17 quarterly disaggregated observations on foreign-currency deposits and non-resident yen deposits available between December 1980 and December 1984, sensible quarterly equations for these variables could not be obtained. Use of monthly data to estimate equations for these two variables also had a number of problems because of the highly seasonal nature of these deposits.

\(^{30}\)Boughton (1979), Tsutsui and Hatanaka (1982) and Hamada and Hayashi (1983).

\(^{31}\)This variable corresponds to RJ\(_{t,3}\) in Chapters 3 and 4.
M2. The price deflator used was the GNP price deflator. All regressors except the inflation rate were in logs and three seasonal dummies were included in each equation.

Tables 5-1 and 5-2 contain the estimates of a number of different equations for the demand for M1 and M2 respectively. The presentation of the results is a little unconventional and requires some explanation. In each table, there are six models and each is named for ease of reference. The results labelled "Initial Model" in both Tables contained current and lagged values of all the four explanatory variables stated previously and two lags on the dependent variable. The column headings refer to the variable included in the model while the rows labelled "Lag 0" and "Lag 1" refer to what lag of the variable is included. So that the number 0.040 in the model labelled "Initial Model" in Table 5-1 refers to the coefficient on the current value of R3 while the number -0.120 refers to the coefficient on the first lag of R3. For the columns labelled M1_1 and M2_1 the value at lag 0 is the coefficient on the respective money stock lagged once and the value at lag 1 is the coefficient on the respective money stock lagged twice. The coefficients of the constant and seasonal dummies are not shown, and the figures in parentheses are the absolute value of the t-values. SEE, DW and R^2 denote the standard deviation of the residuals, the Durbin-Watson statistic and the coefficient of determination respectively.

In the Initial Model for M1 (Table 5-1), only M1_2 and R3_1 are statistically significant at the 5 per cent level. It is interesting that the initial impact of rises in both R3 and RT would be to raise the demand for M1 (suggesting short-term complementarity). The positive long-run impact of GNP and the negative long-run impact of R3 are consistent with a priori expectations. A little surprising are the positive long-run impact of RT given that RT is a rate of return on a competing asset and the positive long-run impact of inflation. These paradoxical long-run impacts are statistically insignificantly different from zero.

In the Initial Model for M2 (Table 5-2), the signs on R3, RT and GNP are consistent with a priori expectations and the long-run negative impact of inflation on money demand is what might be expected if money is held as a substitute for real assets. Both inflation variables, the Gensaki rate lagged one period and the money stock lagged one period are individually statistically significant at the 5 per cent level.

Given the number of variables that are statistically insignificant in each

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32 Shinkai (1984) also considered the consumer price index and the wholesale price index as alternative price deflators but found no evidence to clearly prefer one index over another.
<table>
<thead>
<tr>
<th></th>
<th>M1&lt;sub&gt;-1&lt;/sub&gt;</th>
<th>R3</th>
<th>GNP</th>
<th>INF</th>
<th>RT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.177</td>
<td>0.040</td>
<td>0.037</td>
<td>0.106</td>
<td>0.051</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(1.77)</td>
<td>(0.11)</td>
<td>(0.60)</td>
<td>(1.44)</td>
</tr>
<tr>
<td>Lag 1</td>
<td>0.293</td>
<td>-0.120</td>
<td>0.317</td>
<td>0.169</td>
<td>-0.038</td>
</tr>
<tr>
<td></td>
<td>(2.45)</td>
<td>(3.61)</td>
<td>(0.91)</td>
<td>(1.13)</td>
<td>(1.08)</td>
</tr>
<tr>
<td><strong>SEE = 0.0159</strong></td>
<td><strong>DW = 1.85</strong></td>
<td><strong>R&lt;sup&gt;2&lt;/sup&gt; = 0.985</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Tsutsui-Hatanaka Model** |             |     |      |      |     |
| Lag 0                  | 0.819         | -0.042 | 0.110 |       |     |
|                        | (13.05)       | (5.63) | (2.41) |     |     |
| **SEE = 0.0189**       | **DW = 1.88** | **R<sup>2</sup> = 0.974** | $\rho_1 = 0.48$ (3.53) |

| **Hamada-Hayashi Model** |             |     |      |      |     |
| Lag 0                  | 0.798         | -0.036 | 0.124 | -0.008 |     |
|                        | (9.78)        | (2.37) | (2.14) | (0.41) |     |
| **SEE = 0.0191**       | **DW = 1.87** | **R<sup>2</sup> = 0.974** | $\rho_1 = 0.46$ (3.29) |

| **Boughton Model**     |             |     |      |      |     |
| Lag 0                  | 0.821         | -0.037 | 0.093 | -0.054 |     |
|                        | (13.03)       | (4.11) | (1.84) | (0.82) |     |
| **SEE = 0.0190**       | **DW = 1.89** | **R<sup>2</sup> = 0.975** | $\rho_1 = 0.48$ (3.55) |

| **Extended Tsutsui-Hatanaka Model** |             |     |      |      |     |
| Lag 0                  | 0.232         | 0.043 | 0.184 |       |     |
|                        | (1.84)        | (2.06) | (0.71) |     |     |
| Lag 1                  | 0.280         | -0.105 | 0.123 |       |     |
|                        | (2.44)        | (4.82) | (0.42) |     |     |
| **SEE = 0.0158**       | **DW = 1.84** | **R<sup>2</sup> = 0.983** |

<p>| <strong>Preferred Model</strong>    |             |     |      |      |     |
| Lag 0                  | 0.248         | 0.039 | 0.290 |       |     |
|                        | (2.07)        | (2.07) | (4.83) |     |     |
| Lag 1                  | 0.289         | -0.100 |       |       |     |
|                        | (2.59)        | (5.32) |     |     |     |
| <strong>SEE = 0.0157</strong>       | <strong>DW = 1.86</strong> | <strong>R&lt;sup&gt;2&lt;/sup&gt; = 0.983</strong> |</p>
<table>
<thead>
<tr>
<th>Model</th>
<th>Lag 0</th>
<th>Lag 1</th>
<th>SEE</th>
<th>DW</th>
<th>R²</th>
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<td><strong>Initial Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.654</td>
<td>0.216</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4.52)</td>
<td>(1.77)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Lag 1</td>
<td>0.152</td>
<td>0.002</td>
<td>0.0074</td>
<td>1.81</td>
<td>0.999</td>
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<tr>
<td><strong>Tsutsui-Hatanaka Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.702</td>
<td>0.021</td>
<td>0.0098</td>
<td>1.65</td>
<td>0.998</td>
</tr>
<tr>
<td>(12.19)</td>
<td>(1.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hamada-Hayashi Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.721</td>
<td>0.026</td>
<td>0.0099</td>
<td>1.74</td>
<td>0.998</td>
</tr>
<tr>
<td>(10.50)</td>
<td>(3.62)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Boughton Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.754</td>
<td>0.013</td>
<td>0.0091</td>
<td>1.91</td>
<td>0.998</td>
</tr>
<tr>
<td>(13.37)</td>
<td>(2.16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Extended Boughton Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.648</td>
<td>0.001</td>
<td>0.0076</td>
<td>1.78</td>
<td>0.999</td>
</tr>
<tr>
<td>(4.43)</td>
<td>(0.14)</td>
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<tr>
<td>Lag 1</td>
<td>0.200</td>
<td>-0.021</td>
<td>0.232</td>
<td>2.10</td>
<td>0.999</td>
</tr>
<tr>
<td>(1.61)</td>
<td>(1.99)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Preferred Model</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
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<td>-0.019</td>
<td>0.0076</td>
<td>2.10</td>
<td>0.999</td>
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<tr>
<td>(14.17)</td>
<td>(3.56)</td>
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</tr>
<tr>
<td>Lag 1</td>
<td>0.203</td>
<td>0.237</td>
<td>0.0076</td>
<td>2.10</td>
<td>0.999</td>
</tr>
<tr>
<td>(2.56)</td>
<td>(3.44)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
equation, both Initial Models seem overspecified. A number of alternative attempts were made to reduce the number of variables each equation contained by using the COMFAC methodology and by comparing the equations to ones that have been estimated in other studies. The essence of the COMFAC methodology is to determine whether a dynamic model can be written more parsimoniously as a model with shorter lags on all the explanatory variables and an autoregressive error. The advantages of this simplification are that there are fewer parameters to estimate and more efficient parameter estimates may be obtained. Using the COMFAC methodology, an attempt was made to extract one common root (and hence impose four restrictions) from each Initial Model. The test of the implied restrictions strongly rejected the validity of this common root for both equations with calculated chi-squared statistics of 23.17 for M1 and 26.31 for M2 (critical value: $X^2_4(0.01)=13.28$).

Tables 5-1 and 5-2 also contain estimates of the type of equations estimated by Tsutsui and Hatanaka (1982), Hamada and Hayashi (1983) and Boughton (1979) for M1 and M2 respectively (labelled respectively "Tsutsui-Hatanaka Model", "Hamada-Hayashi Model" and "Boughton Model")34. All are restricted versions of the Initial Model.

In passing it should be noted that for M1, the time deposit variable in the Hamada-Hayashi Model and the inflation variable in the Boughton Model are insignificant. This suggests that the Tsutsui-Hatanaka Model that excludes both the time deposit interest rate and the inflation rate may be the appropriate specification. The Tsutsui-Hatanaka Model is a restricted version of the Initial Model and a test of the restrictions implied by the Tsutsui-Hatanaka Model suggested that the model was not an acceptable simplification of the Initial Model (test statistic=25.51, critical value $X^2_6(0.01)=16.81$).35

A significant first-order autoregressive error is found in the Tsutsui-Hatanaka

33 Suppose the regression model is $a(L)y_t=b(L)x_t+u_t$ where $a(L)$ and $b(L)$ are lag polynomials, then the COMFAC procedure tests if there is a common root in the polynomials $a(L)$ and $b(L)$. That is whether it is valid to write $a(L)$ and $b(L)$ as $a(L)=(1-eL)c(L)$ and $b(L)=(1-eL)d(L)$, where the lag polynomials $c(L)$ and $d(L)$ are polynomials of degree one less than $a(L)$ and $b(L)$ respectively. If this restriction was valid then the model can be written as $c(L)y_t=d(L)x_t+v_t$ where $v_t=u_t/(1-eL)$, that is, $v_t$ is now an AR(1). In going to the model with lower lags on each variable and an autoregressive error, one restriction has been imposed. If there are $k$ variables in $x_t$ then $k$ restrictions would be imposed. McAleer et al (1985) contains a recent illustration of the use of this procedure to aid in specifying a money demand function.

34 Where appropriate a first-order autoregressive transformation has been applied and $\rho_1$ denotes the estimate of the first-order parameter.

35 Not surprisingly, the Hamada-Hayashi and Boughton Models were also unacceptable simplifications of the Initial Model with calculated test statistics 25.32 and 24.70, and a relevant critical value of $X^2_5(0.01)=15.09$. 
Model. The COMFAC methodology can be used to test whether in the Tsutsui-Hatanaka Model, the restrictions implied by the common root associated with the first order autoregression are valid. This is achieved by comparing the model to a model with an additional lag on each of the explanatory variables (labelled "Extended Tsutsui-Hatanaka Model" in Table 5-1). The test of the validity of the two restrictions suggested that the restrictions were rejected (test statistic = 20.32, critical value \( \chi^2(0.01) = 9.21 \)). In contrast, the restrictions implied by going from the Initial Model to the Extended Tsutsui-Hatanaka Model were accepted (test statistic = 0.964, critical value \( F(4,33,0.01) \approx 4.02 \)). Excluding the insignificant GNP\(_{-1}\) in this model gave rise to what is termed the Preferred Model for M1. It is preferred because it represents a statistically acceptable simplification of the Initial Model, all the included variables are statistically significant and as is shown later diagnostic tests do not indicate any faults with it.

The Preferred Model is very like the Tsutsui-Hatanaka Model in that the demand for M1 is a function of GNP, an interest rate on a competing asset and the lagged money stock but the dynamics of the two models are quite different. The long-run income elasticity of M1 in the Preferred Model is 0.63 and is significantly different from unity\(^{36}\). This elasticity seems a little on the low side when compared to the values around unity obtained in the three studies already mentioned. The long-run interest elasticity of M1 was 0.13. As with the Initial Model, the initial response to a rise in R3 is an increase in the demand for M1 followed by a fall in demand.

Turning to the estimated equations for M2 in Table 5-2, the story was a little different. While the time deposit rate in the Hamada-Hayashi Model is insignificant, the inflation rate in the Boughton Model is significant. This suggests that a comparison of the Boughton Model with the Initial Model may be the appropriate place to begin the specification search. A test of the exclusion restrictions implied by going from the Initial Model to the Boughton Model suggested that those restrictions were rejected and that the Boughton Model was not an acceptable simplification of the Initial Model (test statistic = 4.19, critical value \( F(6,33,0.01) \approx 3.47 \))\(^{37}\).

The significance of R3\(_{-1}\) and INF\(_{-1}\) in the Initial Model suggested that the Boughton Model should be expanded by the inclusion of an additional lag on each

---

\(^{36}\) The asymptotic standard error of the estimate of the elasticity is 0.040.

\(^{37}\) Not surprisingly, the exclusion restrictions implied by the Tsutsui-Hatanaka and Hamada-Hayashi Models were also rejected with the respective test statistics 6.65 and 5.26 and respective critical values \( F(6,33,0.01) \approx 3.47 \) and \( F(7,33,0.01) \approx 3.30 \).
of the variables already present. This model is denoted the Extended Boughton Model in Table 5-2. The restrictions implied in going from Initial Model to this model were accepted (test statistic = 1.70, critical value $F(2,33,0.01)\approx 5.39$). It was not possible to accept the exclusion restrictions required to go from this model to the Boughton Model (test statistic = $5.23, F(4,35,0.01)\approx 4.02$). From the Extended Boughton Model, three variables ($M_{2.2}$, $R3$ and $GNP_{1}$) were excluded (test statistic = 1.22, critical value $F(3,35,0.01)\approx 4.51$)\(^{38}\) to obtain the Preferred Model for $M2$.

The Preferred Model for $M2$ is very much like the Boughton Model in the variables that it includes but the dynamics are a little richer. The long-run income elasticity of 1.18 is similar to that obtained in other studies and is insignificantly different from unity\(^{39}\). The long-run interest elasticity is 0.11. It seems a little on the low side when compared with the corresponding elasticity for $M1$ of 0.13.

To determine the adequacy of the Preferred Model for $M1$ and $M2$, each model was subjected to a number of diagnostic tests that are designed to detect misspecification of the functional form, heteroskedasticity of the residuals, non-normality of the errors and general misspecification. Table 5-3 contains the results of these tests and a brief description of each test\(^{40}\). These tests provide no striking evidence of any serious deficiencies in the models. An attempt to generalise the specification of both models by including a time trend or by estimating the model with up to a fourth-order serial correlation pattern found that none of these changes contributed significantly to the model.

The use of ordinary least squares to estimate these models assumes that none of the explanatory variables are endogenous. Should any of the explanatory variables be endogenous it would be necessary to use an instrumental variable estimation technique. The exogeneity of the current values of $GNP$ and $R3$ in the $M1$

\(^{38}\)This model was also an acceptable simplification of the Initial Model as the test statistic for the exclusion restrictions was 1.44 and the critical value $F(5,33,0.01)\approx 3.70$.

\(^{39}\)The asymptotic standard error of the estimate of the elasticity is 0.097.

\(^{40}\)A general discussion of the application of these tests in econometrics is contained in McAleer and Deistler (1986).
Table 5-3: Diagnostic Checks of M1 and M2 Equations

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Statistic Type</th>
<th>Statistic Value</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>RESET</td>
<td>3.21</td>
<td>$x^2_{(2)}(0.01)=9.21$</td>
</tr>
<tr>
<td></td>
<td>Normality</td>
<td>1.04</td>
<td>$x^2_{(2)}(0.01)=9.21$</td>
</tr>
<tr>
<td></td>
<td>Heteroskedasticity</td>
<td>0.02</td>
<td>$x^2_{(1)}(0.01)=6.63$</td>
</tr>
<tr>
<td></td>
<td>ACF of residuals</td>
<td>1) 0.56 2) 0.30 3) 0.13 4) 0.52 5) 0.21 6) 0.02 7) 0.37 8) 1.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACF of squared residuals</td>
<td>1) -0.34 2) 0.08 3) 0.28 4) -1.60</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>RESET</td>
<td>4.96</td>
<td>$x^2_{(2)}(0.01)=9.21$</td>
</tr>
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<td>Normality</td>
<td>1.72</td>
<td>$x^2_{(2)}(0.01)=9.21$</td>
</tr>
<tr>
<td></td>
<td>Heteroskedasticity</td>
<td>0.31</td>
<td>$x^2_{(1)}(0.01)=6.63$</td>
</tr>
<tr>
<td></td>
<td>ACF of residuals</td>
<td>1) 0.52 2) 0.41 3) 0.17 4) 0.21 5) 1.53 6) 1.70 7) 0.46 8) 1.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACF of squared residuals</td>
<td>1) 1.90 2) 0.18 3) 0.09 4) 1.51</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. RESET. This tests whether the coefficients of the predictions squared and cubed are significantly different from zero in the regression of the residuals against these and the other explanatory variables: see Ramsey (1969).


3. Heteroskedasticity. The LM heteroskedasticity test derived in Pagan et al (1981) to test that $\alpha=0$ in $\sigma_t^2=E(\varepsilon_t^2)$, where $y_t$ is the dependent variable in the regression.

4. ACF of residuals. If the model is $y_t=\beta'x_t+\varepsilon_t$, these are the t-statistics that the coefficient of the lagged residuals $\varepsilon_{t-i}$ are zero in the regression of $\varepsilon_t$ against $x_t$ and $\varepsilon_{t-i}$, and these t-statistics are asymptotically distributed as standard normal: see McAleer et al (1985).

5. ACF of squared residuals. The t-statistics formed by regressing the squared residuals against their lagged values and these t-statistics are asymptotically distributed as standard normal. This test was used by Granger and Anderson (1978) to detect non-linear models.
equation, and the current values of GNP and INF in the M2 equation was tested\textsuperscript{41}. The hypothesis of exogeneity was not rejected in either case with calculated test statistics of 1.03 and 4.48 respectively (Critical value: $\chi^2(2)(0.01) = 9.21$). These results justify the use of ordinary least squares.

Having found what appear to be satisfactory equations for M1 and M2, the investigation proceeds to search for currency substitution effects. McKinnon (1982) suggests that the demand for money should be destabilized by currency substitution and this suggests that the stability of the parameters in each Preferred Model should be checked. One check of parameter stability is to estimate the equation over a particular sample and then to forecast out of sample. In fact, evidence of this kind is used by McKinnon to support his argument that the demand for money in individual countries, particularly the United States, has become unstable. As few investigators have calculated the confidence intervals of these out of sample predictions, it has been difficult to make a judgement as to whether there has been \textit{statistically significant} over- or under-prediction\textsuperscript{42}. A note of caution is warranted as to what can be inferred if instability is found. A number of competing causes of instability in the money demand function besides currency substitution have been suggested: financial innovation and deregulation\textsuperscript{43}; general misspecification of the money demand function\textsuperscript{44}; or misspecification of the interest rate variable appearing in the money demand function\textsuperscript{45}. This suggests that if instability is detected it should not automatically be ascribed to currency substitution.

Here the Preferred Models for M1 and M2 were estimated using data up to 1980:IV and then one-step prediction errors were generated for the next sixteen

\textsuperscript{41}The test was conducted by obtaining the predictions from the regressions of GNP, R3 and INF on an instrument set, augmenting the Preferred Model for M1 by the predictions for GNP and R3 and the Preferred Model for M2 by the predictions for GNP and INF, and testing the joint significance of the predictions in each equation. Under the null hypothesis that the variables are exogenous, the tests are distributed as chi-squared with two degrees of freedom. For further details on these tests see Hausman (1978) and McAleer and Deistler (1986).

For the predictions used in the M1 equation the instrument set was: $M1_{-1}$, $M1_{-2}$, $\text{GNP}_{-1}$, $\text{GNP}_{-2}$, $R3_{-1}$, $R3_{-2}$, $\text{INF}_{-1}$, $\text{INFUS}_{-1}$, $\text{REUD}_{-1}$, $\text{DER}_{-2}$, a time trend and seasonal dummies. For the predictions in the M2 equation the instrument set was: $M2_{-1}$, $M2_{-2}$, $\text{GNP}_{-1}$, $\text{GNP}_{-2}$, $R3_{-1}$, $R3_{-2}$, $\text{INF}_{-1}$, $\text{INF}_{-2}$, $\text{INFUS}_{-1}$, $\text{REUD}_{-1}$, $\text{DER}_{-2}$, a time trend and seasonal dummies. \text{INFUS}, \text{REUD} and \text{DER3} are the inflation rate in the United States, the three-month Euro-dollar rate and the actual rate of change of the exchange rate over the next quarter.

\textsuperscript{42}Tsutsui and Hatanaka (1982) and McAleer \textit{et al} (1985) are two cases where confidence intervals for the predictions have been calculated.

\textsuperscript{43}Enzler \textit{et al} (1976).

\textsuperscript{44}Hamburger (1977).

\textsuperscript{45}Kohn and Manchester (1984, 1985).
periods by augmenting each Preferred Model using dummy variables as suggested by Salkever (1976). For M1 and M2, fifteen of the sixteen prediction errors were positive and this is not the pattern of prediction errors about the zero that would be expected. However, the F test that the sixteen coefficients associated with the dummy variables were jointly zero was 0.81 for M1 and 0.89 for M2, well below the critical value of $F(16,22,0.01)\approx 2.95$. An examination of the individual t-tests for the M1 equation indicated that the most significant prediction error had a t-value of 2.52 and this occurred in 84:III. For M2, the most significant prediction error was in 1981:II with a t-value of 2.11. With sixteen predictions and a significance level of five per cent, the likelihood of one significant t-value is quite high. These results seem to suggest quite a degree of stability for both equations and indicate that a degree of caution towards the line of argument developed by McKinnon (1982) is warranted.

One of the reasons for predicting from 1981:I was that rules governing the use of foreign-currency deposits were significantly altered in December 1980. Prior to December 1980, foreign-currency deposits acquired by yen conversion (rather than as a result of export or other external transactions) were limited to ¥3 million. This rule was eliminated in December 1980 and simultaneously, the interest rate payable on foreign-currency deposits was liberalized. These changes may have provided agents with a greater ability to engage in currency substitution and this could have caused the parameters in the money demand function to have become unstable after that time. Had significant currency substitution occurred in the period 1981:I to 1984:IV, it could be expected that sizeable prediction errors would have been observed. The prediction test provides no evidence to support this notion. An alternative to the prediction test was to use a Chow-type test and this was implemented by augmenting the preferred equation with each of the variables multiplied by a dummy that took the value zero up to 1980:IV and the value unity thereafter. These Chow tests also provided no evidence of instability with values of 0.84 for M1 and 1.01 for M2 (Critical value: $F(9,29,0.01)\approx 3.10$).

As a further test of parameter instability, the cusum and cusum squared tests of Brown et al (1975) were applied. These also suggested no parameter instability, for both M1 and M2 the value of the cusum and cusums squared lay well within

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46 See also Pagan and Nicholls (1984). Some studies have used multi-step predictions instead of one-step ahead predictions. The arguments in Pagan (1986) suggest that these multi-step predictions are unlikely to contain any information that is not already contained in the one-step ahead predictions.

47 It is expected that there would be no systematic behaviour between successive residuals. Use of Maddala's (1977, p.88) "contingency table" test for correlation amongst the prediction errors suggests the hypothesis of zero correlation amongst the prediction errors would be rejected.
the bounds prescribed for each observation. Since both the preferred equations contain lagged dependent variables, there is a difficulty in interpreting these tests. But as Pagan and Volker (1981, p.389) argue there is no theoretical reason to believe that in the presence of lagged dependent variables the tests are biased towards accepting the null hypothesis.

Having found what appears to be adequate equations for M1 and M2 that exhibit no parameter instability it is possible to test for the presence of currency substitution by the inclusion of the expected change of the exchange rate\(^{48}\) and a foreign interest rate. Whenever the expected change of the exchange rate variable is included it is necessary to make an assumption about how those expectations are formed. Here, as in Chapter 4, the realised value of the change of the exchange rate is used as a proxy for the expected value of the change of the exchange rate. As discussed in Chapter 4, use of the realised value means it is necessary to use an instrumental variables estimator as there is essentially an errors-in-variables problem associated with the realised value of the change of the exchange rate. In addition, there is the possibility that the equation’s error will be an MA(1) process.

The initial test of the currency substitution hypothesis was conducted by including both a foreign interest rate, the three-month Euro-dollar rate (REU)\(^{49}\), and the actual change of the exchange rate (DER3) in each of the preferred equations. These variables are aimed at capturing both direct and indirect currency substitution. The relevant test statistics from these regressions are contained in Table 5-4, the Joint Test refers to the test of whether the coefficients on REU and DER3 are jointly zero. Three different instrument sets labelled I, II and II were used. Instrument set I included information dated at time t or earlier, instrument set II included information dated at time t or earlier excluding the values of R3, REU and DER3 dated at time t and instrument set III included information dated at time t-1 or earlier\(^{50}\). In all instrument sets, lagged dependent variables are included as instruments. Cumby et al (1983) argue that if the error is likely to be

\(^{48}\) The actual variable used was the expected (or actual) value of the log of the exchange at the end of the next quarter minus the log of the exchange rate at the end of the current quarter but for ease of reference this is referred to as the expected (or actual) change of the exchange rate.

\(^{49}\) REU corresponds to RF\(_{1,3}\) used in Chapters 3 and 4.

\(^{50}\) For M1, instrument set I was: M1\(_1\), M1\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3, INF, INF\(_1\), REU, DER, INFUS. Instrument set II was: M1\(_1\), M1\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3\(_2\), INF, INF\(_1\), REU, DER, INFUS. Instrument set III was: M1\(_1\), M1\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3\(_1\), INF, INF\(_1\), INFUS, REU, DER, INFUS, and a time trend.

For M2, instrument set I was: M2\(_1\), M2\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3, INF, INF\(_1\), INF\(_2\), INFUS, REU, DER, INFUS. Instrument set II was: M2\(_1\), M2\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3\(_1\), INF\(_1\), INF\(_2\), INFUS, REU, DER, INFUS. Instrument set III was: M2\(_1\), M2\(_{1,2}\), GNP, GNP\(_1\), GNP\(_2\), R3\(_1\), INF\(_1\), INF\(_2\), INFUS, REU, DER, INFUS, and a time trend. All instruments sets included seasonal dummies as well.
an MA(1) process because of the substitution of a realized value for its expectation then the dependent variable at lag one will be an invalid instrument. In Chapter 8, it is shown that this proposition is incorrect and the actual restrictions on the use of lagged dependent variables is indicated. The results in Chapter 8 indicate that in the model estimated here all lags of the dependent variable are valid instruments.

For both M1 and M2, the three-month Euro-dollar rate and the expected change of the exchange rate were neither separately or jointly significant regardless of whether Two-Stage Least Squares (2SLS) or 2S2SLS [MA(1)] estimation techniques were used. In neither equation did there appear to be any serial correlation when it was estimated by 2SLS regardless of the information set. The insignificance of these variables appears to be robust to the choice of instruments.

To test the robustness of these results to the choice of proxy for the expected change of the exchange rate, an alternative proxy obtained from the predictions from a regression of the realized change of the exchange rate on an information set was used. This variable together with REU was included in the Preferred Model and the equation was estimated by OLS. These tests correspond to estimation method OLSP in Table 5-4, the information set used to form the predictions corresponds to the instrument used in the 2SLS and 2S2SLS [MA(1)] regressions. In general, the application of ordinary least squares to this type of an equation which contains a generated regressor, the predicted change of the exchange rate, will lead to

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51 2S2SLS [MA(1)] refers to the Two-Step Two-Stage Least Squares Estimator of Cumby et al (1983) allowing for a moving average error of order one.

52 If LM\(_i\) is the test of whether the errors are a simple AR(j) or MA(j) when the equation is estimated by 2SLS, then the tests are:

<table>
<thead>
<tr>
<th>Aggregate Instrument Set</th>
<th>LM(_1)</th>
<th>LM(_2)</th>
<th>LM(_3)</th>
<th>LM(_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.35</td>
<td>0.04</td>
<td>0.25</td>
<td>0.08</td>
</tr>
<tr>
<td>II</td>
<td>-0.15</td>
<td>-0.55</td>
<td>0.31</td>
<td>-0.31</td>
</tr>
<tr>
<td>III</td>
<td>0.07</td>
<td>0.06</td>
<td>0.80</td>
<td>-0.46</td>
</tr>
<tr>
<td>M2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.28</td>
<td>0.63</td>
<td>0.64</td>
<td>0.62</td>
</tr>
<tr>
<td>II</td>
<td>-0.80</td>
<td>0.28</td>
<td>0.73</td>
<td>0.68</td>
</tr>
<tr>
<td>III</td>
<td>-0.14</td>
<td>1.03</td>
<td>0.47</td>
<td>0.48</td>
</tr>
</tbody>
</table>

53 The variable REU+DER3 was insignificant when included in either equation regardless of the instrument set or estimation technique used.
### Table 5-4: Currency Substitution Tests

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Estimation</th>
<th>Instrument</th>
<th>T-Statistic</th>
<th>Joint Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method</td>
<td>Set</td>
<td>REU</td>
<td>DER3</td>
</tr>
<tr>
<td>M1</td>
<td>2SLS</td>
<td>I</td>
<td>0.72</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>0.53</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>0.69</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>2S2SLS [MA(1)]</td>
<td>I</td>
<td>0.84</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>0.22</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>0.28</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>OLSP</td>
<td>I</td>
<td>-</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>-</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>-</td>
<td>1.04</td>
</tr>
<tr>
<td>M2</td>
<td>2SLS</td>
<td>I</td>
<td>1.42</td>
<td>-0.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>0.32</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>0.18</td>
<td>-0.18</td>
</tr>
<tr>
<td></td>
<td>2S2SLS [MA(1)]</td>
<td>I</td>
<td>1.72</td>
<td>-0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>0.63</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>0.28</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>OLSP</td>
<td>I</td>
<td>-</td>
<td>-0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>-</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>-</td>
<td>1.52</td>
</tr>
</tbody>
</table>

Inconsistent parameter estimates and inconsistent hypothesis tests\(^{54}\). These problems arise because the measurement error associated with the generated regressor is potentially correlated with other explanatory variables in the equation. However, where the hypothesis being tested includes the hypothesis that the coefficient associated with the generated regressor is zero, the usual test statistics from an OLS regression can be used to provide a consistent test of the hypothesis\(^{55}\). The results from these OLS based tests that the variables are not statistically significant are consistent with the results obtained from the other estimation methods. No test

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\(^{54}\) Nelson (1975) and Pagan (1984). If say the realised value was regressed on lagged values of itself it is possible that the measurement error (difference between the variable used and the actual variable) could be correlated with some of the explanatory variables in the initial equation. The use of an instrumental variable estimator can potentially suffer from the same problem which is why Pagan suggests that the variables in the auxiliary regression used to generate the predictions contain all the instruments used in the IV estimation. The use of this technique guarantees that the instruments are uncorrelated with the measurement error. Pagan’s solution to this problem essentially means using the realised value of the change of the exchange rate and an instrumental variable estimation technique.

\(^{55}\) Pagan (1984, p.229)
statistic is provided for the test of whether the coefficient on REU is zero in the OLSP regressions as the hypothesis being tested does not include the hypothesis that the coefficient on the generated regressor was zero.

Testing for direct currency substitution by including only DER3 in the Preferred Models indicated that DER3 was not a significant explanator when the equation was estimated by 2SLS, 2S2SLS [MA(1)] or OLSP. When the Preferred Models were augmented by REU only and estimated by OLS, REU was not significant.

It is possible that it is only after the change in the rules governing the use of foreign-currency deposits in December 1980 that agents could freely engage in currency substitution. To take account of this possibility a dummy variable, DFE, that takes the value zero up to and including 1980:III and unity thereafter was defined. It was included together with appropriate expected change of the exchange rate and foreign interest rate variables (DFE.DER3 and DFE.REU) to capture the possibility of “new” investor sensitivity to foreign rates of return following the regulatory change. To some extent, new investor sensitivity to foreign interest rates would be unexpected since Japanese investors could invest in foreign securities prior to December 1980. The test statistics with respect to these variables are contained in Table 5-5, the Joint Test refers to the test of the hypothesis that the coefficients on DFE, DFE.DER3 and DFE.REU are jointly zero. As before, three different instruments sets were used and these are labelled IV, V and VI. Instrument set IV included information dated at time t or earlier, instrument set V included information dated at time t or earlier excluding the values of R3, DFE.DER and DFE.REU dated at time t and instrument set VI included information date at time t-1.\(^{56}\) There was no sign of any serial correlation in either equation when estimated

\(^{56}\text{For M1, instrument set IV was: M1.1, M1.2, GNP, GNP},\text{ R3, R3.1, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. Instrument set V was: M1.1, M1.2, GNP, GNP},\text{ R3, R3.1, R3.2, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. Instrument set VI was: M1.1, M1.2, GNP, GNP},\text{ R3.1, R3.2, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. Instrument set IV was: M2.1, M2.2, GNP, GNP},\text{ R3, R3.1, INF, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. Instrument set V was: M2.1, M2.2, GNP, GNP},\text{ R3, R3.1, R3.2, INF, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. Instrument set VI was: M2.1, M2.2, GNP, GNP},\text{ R3.1, INF, INF, DFE, DFE.REU, DFE.DER3, DFE.INF and DFE.INFUS. All instrument sets also included seasonal dummies.}
For M1, neither the individual nor the joint tests indicate that any of these variables are significant explanators. For M2, only two of the individual t-tests associated with DFE indicate any significant variables at the five per cent level. However, over half the joint tests indicate rejection at the five percent level of the hypothesis that the coefficients on DFE, DFE.DER3 and DFE.REU are jointly zero (Critical value: $\chi^2(3)(0.05)=7.81$). As with Table 5-4, no test statistics are provided for DFE and DFE.REU for the OLSP estimation method as the usual test statistics from an OLS regression are not valid.

An examination of the individual t-statistics for the M2 equation in Table 5-5 suggests that the dummy DFE could be significant and could be the cause of the significant joint tests observed. This is certainly confirmed when only DFE is added to the preferred M2 equation and the equation is estimated by OLS. Table 5-6 contains estimates of this equation and a diagnostic evaluation of it. The sign of DFE indicates that there has been an upward shift in the demand for M2 and the variable has a t-statistic of 2.89. This upward shift ties in with the pattern of prediction errors observed earlier (page 105), namely, that in the equation without DFE, the predictions seemed to be underpredicting the observed value. However, the error for any single observation was not usually large enough to make the prediction error significantly different from zero. The positive sign on DFE is a little unexpected. If M2 were used to finance a “one-off” currency substitution incident, a downward shift in the demand for M2, that is a negative sign, might have been expected. However the sign would be consistent with complementarity between M2 and the foreign assets into which funds might have moved with the funds possibly coming from yen-denominated bonds. Performing the one step-ahead prediction test for this equation over the period 1983:I to 1984:IV gave rise to a test statistic of 0.410 (Critical value: F(8,29,0.01)=3.20). The largest individual t-tests was a mere 1.09 and occurred in 1984:III, so that the M2 equation appears to be quite stable.

---

57 As before LM, is the test of whether the errors are a simple AR(j) or MA(j) when the equation is estimated by 2SLS. The test statistics were:

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Instrument Set</th>
<th>LM_1</th>
<th>LM_2</th>
<th>LM_3</th>
<th>LM_4</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>IV</td>
<td>0.20</td>
<td>0.07</td>
<td>-0.07</td>
<td>-0.35</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>-0.62</td>
<td>0.37</td>
<td>-0.13</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>VI</td>
<td>-1.14</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>M2</td>
<td>IV</td>
<td>-1.40</td>
<td>0.01</td>
<td>0.05</td>
<td>-0.51</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>-1.35</td>
<td>-0.19</td>
<td>-0.14</td>
<td>-0.65</td>
</tr>
<tr>
<td></td>
<td>VI</td>
<td>-1.01</td>
<td>1.19</td>
<td>0.14</td>
<td>-0.07</td>
</tr>
</tbody>
</table>

58 When only DFE was added to the Preferred Model for M1 it was insignificant.
### Table 5-5: Tests for Currency Substitution After December 1980

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Estimation</th>
<th>Instrument</th>
<th>T-Statistics</th>
<th>Joint Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method</td>
<td>Set</td>
<td>DFE</td>
<td>DFE.DER3</td>
</tr>
<tr>
<td>M1</td>
<td>2SLS</td>
<td>IV</td>
<td>0.87</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>0.19</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>-0.05</td>
<td>-1.27</td>
</tr>
<tr>
<td></td>
<td>2S2SLS</td>
<td>IV</td>
<td>0.98</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>[MA(1)]</td>
<td>V</td>
<td>0.20</td>
<td>-0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>0.33</td>
<td>-0.96</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
<td>-</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>-</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>-</td>
<td>0.86</td>
</tr>
<tr>
<td>M2</td>
<td>2SLS</td>
<td>IV</td>
<td>1.93</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>1.81</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>1.66</td>
<td>-0.14</td>
</tr>
<tr>
<td></td>
<td>2S2SLS</td>
<td>IV</td>
<td>2.52</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>[MA(1)]</td>
<td>V</td>
<td>2.04</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>1.49</td>
<td>-0.61</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
<td>-</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>-</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VI</td>
<td>-</td>
<td>1.36</td>
</tr>
</tbody>
</table>

### 5.4 Conclusion

Currency substitution in response to economic variables does not appear to be a significant influence on Japanese money demands. The results presented here suggest that a foreign interest rate and the expected change of the exchange rate are not important influences on the demand for Japanese M1 or on the resident demand for yen-denominated M2. In addition, the results justify the closed economy focus of other studies by Tsutsui and Hatanaka (1982), Hamada and Hayashi (1983) and Shinkai (1984). For M1, the relevant explanatory variables appear to be an interest rate on competing assets, a transaction variable and lagged values of the money stock. For M2, in addition to these variables, the rate of inflation was a relevant variable. The preferred equations differ from those traditionally estimated for Japan by allowing for different dynamic behaviour in the response of money demand to changes in the explanatory variables. The results indicate that this difference is of some importance.
Table 5-6: Currency Substitution in M2

<table>
<thead>
<tr>
<th></th>
<th>M2_-1</th>
<th>R3</th>
<th>GNP</th>
<th>INF</th>
<th>DFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lag 0</td>
<td>0.822</td>
<td>0.162</td>
<td>-0.325</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(15.37)</td>
<td>(2.20)</td>
<td>(4.44)</td>
<td>(2.89)</td>
<td></td>
</tr>
<tr>
<td>Lag 1</td>
<td>-0.022</td>
<td>0.213</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.45)</td>
<td>(3.36)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SEE = 0.0070  DW = 2.49  R² = 0.999

DIAGNOSTIC CHECKS

<table>
<thead>
<tr>
<th>Statistic Type</th>
<th>Statistic Value</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESET</td>
<td>1.16</td>
<td>χ²(2)(0.01) = 9.21</td>
</tr>
<tr>
<td>Normality</td>
<td>0.82</td>
<td>χ²(2)(0.01) = 9.21</td>
</tr>
<tr>
<td>Heteroskedasticity</td>
<td>0.10</td>
<td>χ²(1)(0.01) = 6.63</td>
</tr>
<tr>
<td>ACF of residuals</td>
<td>1) 1.84 2) 0.31 3) 0.06 4) 0.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) 1.64 6) 2.30 7) 0.53 8) 2.28</td>
<td></td>
</tr>
<tr>
<td>ACF of squared residuals</td>
<td>1) 0.12 2) 0.05 3) -1.02 4) -0.91</td>
<td></td>
</tr>
</tbody>
</table>

Following the changes to the rules governing the usage of foreign currency deposits in December 1980 there does seem to have been a significant upward shift in the demand for M2. One possible explanation for this shift is complementarity between yen-denominated deposits and foreign assets so that an increased demand for foreign assets may also lead to an increase in yen-denominated deposits. The demand for M1 does not seem to have been significantly affected. The equations seem to be quite stable when one-step ahead predictions and confidence intervals for these predictions are calculated, a result that seems inconsistent with the existence of currency substitution.

One of the problems encountered in the investigation was the need to find a proxy for the expected change of the exchange rate. The realised change of the exchange rate was used and this required the use of an instrumental variable estimation technique. Instrumental variable techniques require a degree of correlation between the instruments and the problem variable. In the equations estimated here, the correlation between the realised value of the change of the exchange rate, DER3, (dated at time t+1) and the instruments (dated at time t or t-1) was rather low (R²'s around 0.15). In actual time, this separation is three or six months. The correlation was higher for the variable DFE.DER3 (R²'s around 0.35).
alternative proxy was to use the predictions from a regression of the realised value of the change of the exchange rate on an information set. These regressions also suffer from a low correlation between the predictions and the realised value. If the change of the log of the exchange rate is white noise (that is the log of the exchange rate is a random walk) and largely dominated by unanticipated events, such low correlations could be expected. They are also to be expected since the realised value of the exchange rate and the variables in the information set are one or two periods apart. It may be that the insignificance of DER3 and DFE.DER3 in the money demand equations is attributable to this lack of correlation between DER3 and DFE.DER3, and the instruments.

A number of examples where the expected values of variables are included as explanatory variables in econometric models are: the expected inflation rate in an output equation\(^{59}\); the expected output gap in an inflation equation\(^{60}\); the expected inflation rate in a Phillips’ Curve\(^{61}\); and the expected rate of return (including the expected rate of change of the exchange rate) on foreign bonds in a bond demand equation\(^{62}\). In none of these cases is the lack of correlation between the realised value used to proxy the expected variable and the instrument set remarked on as being a problem. It should be noted that the variables that proxy the expectations variable tend to have coefficients that are statistically insignificant. Given the results in this Chapter, a problem with a lack of correlation might have been expected in the estimation of the bond demand equations. It is possible that in the model being estimated here the possibility of finding a good instrument set is precluded by the very nature of the model. In practical applications, this lack of a good instrument set could lead to large standard errors and a tendency to accept the hypothesis that coefficients are not insignificantly different from zero. Using the McCallum (1976) substitution approach may mean that attempts to find significant movements in the demand for bonds, and short- and long-term capital flows in response to expected exchange rate changes may prove difficult.

It may be that investor sensitivities to expected exchange rate changes occur are over much shorter periods than three months. An investigation using monthly rather than quarterly data may provide a sharper test of the currency substitution

\(^{59}\)Taylor (1979) and Cumby et al (1983).

\(^{60}\)Taylor (1979) and Cumby et al (1983).

\(^{61}\)McCallum (1976).

hypothesis and may also give rise to instruments that are more highly correlated with the realised exchange rate change. As noted, an attempt was made to move in that direction but the investigation was hampered by the lack of a suitable monthly transactions variable.

In this Chapter, the impact of a regulatory change permitting the unrestricted use of foreign-currency deposits on the demand for money was examined. The importance of regulatory change more generally for asset demands and the exchange rate are issues taken up in the next two Chapters. Evidence from Chapters 3-5, relating to bond substitution, and the impact of changes in the Japanese time deposit rate on the risk premium and on the Japanese demand for money, is relevant to some of the discussion.
CHAPTER 6
LIBERALIZATION OF JAPANESE FINANCIAL MARKETS

In the 1960's, Japan had a strong commitment to a fixed exchange rate, to a "low" interest rate policy and to heavy controls on capital flows. In the 1980s, Japan has a floating exchange rate, a much more liberalized domestic capital market and far fewer restrictions on capital inflows and outflows. The change has been dramatic. Like many other Western countries, Japan is undergoing a process of liberalization of her financial markets as a result of pressures from both domestic and international sources. These changes have potentially important implications for the efficacy of monetary policy and for exchange rate management. The focus in this Chapter and Chapter 7 is on the impact of these changes on the yen/dollar exchange rate.

Currently two of the focuses of international attention are the large current account surpluses being run by Japan and the large current account deficits being run by the United States. An 'overvalued' dollar (and an 'undervalued' yen) is argued by many to be the principal cause of this surplus-deficit pattern. While the major reasons for the overvalued dollar (and even its existence) are the subject of a deal of dispute, there is widespread agreement about the factors that are important in exchange rate determination. These are output, prices, money supplies, interest rates and trade balances. However, views diverge on the mechanisms of influence and the direction of influence that these variables have on the exchange rate. The present stance and the expected future stance of government policy, whether monetary, fiscal or exchange market intervention (sterilized or unsterilized) policy


2Frankel (1985) contains a recent discussion of a number of possible meanings of 'overvalued' in this context and the consequences of these meanings for policy discussions.

3See the recent survey by Shafer and Loopesko (1983).
have also been identified as important determinants of the current and future
behaviour of exchange rates. The possibility of a link between the financial
structure in any country and exchange rate behaviour has only recently become the
centre of international attention.

Reliance on this link between a country’s financial structure and exchange rate
behaviour has led to the United States, and to a lesser extent Europe, requesting
Japan to liberalize her markets for goods and services and her capital markets (both
her domestic capital markets, and her controls on capital inflows and outflows).
Japan seems to be one of a few, if not the only, country to be subject to these sort
of requests to liberalize her capital markets to counter trade imbalances4.

The connection between capital-market liberalization and the elimination (or at
least a partial alleviation) of the United States current account deficit is indirect. It
is argued that capital-market liberalization in Japan will lead to a stronger yen
relative to the dollar and that, in the medium term, a stronger yen will work to
alleviate Japan’s current account surplus (and the American current account deficit).
The ‘exchange rate-current account’ link is widely acknowledged but the
‘liberalization-strong yen’ argument is rather controversial. This Chapter and
Chapter 7 concentrate on the latter argument. Implicit Japanese government foreign
exchange policy in the 1970s seems to have been based on this ‘liberalization-
exchange rate’ link, in that regulation of capital flows was used as a means of
limiting changes in Japan’s foreign exchange reserves and minimizing fluctuations in
the value of the yen. In addition, one of the reasons put forward for the Japanese
government’s slowness to free up deposit rates is that this would reduce the
government’s influence on the yen/dollar exchange rate.

In discussing the liberalization of the Japanese capital markets and the
determination of the yen rate, it is useful to survey briefly some relevant
characteristics of the Japanese capital market. These discussions contain important
background information for the discussion in both this Chapter and Chapter 7. In
this Chapter, three general arguments relating financial liberalization and the
exchange rate, liberalization increasing the use of the yen (and relates to changes in
the demand functions for yen-denominated and dollar-denominated bonds);
liberalization causing a rise in domestic interest rates; and liberalization impacting
on Japanese savings behaviour, are discussed. The importance of details of capital
controls, the Japanese tax system and the available alternative investment
opportunities are highlighted. In Chapter 7, specific measures that have actually
been implemented or that are proposed are examined.

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4Requests to liberalize capital markets may be an integral part of an International Monetary Fund-
sponsored rescue program for a developing country.
6.1 Characteristics of the Japanese Capital Market

Seven aspects of the Japanese financial system are relevant: (i) market segmentation; (ii) the short-term money markets; (iii) long-term government securities; (iv) market duality; (v) taxation; (vi) the postal savings system; and (vii) international capital transactions. In order to understand the significance of recent and future liberalizations in Japan, it is important to understand the structure of the Japanese financial system and some of the constraints that are imposed on the investment behaviour of Japanese financial institutions. The information is not only critical to an evaluation of the general arguments relating financial liberalization and the exchange rate but also to an evaluation of the current program of liberalization and analyzing the potential effects of these changes of the yen/dollar rate. It also aids in predicting where future liberalization can be expected to occur.

Market Segmentation

One of the major characteristics of the Japanese financial system is the degree of segmentation. Markets are segmented by the type and maturity of the asset, by the size and the type of the investor and, to a lesser extent, geographically. Financial institutions are segmented both by their function and the sector they serve. There is a separation of long- and short-term markets. Government policy has limited the type of financial instruments available to individuals, companies, financial institutions and the rest of the world. Limits on the access of certain agents to various markets have enforced interest rate controls, limited an agent's opportunities for asset substitution and channelled funds in directions desired by the government. Administrative guidance (gyosei shido) to institutions on their financial activities has been strong and arguably influential in redirecting financial resources into certain areas.

The fund-raising and fund investment activities of financial institutions are severely limited, so that except in limited circumstances Long-Term Credit Banks cannot raise funds by deposit collection but can use debenture issues for this purpose. City banks, however, are not permitted to raise funds by debenture issues. Deposits are one of the city banks' main sources of funds but even the maturity of deposits they can accept and the interest rates they can pay are restricted. Banks are prohibited from engaging in the underwriting, dealing, brokerage or distribution

of negotiable securities except public bonds and debentures\(^6\). The functions of the various Japanese financial institutions are prescribed by law. It is very unlikely that, in a completely deregulated environment, these limitations would coincide with the functions that each of these financial institutions would wish to have.

The discouragement of bond finance by imposing the requirement that issues of corporate bonds be backed by collateral\(^7\), the effective prohibition on commercial paper and the lack of a well developed stock market has meant that corporate financing has been dominated by indirect financing, that is, borrowings from financial institutions. The recent ability of large companies to borrow offshore has meant that loans to small and medium size corporations have become the growth areas for banks. This has also meant that the importance of the bank’s prime lending rate has diminished. It has been argued that the institutions and practices evolved around the Japanese banking systems, for example the keiretsu groupings (industrial groups centred on a main bank)\(^8\), have provided Japanese companies with inherent cost advantages over their American counterparts since the cost of capital is argued to be lower in Japan than in the United States. It is therefore believed that financial liberalization will eliminate this alleged cost disadvantage suffered by United States firms\(^9\) and this will to some extent help the United States to reduce its trade deficits.

**Short-Term Money Markets**

The important short-term yen-denominated money markets in Japan are: the Call Market; the Bill Market; the market for Certificates of Deposit (CD); and the Gensaki Market. The relative sizes of the markets are ¥ 5.0 trillion ($20 billion), ¥ 9.8 trillion ($39 billion), ¥ 11.3 trillion ($46 billion) and ¥ 4.3 trillion ($17

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\(^6\) Article 65 of the Japanese Securities and Exchange Law. Although banks were authorized to deal over-the-counter in government bonds in April 1983, the rigid separation of bank and securities business is maintained onshore but not offshore. American Express when it wanted to enter the Japanese securities industry had to close down its bank branch in Tokyo. Japanese banks operating outside Japan can enter areas where they cannot operate domestically enabling them to build up expertise in those areas that will enhance their ability to perform the same functions domestically should the opportunity arise.

\(^7\) This was part of the Japanese response to the recession of the 1930s although even this restriction is slowly being relaxed, following changes in the rules governing issues of Euro-yen bonds by Japanese residents. The outstanding value of unsecured and unguaranteed bank loans has also increased significantly in the 1980s.

\(^8\) For a discussion of the importance of keiretsu groupings: see Sheard (1984).

\(^9\) For example, Yang (1984). A contrary argument by Horiuchi (1984) suggests that in the 1950s and 1960s, Japanese interest rates were higher than those in other industrialised countries.
billion\textsuperscript{10}. The Bank of Japan uses the Bill and Call Markets to conduct its Open Market Operations. Table 6-1 contains details of some of the characteristics of these markets. An additional short-term market has been the interbank deposit market but until recently, under Bank of Japan regulation, the interest rates payable on interbank deposits were considerably less than the call and bill discount rates. There is also a dollar call market with maturities ranging from overnight to two months.

<table>
<thead>
<tr>
<th>Market</th>
<th>Maturity</th>
<th>Minimum Lot Size</th>
<th>Non-Resident\textsuperscript{11} Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call</td>
<td>0-7 days</td>
<td>1m (4000)</td>
<td>No</td>
</tr>
<tr>
<td>Bill</td>
<td>1-4 months</td>
<td>10m (40000)</td>
<td>No</td>
</tr>
<tr>
<td>Certificate of</td>
<td>1-6 months</td>
<td>100m (0.4m)</td>
<td>Yes</td>
</tr>
<tr>
<td>Deposit\textsuperscript{13}</td>
<td>&lt; one year</td>
<td>100m (0.4m)</td>
<td>Yes</td>
</tr>
<tr>
<td>Gensaki</td>
<td>usu. 1-3 months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It would be incorrect to conclude from Table 6-1 that the only differences between these markets were differences in maturity, lot size and non-resident participation. Although the rate of return in each market is freely (market) determined by the forces of supply and demand, there are restrictions on which domestic Japanese agents may participate in each market and what quantities of some assets may be issued by some economic agents. For example, only financial

\textsuperscript{10}Based on the monthly average of the average outstanding balance in each market during the months of July, August and September 1985: Bank of Japan (1986). All conversions into dollars in this Chapter use a yen/dollar exchange rate of ¥250/dollar.

\textsuperscript{11}Non-resident does not include the Foreign Banks that operate in Japan. The Certificate of Deposit and Gensaki Markets were open to foreigners in May 1979.

\textsuperscript{12}While the minimum lot size in the Call and Bill Markets are respectively ¥ 1 million and ¥ 10 million, the standard lot size in both markets is ¥ 100 million.

\textsuperscript{13}Prior to April 1985, the minimum lot size was ¥ 300 million ($1.2 million) and the minimum maturity was 3 months.
institutions can participate in the Call and Bill markets\textsuperscript{14}. In the Call Market and Commercial Bill Markets, until recently, financial corporations which procured funds from that market could not invest in that market and vice versa. There are limits on the quantity of CDs that can be issued by any individual bank depending on the bank’s capital base. Differences in the markets also arise because of the tax treatment of each asset. All final holders of CDs are subject to 20 per cent withholding tax on interest payments on the maturity of the CD. However there is no transaction tax on trading in the CD secondary market. The ‘interest equivalent’ payments that arise because of the difference between the purchase and the agreed repurchase price on Gensaki transactions are not subject to withholding tax although any interest payments received on the underlying security are subject to withholding tax\textsuperscript{15}. Investors in Gensaki assets are subject to a transaction tax\textsuperscript{16}.

As from April 1, 1985, all financial institutions in Japan have been able to issue Money Market Certificates (MMCs)\textsuperscript{17}. MMCs are a large denomination deposit, over ¥ 50 million ($0.2 million), with market-related interest rates. The maximum rate of interest has been set at 0.75 per cent less than the average Certificate of Deposit rate announced weekly by the Bank of Japan. The maturities can range from one to six months and the contract cannot be cancelled for one month after sale. MMCs are not negotiable and if cancelled before maturity, the interest to be paid will be that payable on ordinary deposits.

The high minimum lot sizes for Certificates of Deposits, Gensaki transactions and Money Market Certificates are designed to prevent a flow of funds from bank deposits held by individuals to Certificates of Deposits, Gensaki Bonds and Money Market Certificates. Given their high minimum lot size, there would obviously be an opportunity for unit trusts or money management funds to step in and act as aggregators of personal savings to overcome these limits. But even the setting up of these money management funds has been strictly controlled as have been the rates of interest payable on existing unit trusts. There is now an important similar

\textsuperscript{14}This contrasts with the situation in England and the United States where not only financial corporations but also business corporations and even individuals may participate.

\textsuperscript{15}Nomura Shōken (1985a, p.72). Since April 1985, non-residents are no longer subject to the 20 per cent withholding tax.

\textsuperscript{16}The treatment of Gensaki assets for the securities transaction tax depends on the underlying asset and ranges from zero for Certificates of Deposits, 0.01 per cent for National Bonds and 0.015 per cent for bonds, debentures and other securities yielding fixed rate interest (Gomi 1984, p.39). These are the tax rates when sales are by dealers for their account, the tax rates are roughly trebled for other types of sales.

\textsuperscript{17}Sōgo and trust banks were allowed to start selling MMCs from March 18, 1985.
instrument called the Chuki Kokusai Fund\textsuperscript{18} which is based on medium-term government securities. It has a higher yield and is more liquid than one year time deposits. These and similar assets like, Wide Accounts, Big Trusts and Jumbo Accounts, have enabled small investors to enjoy market related rates of return.

Despite the number of short-term assets with market-determined interest rates, the interest rates on small-denomination deposit instruments in both the banking and postal savings systems are still subject to strict interest-rate controls. Interest rates on ordinary and savings deposits in the banking system are regulated under the Rinji Kinri Chōsei Ho (Temporary Interest Rate Adjustment Law) of 1947. The Yokin Hoken Kikō (Deposit Insurance Corporation) operates a deposit insurance system that guarantees deposits with member institutions up to the value of ¥ 3 million\textsuperscript{19}.

The interest rates on large denomination ( > ¥ 1 billion) time deposits were liberalized in October 1985. The Ministry of Finance announced in January 1986 that from Autumn 1986 the minimum denomination on time deposits with liberalized interest rates would be reduced to ¥ 500 million; the maximum maturities for CDs and MMCs would be extended from six months to one year; and the issuance ceilings of CDs and MMCs would be raised from 150 per cent to 200 per cent of the financial institution’s net worth. The minimum denomination of time deposits with liberalized interest rates would be reduced to ¥ 300 million in September 1986 and ¥ 100 million in spring 1987. It is not clear when interest rates on small denomination deposits will be liberalized but it will follow the deregulation of interest rates on large denomination deposits probably by a gradual lowering of the minimum denomination of deposits with liberalized interest rates. Yet to be determined is the order of liberalizing short- and long-term rates. Problems resulting from the inversion of the yield curve suggest that long-term rates may be deregulated first.

**Long-Term Government Securities**

Long-term national government bonds are sold to an ‘underwriting syndicate’

\textsuperscript{18} ‘Chuki Kokusai’ refers to medium-term government securities.

\textsuperscript{19} Bank of Japan (1978, pp.112-5) and Toyo Keizai (1984, pp.258-9). Institutions covered include ordinary banks, trust banks, long-term credit banks, foreign exchange banks, mutual banks, Shinkin banks and credit associations. Institutions pay 0.008 per cent of their outstanding deposits to the Deposit Insurance Corporation as an insurance premium.
that consists of banks and other financial institutions\textsuperscript{20}. Until around 1982 these bonds were typically issued at rates of return lower than the market rate\textsuperscript{21}. Conditions of issue and yields on new issues are negotiated between the Ministry of Finance and the underwriter's syndicate. The compulsory acquisition of these bonds by financial institutions has acted as a kind of taxation on the profits of the financial institutions, on the reasonable assumption that the levels forced on financial institutions were greater than their desired holdings given the returns on these bonds. This was possible because the Ministry of Finance had powerful regulatory instruments. Since 1982, the issuance rates on government bonds have been more in line with market rates and are even sometimes above market rates. This was probably the result of a subtle change in the power balance between the syndicate and the Ministry of Finance. Government bonds could be liquidated by sale to the Bank of Japan but as there were limits on the amount the Bank would liquidate, it was necessary to develop a secondary market in these bonds. The prohibition on sales of bonds to the public has also been relaxed. Until April 1977, the Bank of Japan operated a price support scheme in the secondary market. Foreigners are able to acquire government securities. Elimination of the 'compulsory acquisition' of government bonds could potentially cause substantial changes in portfolio behaviour, particularly in respect of financial institutions investing in foreign securities.

**Market Duality**

There is a duality of markets in Japan referring to the fact that in some markets, interest rates are market determined while in other markets the interest rate is government determined. This duality even occurs between assets that would be expected to be extremely close substitutes; for example, the primary and secondary markets for national government bonds. Some examples of the 'determined' interest rate markets are the deposit market, the corporate bond

\textsuperscript{20}Financial institutions participating in the syndicate include City Banks, Long-Term Credit Banks, Regional Banks, Trust Banks, Sogo Banks, Shinkin Banks, Insurance Companies and Securities Companies. Foreign banks have participated in the underwriting syndicate since April 1984.

\textsuperscript{21}Pettway (1982) contains a discussion of the relationship between yields in these primary and secondary markets.
market, the loan market. Some examples of 'free' interest rate markets are the markets for Certificates of Deposits, transactions in bonds with repurchase agreements (gensaki market) and the secondary bond market. Figure 6-1 contains an indication of the links between the principal interest rates in Japan. Also depicted in this figure are the important onshore foreign-currency markets for foreign-currency deposits and call dollars, and offshore currency markets for Euro-currency (yen and non-yen) bonds and Euro-currency (yen and non-yen) deposits.

**Taxation**

In Japan, an individual's income, whether it be from employment, business, interest, dividends or capitals gains, is taxed on an integrated basis. Until December 31 1986, it is also possible for an individual to choose to have income from interest, dividends or capital gains taxed separately and at a potentially lower marginal rate of taxation than that applied to other income. In 1985, the reduced rate of taxation to be applied to this income was 35 per cent.

In addition, certain interest income is tax exempt: interest from postal savings on a principal sum up to ¥ 3m, interest from small savings on a principal sum up to ¥ 3m, interest from national and local government bonds on a principal sum up to ¥ 3m and interest from savings for the formation of employee's assets on a principal sum up to ¥ 5m. Therefore interest on a principal sum up to the value of ¥ 14m is potentially tax free. Interest derived from foreign-currency deposits does not fall into any of the tax exemption categories. This system of tax

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22 Mechanisms may still exist that have the potential to bring about market-determined or close to market-determined rates of return in some of these markets; for example, in the loan market the use of compensatory deposits increases the actual interest rate paid on loans. There has been much debate in Japan about whether the effective interest rates paid in the loan market are competitively determined or not; see Kuroda (1979), Hamada and Iwata (1980), Ito and Ueda (1982), Tsutsui (1982) and Royama (1983). From July 1979, the Ministry of Finance has prohibited banks from accepting compensatory balances from corporate borrowers within one week, either before or after lending.


24 Postal savings include Postal Savings Certificates (Teigaku Yūbin Chokin) in the Postal Savings System.

25 Small savings include time deposits in the banking system, Chuki Kokusai Funds issued by Securities Companies, Loan Trust Accounts (Kashitsuke Shintaku), bonds and debentures.

26 These are savings acquired under savings contracts where the payment of installments or premiums is withheld by the employer from the employee's salary. The availability of this type of arrangement is dependent on the employer.

27 Okurashō (1983, p.141). However capital gains made because of exchange rate changes are not taxable.
Figure 6-1: The Dual Structure of Interest Rates, January 1985

**Regulated Rates**
- Bank debentures
  - 6.700 (5 yr)
- Government bonds
  - 6.666 (10 yr)
- Long-term prime rates
  - 7.4
- Yields on newly-issued bonds
- Expected rate of dividend
  - 6.72 (5-year loan trust)
- Short-term prime rates
  - 5.3
- Rates on time deposits
  - 3.5 - 5.75 (1 week - 2 yrs)
- Official discount rate
  - 5.0
- Yield on short-term government securities (60 days)
  - 4.94

**Offshore Markets**
- Yield on long-term government bond (over-the-counter quotes)
  - 6.620 - 6.678 (due 7/94)
- Yields on medium-term govt bonds sold in competitive bidding
  - 5.875 (2 yr)
- Average contracted interest rates on loans and discounts (all banks)
  - 6.360
- CD rates, 3-month Eurodollars
  - 6.200 (3-month Eurodollars)
  - 6.365 (90-day CD)
- Call and bill rates
  - 6.000-6.3125 (Call)
  - 6.250-6.3125 (Bill)
- Dollar time deposits
- Dollar Call market

**Market-Determined Rates**
- Euroyen bonds
  - 7.17
- Euroyen CDs
  - Eurodollar CDs
- Euroyen time deposits
  - 6.25 - 6.3125
- Eurodollar time deposits
  - 8.2875-12.625

**Offshore Markets**
- U.S. internal money markets
  - 7.82 - 10.68 (Treasury bill rate)

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**Interest-rate arbitrage**  **Connected interest rates**  **Assured profit**  **Forward market**
exemptions, called the Maruyu system, is only available for individuals. A withholding tax system applies to wages and, where taxable, to interest and dividends. In addition, capital gains made by individuals on the sale of securities are not taxable unless the individual trades sufficiently often and in sufficiently large quantities to be deemed a trader for tax purposes.

For corporations, the general rule is to tax income, interest income, capital gains and exchange rate gains all at the same rate. Distributed profits, for large corporations, are currently taxed at the rate of 33.3 per cent while undistributed profits are taxed at the rate of 43.3 per cent.²⁸

The Postal Savings System²⁹

The Postal Savings system is a deposit collection system run by the network of post offices throughout Japan. These deposits (called postal savings) are used to finance the national government’s investment program. In contrast to most of the financial system which is under the control of the Ministry of Finance, the postal savings system is under the control of the Ministry of Posts and Telecommunications. The postal savings system is very large relative to the banking system. For example, in the second quarter of 1985, total deposits in the banking system averaged ¥ 213 trillion ($0.85 trillion), whereas total deposits in the postal savings system totalled ¥ 95.4 trillion ($0.38 trillion).³⁰

Savings in the postal savings system are subject to tax advantages and in some cases to higher rates of return than are available from the corresponding deposits with banks. These tax advantages arise from the general tax exemption for an individual’s interest income discussed previously and the well-known fact that the enforcement of the monetary limits on the exemption levels is laxer in the postal savings system than in the banking system. It has been possible to evade the payment of tax on interest income altogether by depositing in many postal savings accounts. As a result of this exemption, the proportion of personal savings held as tax-exempt savings has been rising over the past 10 years and stood at 59.4 per

²⁸The tax rates applying to the distributed (undistributed) profits of large corporations were 40 (30) per cent between 1975 and 1980, 42 (32) per cent between 1981 and 1983 and 43.3 (33.3) per cent in 1984 and 1985: Economic Planning Agency (1983, p.210) and Gomi (1984, p.151). Variations in tax rates are important not only because they will affect asset demands by altering the after-tax rates of return but also because the parameters of the demand functions can be expected to be functions of the tax rates. Changes in the tax rates could therefore potentially cause instability in the demand functions.

²⁹See Osborn (1985b) and Nomura Sogo Kenkyujo (1985).

³⁰Bank of Japan (1986).
In March 1983. In 1981 and 1982 when the government moved to tighten surveillance on the tax-exempt accounts, there was a boom in the sale of zero-coupon foreign-currency bonds issued in foreign markets, which were also tax free. Part of the tightening up on surveillance and enforcement of the monetary limits was a proposal to set up a ‘Green Card’ identification system to eliminate some of the abuse of this exemption. Legislation implementing this proposal was passed by the Diet but was abolished without ever being implemented. Instead, the rigour of surveillance on persons opening new accounts on or after January 1, 1986 has been increased. Existing tax-exempt accounts, if unused after that date, will not be affected by the changes until their maturity and reinvestment is required. Some of these accounts have maturities of up to 10 years. A substantial shift into these accounts prior to 1986 can be expected to have occurred, in anticipation of these changes.

International Capital Transactions

Since the move to floating exchange rates in 1973, Japan has not engaged in a policy of totally prohibiting international capital transactions. An example of the importance of Japanese international capital transactions is the substantial holding of outstanding United States Government Treasury Bills by Japanese agents (excluding official holdings). A surplus (or a deficit) on the Japanese current account, in the absence of intervention by the Bank of Japan, must imply a build-up (or running down) of financial assets by Japan. Regulations on capital flows have allowed this asset build-up to occur, even though they might have altered the currency denomination of the assets held. Specifically the regulations may have encouraged the assets acquired to be denominated in foreign currencies rather than in yen. Appendix B contains a brief description of some of the important Japanese policy changes with respect to capital controls over the period from 1973 to 1984.

Although the general principle governing international capital transactions is that they are permitted unless specifically restricted, controls on capital flows still exist. However these controls seem to be becoming less important over time. The most important remaining capital inflow restriction until 1984 was the restriction on investment in eleven designated companies. Foreigners were prohibited from acquiring more than a specified percentage of the ownership of these eleven companies. This control was eliminated in May 1984. Capital outflows like loans,
usance\textsuperscript{33} exceeding one year, issues of yen-denominated bonds (samurai bonds) in Japan by non-residents\textsuperscript{34} and direct investment abroad are subject to Ministry of Finance approval. There are stringent restrictions on Japanese residents holding bank accounts in foreign countries\textsuperscript{35} even though foreign-currency accounts can be held in Japan. These restrictions on holding overseas bank accounts are probably aimed at preventing Japanese residents taking advantage of higher Euro-yen deposit rates which would tend to undermine the regulated deposit rates in the banking and postal savings system.

With high nominal rates of return on foreign (American) long-term bonds in comparison to Japanese domestic rates, Japanese life-insurance companies have been investing heavily in foreign bonds to finance life-insurance policies with higher yields. Life-insurance companies' offshore lending has also been increasing quite rapidly given the stagnant domestic demand for funds and potentially higher rates of return on foreign lending. Until March 1986, life- and general-insurance companies were subject to Ministry of Finance rules that limited their holdings of foreign bonds issued by non-residents to less than or equal to 10 per cent of their total assets\textsuperscript{36}. In September 1985, life- and general-insurance companies held respectively 9.2 per cent and 8.8 per cent of their assets in foreign bonds\textsuperscript{37}, their holdings having steadily risen over 1984. These figures indicate that in September 1985, the 10 per cent limit was not binding on the insurance industry. It is of course possible that for individual companies the constraint was binding and that this is hidden by the use of industry figures. From March 1986, the ceiling on investment portfolios for life-insurance companies was raised from 10 per cent to 25 per cent. Concurrently, all assets denominated in foreign currencies, including foreign-currency deposits which were not previously restricted, were included under the general ceiling. The limit

\textsuperscript{33}Import usance is a restricted loan from a bank, typically denominated in American dollars, that requires import documentation for government approval. Usance needs to be contrasted with impact loans that are untied loans from banks, typically denominated in American dollars, that require no documentation for government approval.

\textsuperscript{34}There are restrictions on who may issue these bonds, the time between successive issues and the size of each issue. Some relaxation of these restrictions occurred in early 1984.

\textsuperscript{35}Financial institutions are allowed to have accounts abroad and other residents may be authorized, on a case by case basis, to operate these accounts in connection with overseas business activities. Japanese residents are not authorized to have accounts abroad for investment purposes. Overseas subsidiaries of Japanese companies are free to operate accounts abroad.

\textsuperscript{36}Economic Planning Agency (1983, pp.156-7).

\textsuperscript{37}These figures are derived from the ratio of holdings of 'Foreign Securities' to 'Total Assets (including other assets)'. Bank of Japan (1986). These figures are misleading because they include foreign-currency assets that are not counted for the purposes of the 10 per cent rule.
applying to general-insurance companies was not changed. For Pension Trust Banks, a similar 10 per cent limit applies to their holdings of foreign-currency bonds. In September 1985, Trust Banks held only 3.7 per cent of their assets in this form. While the domestic sale of foreign Commercial Paper (CP) and Certificates of Deposits (CDs) is permitted (since 1984) an additional limitation is that life-insurance companies' holdings of foreign CPs and CDs must not exceed 3 per cent of their assets. For general-insurance companies, their holdings of foreign CPs, CDs, Bankers' Acceptance Bills (BA) and Mortgage Certificates must not exceed 3 per cent of their assets. A further rule governing life-insurance companies states that they are not allowed to treat most of the capital gains they make on their domestic or international portfolios as income and so these gains cannot be included in the dividends paid to policy holders. This rule has the potential to inhibit life-insurance companies investing in some foreign-currency assets.

While the general rule governing capital transactions is that they are permitted unless specifically restricted, in emergencies, most capital transactions not subject to specific restrictions may be subject to prior approval. The emergency situations defined are where the capital transactions: result in drastic fluctuations of the exchange rate; result in an international flow of funds large enough to adversely affect Japan's money or capital markets; or make maintenance of equilibrium of Japan's balance of payments difficult. Some commentators have viewed the effect of these provisions as merely recasting the old regulatory framework in a new guise, while others view the law as greatly liberalizing capital flows and in many cases abolishing capital controls.

39 Bank of Japan (1986). This figure is to some extent misleading in that there are other non Pension Trust Banks included in the Trust Bank category and because the figures refer to 'Foreign Securities' rather than foreign-currency securities.
40 A Banker's Acceptance is an order in the form of a draft by one party (drawer) to a bank (drawee) and is accepted by that bank to pay a third party a certain sum at a specified date. The typical transaction occurs between exporters and importers and is like obtaining a direct bank loan. The draft bearing the bank's acceptance becomes a marketable security which, when offered for sale by the bank at an appropriate discount from face value, is an attractive short-term investment.
41 See Osborn (1985a).
42 Horne (1985a, p.169).
43 See, for example, Borsuk (1979).
44 For example, OECD (1982) and Pigott (1983).
By spelling out the conditions for the reintroduction of capital controls, these provisions reinforce to some extent the private investor's ability to anticipate the timing of the reimposition of controls but not their character. One negative aspect of these provisions may be to raise investor perceptions of the probability of the imposition of capital controls at some time in the future, compared to the situation where there is no provision. This has the potential to reduce the attractiveness of yen-denominated assets for foreigners and the attractiveness of foreign-currency denominated assets for residents\textsuperscript{45}.

Pigott (1983, p.27) argues these emergency provisions were invoked in 1982 in a clear reference to the Ministry of Finance’s ban on Japanese purchases of zero-coupon foreign-currency-denominated bonds. The Ministry of Finance feared that large-scale purchases of zero-coupon bonds would add to the weakness of the yen as well as undermine the integrity of the tax system.

An often-forgotten restriction on capital outflows relates to restrictions or prohibitions on the holdings of foreign securities or foreign-currency securities in the portfolios of various government financial institutions, government-related institutions\textsuperscript{46} and specialised institutions for agriculture, fisheries and forestry. So, for example, the Postal Life-Insurance Fund (Kani Seimei Hoken Shikin) and the Norinchukin Bank, the agricultural co-operatives’ bank, have recently begun investing heavily overseas. But the Postal Life-Insurance Fund and the Postal Pension Fund are limited to investing less than 10 per cent of their assets in corporate bonds and foreign assets\textsuperscript{47}. There is some pressure for the limit to be raised to 25 per cent but the weakness of yen at the time as cited as one reason for not raising it\textsuperscript{48}. The Norinchukin Bank is limited to investing in foreign bonds with an A-rating or higher\textsuperscript{49}. There are even reports that the Ministry of Posts would like to place up to 10 per cent of postal savings into foreign investments although this seems unlikely to occur\textsuperscript{50}.

\textsuperscript{45}Friedman (1968).

\textsuperscript{46}For example, the Government Officials’ Mutual Benefit Association.

\textsuperscript{47}Economic Planning Agency (1983, pp.158-9). In November 1986, these two institutions appeared to hold 10.6 per cent of their assets in this form but this arises because the data probably includes bonds other than those controlled by the limit: Bank of Japan (1986).

\textsuperscript{48}Ollard (1984, p.138).

\textsuperscript{49}Economic Planning Agency (1983, pp.156-7).

\textsuperscript{50}See Osborn (1985b, p.107)
Another restriction relates to the ability of government and government related institutions to issue foreign bonds. Conditions have recently been relaxed for municipalities to issue foreign bonds. This together with a perceived lower cost of funds in the Euro-markets has led to an increase in the issues by municipalities of foreign-currency bonds in the Euro-market, for example, issues by the Tokyo Metropolitan Government and the City of Kobe. There is even the possibility that municipal governments will be permitted to issue Euro-yen bonds.

Another potential impediment to capital flows is the effect of taxation on portfolio choice. Differences in the taxation treatment of capital gains and losses, exchange rate gains and losses, interest payments and the deductability of interest payments can lead to distortions in the portfolio choice so that the after tax rates of return to different investors within Japan and to investors in different countries diverge. While the brief discussion of the taxation of corporations in Japan on page 125 indicates the tax system may be relatively neutral in this regard, the same cannot be said for individuals where the tax system favours deposits in the domestic financial system and financial assets that will produce capital gains. The ‘Green Card’ issue discussed on page 126 and the subsequent portfolio shift into zero-coupon foreign-currency bonds illustrates clearly the strong connection between taxation, portfolio behaviour and capital flows.

In June 1984, the United States removed its 30 per cent withholding tax on income from portfolio investment in financial corporations. The tax treaty between Japan and the United States meant that withholding tax applied at the rate of 10 per cent anyway. Japanese insurance and securities companies claim that the absence of American withholding tax has not provided them with greater incentives to invest in American securities because they were previously able to deduct United States’ withholding tax from their annual earnings anyway. Japan maintained its 20 per cent withholding tax until April 1985 when it was abolished for income on Japanese securities received by non-residents.

Foreign-exchange banks are subject to controls on their overall net positions in foreign currencies. Foreign-exchange banks are free to accept foreign-currency deposits from residents and non-residents and to make foreign-currency loans to

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51 Makin (1984a, 1984b) and Makin and Sauer (1984). Sieper and Fane (1982, pp.226-30) provide an interesting discussion of how the differing tax treatment of Australian intermediaries and non-intermediaries will affect overseas borrowing and lending by these investors. Levi (1977) considers how taxation differences between countries will affect borrowing and lending patterns in those countries.

52 This income includes interest from deposits and bonds issues by financial institutions and dividends on shares issued by financial institutions.
residents\textsuperscript{53}. These foreign-currency accounts were liberalized in December 1980 by permitting the payment of market-related rates of interest and abolishing rules restricting their usage. This should be compared with the position in the United States where the Federal Reserve Board has positively discouraged American banks from soliciting foreign-currency deposits from residents even though there are no formal exchange controls on non-bank residents of the United States. In December 1983, of the outstanding foreign-currency deposits held with Japanese foreign-exchange banks, only 1.7 per cent was held by individuals while the remaining 98.3 per cent was held by corporations\textsuperscript{54}. The monthly average of the total amount held in foreign-currency deposits in the third quarter of 1985 was ¥16.1 trillion\textsuperscript{55}. Foreign-currency deposits held by residents and non-residents are subject to minimum reserve requirements that are determined by the Bank of Japan\textsuperscript{56}.

Non-resident accounts in yen may be opened by any non-resident with any authorized bank in Japan. The monthly average of the total amount held in non-resident accounts in the third quarter of 1985 was ¥2.2 trillion\textsuperscript{57}. There are no restrictions on credits to or payments from these accounts and balances may be freely converted into any foreign currency. Interest is payable on the balances in these accounts but the payment of interest may be limited when it is deemed necessary to prevent drastic fluctuations in the yen exchange rate. In March 1980, interest rates on yen deposits held by official foreign institutions were liberalized. Interest rates on yen deposits held by other non-residents are still subject to the same controls as yen deposits held by Japanese residents. Like resident yen accounts, non-resident yen accounts are subject to minimum reserve requirements determined by the Bank of Japan\textsuperscript{58}.

\textsuperscript{53}The impact of shifts into and out of foreign-currency deposits will be influenced by the extent to which banks offering them attempt to cover their additional foreign exchange exposure by transactions in the spot and forward markets.

\textsuperscript{54}Okurasho (1983, p.140).

\textsuperscript{55}Bank of Japan (1986).

\textsuperscript{56}In December 1986, these reserve ratios were 0.25 percent on non-resident foreign-currency deposits, 0.375 per cent for resident foreign-currency time deposits and 0.5 per cent for other foreign-currency deposits held by residents (Bank of Japan, 1986).

\textsuperscript{57}Bank of Japan (1986).

\textsuperscript{58}In December 1985, the reserve ratio for non-resident yen deposits was 0.25 per cent. This was considerably lower than reserve ratios applied to most deposits in the banking system (Bank of Japan, 1986). However, reserve ratios on additions to these non-resident yen deposits have been as high as 100 per cent.
6.2 Liberalization and the Exchange Rate: General Issues

The general connection between liberalization and the exchange rate has been expressed by 'The Working Group on the Yen/Dollar Exchange Rate'\(^{59}\) (1984, p.8) when it stated that it expected measures to "internationalize the yen and liberalize Japan's capital markets ... will lead to a stronger yen". Three arguments have been made to suggest a link between financial liberalization and the value of the yen. Firstly, financial liberalization will lead to increased use of the yen, lifting the demand for the currency and consequently lifting its value. Secondly, capital controls help to maintain artificially low domestic interest rates\(^{60}\). Low interest rates discourage investment in yen-denominated securities by non-residents and encourage Japanese residents to invest in foreign securities. Eliminating these low interest rates will encourage investment in yen-denominated securities. Thirdly, Japan's high savings rate would be reduced by financial liberalization and this would lead to an appreciation of the yen.

6.2.1 Liberalization and the Yen

If deregulation or financial liberalization includes capital control deregulation an impact on the yen could be expected. Liberalization that causes a once-and-for-all shift in asset preferences from dollar assets to yen assets could be expected to cause the yen to appreciate\(^{61}\). For demand shifts between bonds denominated in one currency and bonds denominated in another to significantly impact on the exchange rate requires that bonds denominated in different currencies be imperfect substitutes. The evidence from Chapters 3 and 4 provide some evidence to support view that yen and dollar bonds are imperfect substitutes but the evidence is not overwhelming.

However, the bulk of administrative guidance and regulation at the present (as discussed on pages 126-129) is over capital outflows; for example, limits on institutions investing in foreign-currency-denominated or foreign securities\(^{62}\). The recent lifting of the 10 per cent limit on life-insurance companies' investment in

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61 For example, Bryant's (1980a, p.13) discussion of a private-sector shift out of dollar-denominated into ECU-denominated assets.

62 Frankel's (1984b) discussion concentrates on the moves to ease the issuing conditions for Samurai bonds, relax the limits on overseas yen lending by banks and the authorization of the sale of foreign CPs and CDs in Japan. Iwata (1985a) stresses similar moves.
foreign securities to 25 per cent is one example of this capital outflow liberalisation. Hence, if the limits were binding and bonds denominated in different currencies are imperfect substitutes, deregulation of this type could be expected to lead to increased demand for foreign-currency bonds rather than yen-denominated bonds and so lead to a weaker rather than a stronger yen.

The effect of the changes will also be influenced by the effectiveness of the existing controls, that is, the extent to which existing controls can be avoided, the extent to which the changes in the capital controls were anticipated and the existence of closely substitutable but unregulated alternative assets. The OECD (1982, p.59) argues that the "increasing financial interdependence among most OECD countries and the increasing fungibility of financial capital limits the scope of application of efficient controls".

It is well known that problems can arise in the enforcement of capital controls when evasion is undertaken through: transactions where no cash payment is made; firms using current account transactions to effect capital account transactions; dividend transfers between subsidiaries and parent companies; the manipulation of transfer prices; and variations in the terms of trade credit extended to importers and exporters. These means of undermining capital controls are particularly relevant in Japan given the number of Japanese companies with overseas subsidiaries that can then make use of the unregulated Euro-currency market rather than the regulated domestic market and the importance of the Japanese Trading Companies (Sogo Shosha) in Japan's international trade.

Komiya and Suda (1980) have argued that while Japanese capital controls were often drastic in appearance, their impact on capital flows and exchange rates was negligible. The control although drastic for the asset to which it was applied was largely ineffective because it left open the possibility of substitution. As discussed in Chapter 3, there is contrary empirical evidence of divergences from covered interest rate parity in Japan suggesting that prior to 1979 and 1980, capital controls were of some effect. Some work by the Economic Planning Agency (EPA) suggests that the long-term capital account and portfolio flows were also affected by

63 Similar arguments apply to direct controls on domestic money markets, they can be undermined by asset substitution and offshore disintermediation.

64 See Sieper and Fane (1982, pp.136-9). Friedman (1968, p.422), for example, argues that given sufficient economic incentives, agents will always find ways to evade and avoid the controls.

65 See, for example, Roehl (1983).

the liberalizations of 1979 and 1980\(^\text{67}\).

The effect of the anticipation of capital controls is very much dependent on the way the capital controls are proposed to be applied and the degree to which the actual capital controls are anticipated. Consider the application of reserve requirements to non-resident free-yen deposits in November 1977\(^\text{68}\). The reserve requirements only applied to additions to these deposits so that rather than affecting the rate of return on existing holdings they affected only the rate of return on additions to the holdings. The requirements acted like a tax on one-way portfolio adjustment rather than a tax on existing portfolio positions. Any anticipation of the fact that the reserve requirements would apply only to additions to these accounts would bring forward the deposits the control was designed to prevent. Anticipation of the relaxation of these controls would have caused the deposits to be postponed. Here correct expectations of the imposition of reserve requirements would have operated to destabilize capital flows and cause the yen/dollar exchange rate to further strengthen. This was the opposite of the desired result. If applied to all deposits, an expected increase in reserve requirements would reduce the current rate of flow into these deposits, stabilizing capital flows and causing the exchange rate to weaken. Correct expectations would be stabilizing. A similar argument would apply to prohibitions on the purchases of additional yen bonds with maturities of five years or less in March 1978.

If there is a perfectly substitutable unregulated asset, a capital control will be completely ineffective, since all the funds will flow into the unregulated asset. The existence of close substitutes will not completely nullify the capital controls but will limit their effectiveness. For example, until March 1986 the limits on life-insurance companies investment in foreign bonds did not apply to foreign-currency assets issued by residents. Not surprisingly, insurance companies invested heavily in foreign-currency deposits with domestic banks\(^\text{69}\). The foreign-currency deposits cannot be expected to be perfect substitutes for the long-term foreign-currency bonds that the

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\(^{68}\) This issue cannot be investigated empirically because data on non-resident yen deposits was not available separately before November 1980. In addition, no data on the interest rates paid on these accounts seems to be publicly available so it is not possible to know whether the constraint was binding or not. Officials in some Japanese banks asserted in interviews that the increase in reserve ratios would have restrained the growth of non-resident free-yen deposits but could provide no quantitative proof for their assertion. They were not able to provide any evidence to substantiate or disprove the possibility of any anticipation of the change.

\(^{69}\) For the purpose of this rule, the status of foreign-currency bonds issued by Japanese institutions ('Sushi' bonds) in the Euro-currency market is important as they were not counted for the purposes of the 10 per cent rule.
insurance companies have been investing in because they do not have the same maturity or liquidity characteristics. A perhaps more costly way for the insurance companies to get around the regulations was to establish foreign branches which could then invest in the foreign bonds. Another two examples of the circumvention of controls are Japanese banks using the Euro-dollar and Euro-yen markets for interbank deposits to avoid interest rate restrictions on domestic interbank deposits\textsuperscript{70} and the relaxation of restrictions on General Trading companies overseas financing which enabled them to provide some Japanese companies with finance despite Ministry of Finance regulations on bank loan volumes\textsuperscript{71}.

These examples of circumvention illustrate the fact that while it may be possible for the Japanese authorities to regulate the financial behaviour of their own residents, controls on non-residents and residents operating offshore are difficult, if not impossible, to implement. Legitimate transactions between residents and the uncontrolled non-residents potentially undermine the controls. In addition, the examples indicate that the constraints may not be as binding as they first appear. This suggests that relaxation of some of the constraints may have no effect at all.

6.2.2 Low Interest Rates and the Yen

In the literature on the order of liberalization of trade, domestic capital markets and international capital markets, there seems to be agreement that a country’s international capital market should only be opened up after the domestic capital market\textsuperscript{72}. The argument is that opening the domestic capital market to the international capital market at a stage where the domestic capital market is still repressed, with interest rates at artificially low levels, will lead to a massive one-off portfolio shift into foreign assets (a massive capital outflow) and a real depreciation of the domestic currency. In the reverse case, liberalization of the domestic financial market followed by opening up the market to international influences could well result in a discrete portfolio shift on the part of international lenders, a great inflow of capital, an exchange rate appreciation and an effect on export activities. It is argued in some of the literature that it is necessary to have capital controls to lessen the impact as the market may not necessarily work in response to ‘one-off’ sharp policy changes.

\textsuperscript{70}\textsuperscript{70}Horiuchi and Hamada (1985).

\textsuperscript{71}\textsuperscript{71}Roehl (1983, p.12).

Japan has not followed the path of either complete liberalization of the domestic capital market followed by liberalization of the capital account; or complete liberalization of the capital account which would imply a liberalization of the domestic market. In contrast or as a response to the problems discussed previously, Japan's approach would seem to be gradual liberalization of both the domestic capital markets and of controls on capital flows.

As deregulation has not gone as far as eliminating completely Japan's 'low interest rate' policy and it will be some time before Japan has fully liberalized financial markets (see the Ministry of Finance's plan for liberalizing interest rates that is discussed on page 121), the arguments on the order of liberalization are still relevant for Japan. Certainly in the bank deposit area, nominal interest rates would seem to be 'artificially low'. Frankel (1984b, p.49), for example, argues that if the Japanese government has by regulation kept interest rates lower than they would otherwise have been, then it has encouraged a net capital outflow and thereby weakened the yen. The usual arguments are that low interest rates on yen assets discourage foreigners from holding yen-denominated assets and encourage Japanese to hold foreign-currency assets. Since the arguments relating to the incentive effects of the 'low interest rate policy' potentially differ between foreigners and Japanese, the effects on the two groups are discussed separately.

Deregulation will certainly mean that some of these nominal interest rates on deposits will rise. Here the emphasis is on the effect on foreign portfolios. The existence of both regulated and unregulated interest rates in Japan would seem to take out much of the force of the liberalization arguments, which usually presume only two domestic-currency-denominated assets, currency and interest-bearing time deposits, the latter with a regulated rate of return\(^73\). When in addition there are assets with market-determined interest rates which are open to international buying and selling, most of the international asset substitution and portfolio diversification can be expected to operate through those bonds. Hence liberalization of interest rates on time deposits may be largely irrelevant for portfolio shifts by foreigners between yen- and dollar-denominated assets. The interest rates on time deposits are not particularly relevant rates for foreigners given the number of internationally-traded assets denominated in yen (which are likely to be highly substitutable for yen time deposits) that they can invest in; for example, gensaki bonds, national bonds in the secondary market, certificates of deposits, Euro-yen bonds and Euro-yen deposits. The difference between three-month Euro-yen and domestic bank

\(^{73}\) For example, McKinnon and Mathieson (1981).
deposit rates was 3 per cent in 1982, 2.56 per cent in 1983 and 2.69 per cent in 1984. Euro-yen time deposits must be highly substitutable for yen-denominated deposits with Japanese banks, liberalization of deposit rates may merely bring these deposits back onshore. That is, yen time deposits with the Japanese banking system would seem to provide foreigners with an asset that is very little different from what is already available. Deregulation could be expected to principally cause shifts in the pattern of holdings of various yen assets with differing financial institutions.

Turning to the effect on Japanese portfolios, the ‘low’ interest rates that individuals have been paid on time deposits must be offset against the provision of the tax exemption for income derived from savings. The way after-tax rates of return will move depends on the timing of the liberalization of interest rates on small-denomination deposits and moves to reform the Maruyu system for exempting certain interest income received by individuals from personal taxation. Liberalization of interest rates can be expected to lead to higher nominal (and after-tax) rates of return. The reform of the Maruyu savings system (moves to eliminate the revenue loss it causes) would have the opposite effect. As the tax exemption is to some extent the government’s quid pro quo for permitting only low nominal rates of return to be offered on savings deposits, it may be reasonable to suppose that deregulation of small denomination deposits will be associated with a reduction or an elimination of the tax exemptions. The combined effect of these two changes is not altogether clear but it is presumed they result in higher after-tax rates of return on deposits. Exactly what effect the combined changes would have depends on the rates of return on these deposits before and after the change, and the change in the marginal rate of taxation applying to the interest income.

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74 Morgan Guaranty Trust, World Financial Markets, various issues and Bank of Japan, Keizai Tokei Geppo (Economic Statistics Monthly), various issues. All rates are at the end of December.

75 Frankel (1984b)’s implicit assumption is that the Maruyu system will remain unchanged so that higher nominal rates would also lead to higher after-tax rates of return.

76 Here the new nominal rates of return necessary to generate rates of return that were identical to those prevailing in January 1985 for various marginal tax rates are calculated. The three-month and two-year time-deposit rates were 3.5 per cent and 5.75 per cent in January 1985. For most individuals, these were also the after-tax rates of return. If this interest were to suddenly become taxable to maintain identical after-tax rates of return at a marginal rate of 10.0 per cent would require interest rates of 3.89 per cent and 6.39 per cent respectively; at the marginal tax rate of 35 per cent applied to separate taxation of interest, the required rates of return would be 5.38 per cent and 8.8 per cent, while at the 70 per cent marginal tax rate, the required rates of return would be 11.67 per cent and 19.17 per cent. Supposing in a deregulated environment, the rates on time deposits were something like the 3-month Gensaki rate (6.2 per cent) and the 2-year government-bond yield (5.875 per cent), it would appear that after tax rates of return on short-term deposits would probably rise while those on long-term deposits would probably fall if the marginal rate of tax applied to interest income was to be less than 35 per cent. The initial changes of the Maruyu system may be to tax all interest and dividend income that is now tax free at the marginal tax rate of 10 per cent (Iwata 1985b).
The low interest rates in the deposit area need to be contrasted with the high interest rates charged in the consumer finance area. These lending rates could be expected to fall as deregulation proceeds and competition in the supply of consumer finance increases.

The effect of higher after-tax rates of return on time deposits for individuals and higher nominal rates of return for corporations, could be to disturb portfolio equilibrium. Through attempts by investors to restore portfolio equilibrium these could have an effect on the exchange rate. Increased returns on time deposits will lead to substitution into these deposits from yen-denominated bonds, disturbing asset equilibrium. For example, in October 1985, when interest rates on deposits with a denomination greater than ¥1 billion were liberalized, most of the initial asset shift seems to have been from the Gensaki and Certificate of Deposit Markets. Predicting how the exchange rate will be affected by this change is difficult given that an increase in time deposit rates could be expected to increase the demand by non-banks for time deposit, and reduce the demand by non-banks for demand deposits (and currency) and for yen-denominated bonds. Offsetting this would be increased demands by banks for yen-denominated deposits (and increased reserve requirements) resulting from increased time deposits with them. The critical prerequisite to any of these changes is that the initial portfolio equilibrium be disturbed.

The equations estimated for M1 and M2 in Chapter 5 suggest that changes in the time deposit rate do not significantly influence the demand for demand or time deposits. Risk premium equations estimated in Chapter 4 do not suggest that changes in time deposit rates significantly influence the risk premium. In addition, the Japanese time deposit rate was not a significant explanatory variable in the equations estimated for resident holdings of yen-denominated bonds by Danker et al (1985) over the period 1974-80. Taken together this evidence would cast doubt on whether Japanese portfolios will be significantly influenced by changes in Japanese deposit rates.

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77 Anstie and Harper (1982, pp.282-4). The absence of banks and other financial institutions in the consumer-finance area can be explained by their inability to enforce legally interest rates in excess of 15 per cent per annum when a borrower defaults and a legal restrictions on banks lending to consumer money lenders. The maximum of 15 per cent needs to be compared with the 73 per cent maximum on interest rates that can be charged by Sarakin (Salaryman’s Finance) Consumer Credit Firms.

78 In a monetary model of the exchange rate (based on the demands for M1 aggregates), the impact of changes in time deposit rates on the exchange rate is through the effect of changes in time deposit rates on the domestic demand for money. In the demand for M1, an increase in time deposit rates lowers the demand for M1 and thus causes a depreciation. The demand for M1 estimated in Chapter 5 provides no evidence to suggest that the demand for M1 is significantly influenced by changes in the time deposit rate. Hence based on that estimated M1 function, no significant change in the exchange rate might be expected.
6.2.3 Savings and the Yen

Higher real interest rates in the United States vis-a-vis Japan have been suggested as the cause of the capital outflow from Japan to the United States. This outflow has worked to increase the value of the dollar. These high real interest rates have been attributed to the relatively high savings rate in Japan and the relatively low savings rate in the United States\(^79\). By this argument measures to reduce the high savings rate in Japan (or increase the savings rate in the United States) should have an effect of strengthening the yen.

As is well known, the ratio of average savings in Japan in relation to disposable income is among the highest in the world. A number of reasons have been suggested for this\(^80\): (1) the limited availability of housing credit (rationing of mortgages) and consumer credit\(^81\); (2) tax incentives to save in the form of: the tax-exempt nature of some deposits\(^82\); the tax exemption for capital gains from the sale of securities; and the limited deductability of life-insurance premiums\(^83\); (3) relatively low marginal rates of taxation for individuals; (4) corporate promotion of savings through investment plans, given their tax exempt status; (5) aggressive savings campaigns conducted by banks and savings institutions; (6) the low level of social security benefits; (7) the system of biannual bonus payments\(^84\); and (8) the limited variety of alternative investment vehicles. The second, third and fourth reasons can be summarised as measures that increase the after-tax rates of return to lending while the first reason can be partially summarised as increasing the cost of borrowing to individuals. These might alter an investor’s intertemporal consumption pattern. The other factors (5-8) can be summarised as institutional.

It is argued that changes in some of these factors will significantly influence savings behaviour. For example, Hayden (1982) has suggested that the elimination of tax incentives for savings, the growth of the mortgage market and demographic changes (the ageing of the population), should imply reduced saving and increased

\(^{79}\) Frankel (1984b, p.65).

\(^{80}\) See Wallich and Wallich (1976) and Hayden (1982).

\(^{81}\) Although the consumer financing market has grown at average annual rate in excess of 11 per cent since 1970.

\(^{82}\) Frankel (1984b) stresses this as one of the ways the Japanese government has promoted national saving.

\(^{83}\) See Komiya (1966).

\(^{84}\) For example, Ishikawa and Ueda (1984).
consumption. The expectation of future short-falls in the public pension system may lead to increased saving.

Two different arguments need to be distinguished here: shifts in the savings function as a result of unspecified institutional changes; and changes in savings as a result of changes in the after-tax rate of return on time deposits, either through changes in the tax exemption provisions or through lifting the artificially low interest rates. The effects of institutional changes are considered first.

Suppose that because of some institutional change at each level of asset yields and wealth, there is a permanent decline in saving (permanent increase in consumption) in Japan. In the short run assuming static expectations with given asset holdings, there will be no change in the equilibrium interest rates or asset prices. There would, however, be an immediate worsening of the current account as people began to spend more and save less. The deficit on the current account implies asset decumulation and falling domestic wealth. Falling domestic wealth and changes in the relative supplies of financial assets over time imply rising domestic interest rates, reduced investment and some restoration of savings. There will be a period of rising prices as a result of increased demand and a depreciation of the yen. The important link to establish is that the institutional change will lead to significant changes in aggregate savings patterns.

The earlier discussion of Japan’s low interest rate policy suggested that after-tax interest rates may rise as a result of liberalization of interest rates on deposits and reform of the Maruyû system. To make any statement on the effect of changes in interest rates on the yen/dollar exchange rate through alterations in savings behaviour it is necessary to know how changes in the interest rate affect savings (or consumption). In a simple two-period model, the theoretical relationship between consumption and the real rate of interest depends on whether the individual is a borrower or a lender. For a net borrower, a rise in the real interest rate has an unambiguously negative effect on consumption (positive effect on saving). For a net lender, the relationship is ambiguous with opposing income and substitution effects. Since the household sector is a net lender, these microeconomic effects (apart from distributional effects) suggest that the sign of the (real) interest-rate effect on

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85 Given perfect foresight, a depreciation of the exchange rate would be expected, which would imply an immediate shift out of yen-denominated assets into dollar-denominated assets. This asset shift would cause the exchange rate to depreciate immediately.

86 See, for example, Bryant (1980b, pp. 389-400,407), Dornbusch (1980, pp.247,251,269) and Kenen (1982).
savings is, a priori, indeterminate\textsuperscript{87}. There is a general presumption in the literature that empirically the (real) interest-rate effect on consumption is likely to be negative\textsuperscript{88}.

The empirical evidence on interest-rate effects on consumption or saving in Japan is ambiguous. A negative and significant after-tax real interest rate effect on the savings ratio was found by the EPA (1983, p.205); no significant nominal interest-rate effect on personal saving was reported in Ishi (1983); no effect of the interest rate on consumption is present in Amano (1980); and significant but ambiguous nominal interest-rate effects on consumption are contained in Yoshitomi \textit{et al} (1981, p.68) and the EPA (1984, p.237). The contradictory evidence on interest rate effects on consumption and saving suggests that Komiya's conclusion in 1966 is still valid: namely that there is no convincing evidence that the interest rate (nominal or real, or before or after tax), significantly affects savings\textsuperscript{89}. Hence it is unlikely that major changes in the tax system (or deregulation of interest rates) would have a major effect on the exchange rate through savings behaviour.

\subsection*{6.3 Conclusion}

The evaluation of the general arguments linking financial liberalization and the determination of the yen/dollar exchange rate suggested that a weaker yen may be the result of financial liberalization. Firstly, most existing capital controls inhibit Japanese investment in foreign-currency assets and lifting these controls could be expected to increase the demand for foreign-currency assets and thereby weaken the yen. This does depend on the extent to which these controls are binding constraints on investor behaviour and whether bonds denominated in different currencies are imperfect substitutes. Secondly, while interest rates on time deposits in Japan are low, it was argued that those rates of return were not particularly relevant for foreigners given the range of attractive investment opportunities in Japan and the Euro-currency markets. For Japanese investors, it was necessary to determine whether after-tax rates would rise as a result of a combination of a reform of the Maruyn system and the liberalization of deposit rates. Should after-tax rates of

\textsuperscript{87}Henderson and Quandt (1971, pp.307-9). It is not clear how the distributional effects would affect the interest-rate-saving relationship.

\textsuperscript{88}For example, Taubman (1971, p.163).

\textsuperscript{89}Komiya (1966). Horiuchi (1984) also claims that it is impossible to draw any definitive conclusions on this issue. American studies on the response of aggregate saving to changes in interest-rate are also conflicting: Boskin (1978) and Howrey and Hymans (1978). Frankel (1984b, p.63) presumes the net effect of liberalizing interest rates will be a small increase in the savings-investment gap and only a small effect on the exchange rate.
return rise and provided portfolio equilibrium is disturbed by the change, an effect on the exchange rate might be expected but predicting the direction of that impact is a little difficult. The empirical evidence cited casts doubt on whether portfolio equilibrium would be disturbed. Thirdly, the link between savings behaviour and the exchange rate is important. Changes leading to a permanent reduction in savings in Japan could be expected to lead to a yen depreciation but it is necessary to identify the particular changes and how they will significantly alter savings behaviour. The link between changes in after-tax rates of return and savings is, given the empirical evidence, not very strong and cannot be relied on to strongly assert that changes in the tax system relating to the taxation of interest income or the liberalization of deposit rates will significantly alter savings behaviour and therefore lead to a change in the exchange rate.

This Chapter has concentrated on examining general arguments linking financial liberalization and the value of the yen. In the next Chapter, some specific changes that have occurred or that are proposed are examined to determine their possible impact on the yen.
CHAPTER 7
THE IMPACT OF RECENT JAPANESE REGULATORY CHANGE ON THE EXCHANGE RATE

In the discussion in Chapters 3 and 4, the importance of two particular regulatory changes - the introduction of foreigners into the Gensaki and Certificate of Deposits markets in 1979 and the new foreign exchange law of 1980 - for the choice of estimation period and also for the interpretation of the results in those Chapters was stressed. The possibility that changes to the rules governing the use of foreign-currency deposits in 1980 affected the degree of currency substitution was investigated in Chapter 5. With respect to structural change, the power of econometric techniques to detect structural change and the ability to attribute the detected change to a particular cause especially when a number of changes are introduced at close intervals are both questionable. In Chapter 6, general arguments linking financial liberalization and the exchange rate were discussed. The critical changes discussed related to general changes in capital controls, the determination of interest rates on Japanese time deposits and the reform of the Maruyu savings system. These are prospective changes in the financial system but as is illustrated in Appendix B there have been many changes in the legal and regulatory environment in Japan over the past ten years. The discussion in the next section indicates that there are still a number of pressures for further change. This Chapter complements the work in Chapters 3-6 by suggesting where some important changes may have impacted on the demand for and supplies of yen-denominated and foreign-currency denominated assets. By examining a number of particular regulatory changes, a number of the important characteristics of regulatory change affecting the exchange rate can be elucidated. This will hopefully assist in understanding the impact of future changes.

The discussion is necessarily qualitative because much of the deregulation was undertaken recently and it is therefore difficult to obtain quantitative estimates of
the effect of these changes\textsuperscript{1}. Quantification of the direct impact of changes on the exchange rate is made difficult by the inability of existing exchange rate models to explain movements exchange rate movements. An attempt using econometric techniques is made to determine the impact of two changes on the risk premium equations estimated in Chapter 4. In any case, since policy changes are often either shifts in the application of existing rules or explicit changes in policy that only serve to codify changes that have already occurred, the econometric effect of these changes can be difficult to detect. Two further complicating factors are the extent to which the measures are anticipated and the extent to which there is a substantial lag between the announcement and implementation of a measure. Tests that attempt to determine the impact of "news" (announcement effects) on the foreign exchange market may be only capturing the extent to which the market wrongly predicted the outcome. Frankel (1984b, pp.55-60) examines the reaction of the spot dollar/yen rate and the one-year forward dollar/yen rate on the day the Working Group's report was released (May 29, 1984) and on each of the days in the preceding seven months when there were newspaper reports of related news. He finds no statistically significant effect of most of the news on either the spot or forward rates. Should part of this news be anticipated, the results are consistent with anticipations largely being correct.

7.1 Pressure for Recent Regulatory Changes\textsuperscript{2}

The pressures for change in the Japanese financial system initially came from three sources. Firstly, the inability of the financial markets to absorb the massive issues of national government bonds resulting from the large budget deficits in the 1970s. The initial impact of these bond issues was on the long-term asset markets. Secondly, high rates of inflation in the post-oil-shock period coupled with the maintenance of low nominal interest rates meant that some investors found it difficult, if not impossible, to obtain positive real rates of return on their investments. This was because for most individuals the principal available asset was bank deposits and there was no possibility of discounting the price of the asset to

\textsuperscript{1}Mathieson (1983) claims success in estimating a financial model for Chile for a period when the Chilean economy was undergoing extensive trade, fiscal and financial reforms. Simple dummy variables were used to capture the effects of various financial changes. The method of estimation (Full Information Maximum Likelihood) and the lack of any diagnostic tests for the estimated equations makes it difficult to evaluate Mathieson's claim.

raise its effective nominal yield. Lack of secondary markets for other securities prevented this happening with bonds. Thirdly, the Bank of Japan's decision in July 1974 to shift to controlling money growth directly rather than allowing the money supply to vary as needed to fix the value of the yen against the dollar has been argued to have required interest rates to become more flexible.

Pressures for change still exist but they are now different in nature. Firstly, issues of long-term government bonds on a large scale to finance the current budget deficit started in fiscal year 1975 and have continued on a massive scale. The usual maturity of government bonds has been 10 years. The shortening of the time to maturity of the outstanding government bonds that were issued up to 10 years ago means that the quantity of outstanding government bonds with short-term maturities will increase drastically after 1985. This will mean increased competition with the existing short- to medium-term assets. In addition, the consequent changes in portfolio behaviour may induce changes in the flow of funds that bring about the need for further innovation including the development of additional short-term markets; for example, a market for short-term government securities. As these long-term bonds approach maturity, they will be traded as de facto short-term government securities with market rates of interest. This will naturally lead to a market for short-term government securities. This maturing debt will also need to be refunded and to achieve this, a diversification of the range of government debt instruments in terms of maturity and other characteristics may be necessary. The high level of government deficit financing dominates the financial system and is also a potential stumbling block to a truly free financial system, because it inhibits the development of commercial bond and debenture markets. In 1983, the deficit of the combined government sector (including public corporations and local authorities) was ¥ 19.1 trillion in comparison to the deficit of the corporate sector of ¥ 10.0 trillion. The combined government sector's deficit has been considerably larger than the corporate sector's deficit since 1975.

Secondly, arbitrage between 'free' and 'fixed' interest rate markets maintains some pressure on the 'fixed' interest rate sector of the financial system. The result of the arbitrage being that funds have a tendency to move toward the 'free'

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4 In 1977, issues of 5-year discount bonds were made, followed in 1978 by issues of bonds with maturities between 2 to 4 years. In August 1983, 20-year interest-bearing government bonds were issued.

5 Bank of Japan; Keizai Tōkei Nenpo (Economic Statistics Yearly), various issues and Bank of Japan; Keizai Tōkei Ceppo (Economic Statistics Monthly), various issues.
markets where the interest rates are higher. As an illustration, in the last decade, the portion of the net increase of Japanese corporate financial assets held in market-determined interest instruments as opposed to regulated interest instruments has risen from 8 per cent to 54 per cent. This arbitrage has had significant effects on the market shares of various financial institutions. To protect these market shares, various institutions seek further deregulation to give them a more advantageous position vis-à-vis other financial institutions but such a deregulation can have a 'ripple' effect leading to further deregulation. Since December 1980, residents have been able to use foreign-currency deposits, with rates of return close to those in the Euro-currency markets, together with forward contracts (even when they were based on the real demand principle) to set up assets equivalent to yen-denominated assets creating further pressure on domestic interest rates.

Thirdly, Japan has been subject to a great deal of international pressure to liberalize her financial markets. An undervalued yen or overvalued dollar is argued to be the cause of the United States' large current account deficits and Japan's large current account surplus. Japan has come under strong pressure to open up her product and capital markets to foreign competition and has made some progress on these fronts. Liberalization of financial markets resulting in an increased demand for yen-denominated assets and a reduced demand for foreign-currency-denominated assets is argued to be a means of helping the yen reach its 'true' value. One of the strongest statements supporting this view is contained in Murchison and Solomon (1983).

American pressure led to the establishment of the Working Group on the Yen/Dollar Exchange Rate following the summit between President Reagan and Prime Minister Nakasone in November 1983. The report by Murchison and Solomon (1983) formed the basis for the United States' liberalization requests put forward during meetings of The Working Group. The initial report of the Working Group

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7 In other countries, one of the responses to heavy regulation of the banking system was extensive evasion through the growth of less-regulated financial institutions or disintermediation. As indicated previously, significant shifts in funds to the Postal Savings System from other deposit-taking institutions were induced by the more attractive assets available with the Postal Savings System as well as the tax advantages associated with such deposits. Except in the consumer-finance area, where sarakin companies and the loan departments of large department stores have expanded, few unregulated financial institutions seem to have developed.

8 The Working Group was made up of officials from the Japanese Ministry of Finance and the American Department of the Treasury.
was presented in May 1984\(^9\). As a result of both the summit and the Working Group meetings a number of liberalization measures were agreed to. Liberalization measures announced after the summit included the abolition of the designated company rule; changes in the issuing rules for Certificates of Deposit, relaxing of rules governing Euro-yen bond issues by residents and the abolition of the real-demand rule applying to forward exchange contracts. Some of the measures announced in the Working Group’s report included the elimination of restrictions on the overall spot foreign exchange positions of foreign-exchange banks, relaxation of rules governing Euro-yen bond issues by non-residents, relaxation of the conditions on Euro-yen loans to residents and further changes to the issuing rules for Certificates of Deposit.

Japanese government policy towards deregulation seems to be based on the premise that priority is given to the protection of the acquired rights of each type of institution, to the equalization of gains and losses from policy changes\(^10\) and to minimizing the potential disruptive effects of deregulation arising from the exit (and entry) of financial institutions from the industry. The recent problems with financial institutions in Chicago, Ohio, Maryland and London will reinforce the fears of some Japanese policymakers that financial liberalization will cause disruption and will cause some financial institutions, especially the small financial institutions like the credit co-operatives, to fail. The Toyota Shōji incident where a Japanese brokerage business collapsed and the Heiwa Sogo Bank incident that required the takeover of the bank by the Sumitomo Bank have also brought forth calls for measures to ‘protect the public’. The policy of protecting existing rights and minimizing the disruptive effects of deregulation means that ‘piecemeal’ rather than revolutionary changes in the financial system have and are likely to occur. One of the reasons for the development of this policy is that even within the Ministry of Finance, each Bureau tries to obtain benefits and minimise the losses for the financial institutions within its control\(^11\). One consistent opponent of deregulation is the Budget Bureau in the Ministry of Finance, because it believes deregulation will substantially increase the costs of financing the prospective national government debt and rolling over the existing government debt.

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\(^10\) It is obvious that regulatory changes will impose differing gains and losses on agents. For example, opening the ‘samurai’ market to domestic corporations leads to greater reliance on the capital markets than on bank finance.

7.2 Liberalization and the Exchange Rate: Specific Changes

It is necessary to distinguish between three types of regulatory change: (i) changes that will primarily increase competition between financial institutions and reduce financial institutions’ margins; (ii) changes that will primarily increase the substitution between domestic assets; and (iii) changes that will primarily increase (or decrease) the demand for yen-denominated assets relative to foreign-currency-denominated assets. An illustration of the first type of change would be permitting banks to deal in government bonds, increasing the competition with the securities companies. The second type of change can be illustrated by the introduction of the CD market which has meant a substantial reduction in the relative size and importance of the Gensaki market. An illustration of the last type of change would be the opening up of the Gensaki market to foreign participation. It is only the last type of change that could be expected to have any significant effect on the exchange rate. Changes that cause an asset shift toward (away from) yen-denominated assets from (to) foreign-currency-denominated assets, by increasing (decreasing) the demand for yen assets could be expected to appreciate (depreciate) the yen/dollar rate. However, it should be realised that regulatory changes that cause a shift between short- and long-term assets denominated in the same currency (provided these are imperfect substitutes), and changes that cause a shift between money and bonds in the same currency can also have exchange rate effects. Some measures may have components of each of these types of change. The general domestic deregulation of interest rates in Japan has implied that a larger proportion of the funds are raised by financial institutions at market interest rates. One result of this has been a higher average cost of funds. This, combined with a slack demand for long-term funds leading to a reduction in lending rates has caused a profits squeeze. As discussed in Chapter 6, it can also influence substitution between yen assets, and between yen and dollar assets.

The remaining part of this section is devoted to an examination of a selection of the recent changes stated in Appendix B. These changes are: permitting

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12 Royama (1983, p.13). Two further examples are the general shift out of equities into postal savings (Christelow 1981, p.47) and the preference of some companies to issue convertible bonds and market value shares instead of borrowing from banks which has put downward pressure on the long-term prime rate.

13 See Bryant (1980a). It is easily shown in Fukao and Okubo’s (1982, 1984) model that an appreciation of the yen is expected if there is a shift from foreign-currency assets to either short-term or long-term yen-denominated assets.

14 Although the effect is not derived by Fukao and Okubo (1982, 1984), it is easily shown that in their model a depreciation could be expected to occur if there is a one-off demand shift from short-term to long-term bonds. Bryant (1980a, p.14) contains a discussion of the likely effect on the exchange rate of a shift between money and bonds denominated in the same currency.
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foreigners to transact in the Gensaki and Certificates of Deposits Market in May 1979; decontrol of foreign exchange regulation - de facto in 1979 and fully in 1980; abolition of the transaction-based forward-exchange principle in April 1984; reductions in the minimum lot size of Certificates of Deposits; liberalization of the rules for resident and non-resident companies to raise funds on the Euro-yen bond market in 1984; and the introduction of a Bankers’ Acceptance Market in June 1985. In addition, two major changes currently under consideration, the freeing up of the Treasury Bill market and making Tokyo an offshore banking centre, are also evaluated.

Foreigners Entry into Gensaki Market and CD Market. In May 1979, a CD market was established in Japan and foreigners were permitted to operate in this market and the Gensaki market for the first time. Permitting foreigners to transact in the Gensaki and Certificates of Deposit market was of some importance because it gave foreigners their first opportunity to enter a Japanese yen-denominated short-term money market. Prior to May 1979, there were often substantial deviations from covered interest rate parity. From May 1979, covered interest rate parity seems to hold reasonably well, since arbitrage could now occur. By opening up a short-term yen-denominated asset to foreigners, this move could be expected to have increased the demand for yen assets and so lead to an appreciation of the yen/dollar rate, all other things being equal. Consistent with this argument, is evidence in 1978 that the Gensaki rate exceeded the Euro-yen interest rate suggesting that controls were operating to reduce capital flows into Japan.

In the model in Chapter 4, a one-off upward shift in the constant term in the risk premium equation could reflect a one-off upward shift in the demand for yen-denominated bonds. To test for this effect, a dummy variable, DGEN, taking the value zero prior to May 1979 and unity from May 1979, was included in both risk premium equations. This variable did not prove to be statistically significant in either the one-month or three month periods, regardless of the estimation period or estimation technique used. The sign of the coefficient on this variable depended on

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15 Komiya and Suda (1980), Otani and Tiwari (1981), Ito (1983, 1985) and Chapter 3 contain a discussion of the impact of this change on covered interest rate parity.


17 There is an identification problem here as a change in the constant term in the risk premium equation might also reflect a change in the coefficient on the risk premium in the yen-denominated bond demand equation. If this was the case, all other coefficients in the risk premium equation could be expected to change too.
the estimation technique and the estimation period. Consistent with this negative evidence is Danker's (1983) finding that this change had an insignificant impact on the demand by foreigners for yen-denominated assets.

Foreign Exchange Control. The new Foreign Exchange and Foreign Trade Control Law of December 1980 reversed the principle of foreign exchange regulation from 'prohibition in principle' to 'freedom in principle'. The importance of that change is more than technical given the delay and cost incurred in obtaining official approval for transactions. The new law also permitted, in principle, Japanese banks to borrow and lend in foreign currencies at home and abroad; widened the scope for foreign portfolio investment, in particular, lifting of the 25 per cent ownership limitation, except in designated companies; and gave Japanese companies greater freedom to borrow abroad. Since it affected both inflows and outflows it is difficult to determine whether it would have weakened or strengthened the yen.

One important part of the new law was the liberalization of the rules for operating resident foreign-currency deposits. Prior to December 1980, foreign-currency deposits held with Japanese banks acquired by yen conversion (rather than as a result of export or other external transactions) were limited to ¥3 million. Since December 1980, conversions of yen into foreign-currency deposits and conversion of foreign-currency deposits into yen have been free of restrictions. By investing in foreign currency deposits with Japanese banks and covering the exchange risk in the forward market, investors have been able to set up an asset with a known yen rate of return (except where default occurs on one of the contracts). Any difference between this rate and domestic interest rates after taking account of transactions costs and taxes could be expected to lead to funds moving from the asset with the lower return to that with the higher return. The impact of lifting restrictions on foreign-currency deposits on currency substitution was investigated in Chapter 5 and no significant increase in currency substitution was detected. Following the entry of foreigners into the Gensaki and CD market, and the 1980 Foreign Exchange and Foreign Trade Control Law covered interest rate parity holds suggesting that any capital controls applying to short-term instruments are not particularly effective and that the removal of these existing controls will not lead to significant changes in the value of the yen.

As with the entry of foreigners into Japanese short-term money markets, an

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18. The estimation periods were: 73:03-80:11, 73:03-84:12, 75:01-80:11 and 75:01-84:12.

19. A discussion of the difference between capital controls on a 'prohibition in principle' basis and on a 'freedom in principle' basis in the Australian context is contained in Sieper and Fane (1982, p.136).
attempt was made to detect a one-off shift in the risk-premia equations in response to the new foreign exchange law by including the dummy, DFE, defined in Chapter 5. The significance and sign of the coefficient on this dummy depended on the estimation period and the risk premia used\textsuperscript{20}. This suggests that the dummy variable may be picking up other effects and is indicative of the problems encountered in attempting to detect structural change using econometric models.

One difficulty with the new law was that while the legal change occurred in December 1980, the legislation passed the Diet in December 1979 and the administration of the existing foreign exchange legislation was liberalized prior to December 1980. This may be the reason that Danker (1983) found a significant upward shift in foreign demand for yen-denominated bonds in March 1980.

Capital Outflow Controls, 1981-83.\textsuperscript{21} In the period 1981-83, capital outflow controls, like the ban on the purchase of foreign-currency zero-coupon bonds, bans on the purchase of foreign CDs and CPs and limits on life- and general-insurance companies purchasing foreign bonds, were aimed at stopping the yen depreciation. Deregulation of these measures, by raising the demand for foreign-currency-denominated assets, might be expected to cause the yen to depreciate. However, as indicated in Chapter 6, the limits of life- and general-insurance companies were not binding at this time. The impact of the bans on purchasing foreign CDs and CPs depends on the degree of substitutability between them and instruments like Treasury Bills and other government paper denominated in foreign currencies. A high degree of substitutability is to be expected suggesting a minimal impact on the yen.

Zero-coupon bonds refer to foreign-currency denominated discount bonds. These bonds had been very popular with individual investors because no interest withholding tax was levied, capital gains were not taxable if the bonds were not held to maturity and exchange-rate capital gains were not taxable. The bonds were particularly attractive to high-income investors who could not deposit funds in tax-free savings accounts or who feared the loss of the tax-free savings exemption. In 1981, they became popular as a result of the ‘Green Card’ issue and were finally banned from March 1982 to February 1983. With the announcement that they would be subject to taxation and increased reporting of purchases and sales of these

\textsuperscript{20} For both risk premia equations, a significant positive effect was detected when the estimation period was 73:03-84:12 and an insignificant negative effect was detected when the estimation period was 79:05-84:12. A significant positive effect was detected for the three-month risk premium equation for the period 75:01-84:12 and for the same period for the one-month risk premium equation the effect was positive but insignificant.

\textsuperscript{21} Pigott (1983).
bonds from April 1985, Japanese investors have stopped buying them. The tax-free nature of this instrument when compared to other interest paying foreign-currency denominated instruments suggests there would be a low degree of substitutability between these two instruments and a ban on the purchase of zero coupon bonds could be expected to have some impact. By reducing the demand for foreign currency bonds, the measure it could be expected to cause an appreciation of the yen.

CD Lot Size. Two recent reductions in the minimum lot size for CDs have occurred. In January 1984, the minimum lot size was reduced from ¥500 million to ¥300 million and in April 1985 it was further reduced to ¥100 million. The reduction in the minimum lot size for CDs is relevant for non-residents since they can invest in CDs in Japan. However, the current minimum lot size was not so binding for foreigners. Until 1985, the binding constraint for foreigners was their desire for short-term instruments, like Gensaki assets, rather than CDs which had a shortest maturity of three months. This maturity difference was eliminated in 1985, when the minimum maturity for CDs was reduced to one month. The high degree of substitutability expected between Gensaki assets and CDs, suggests minimal exchange rate effects. One indication of the degree of high substitutability between CDs and Gensaki assets is the high correlation coefficient of 0.98 between the returns on these two assets over the period May 1979 to December 1984.22

Real Demand Based Forward Transactions. Prior to 1 April, 1984, the rule governing forward transactions involving residents was that forward transactions had to be carried out on the basis of "real demands" for forward contracts. That is, an import or export contract, or a foreign-currency asset or liability was necessary to be able to enter the forward market and the forward contract could be used to cover that transaction only. The abolition of the transaction-based forward-exchange principle means that there are no restrictions on the use of this market and that any resident can engage in forward transactions for any purpose without limitation on the amount. This change may permit a little more speculation through the use of the forward exchange market, but there was plenty of scope for speculation by exporters, importers and asset holders with foreign-currency-denominated assets (or liabilities) under the previous rules, both in when forward cover was taken out and

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22 The correlation coefficient was calculated using monthly figures on the average interest rates on Certificates of Deposit (<120 day maturity) of all banks (on a new deposit basis) and on the average yield on three-month Gensaki assets. Source: Bank of Japan; Keizai Tokei Nenpo, (Economic Statistics Yearly), various issues.
the extent to which the outstanding risk was covered\textsuperscript{23}. Between December 1980 and March 1984, the rule does not appear to have inhibited covered interest rate parity suggesting that it was not impeding short-term capital flows. For particular companies, their investment opportunities could have been expanded by the abolition of the rule. Companies with an import orientation, like petroleum importers, whose import contracts were in dollars could previously only buy dollars forward while export oriented companies, like car manufacturers and electric appliance manufacturers with export contracts denominated in dollars could only sell dollars. It might be expected that these types of companies are now able to engage in speculation in both directions. However, other financial markets could have been used between December 1980 and March 1984 to effect these speculative transactions. In addition, the rules did not apply to foreign subsidiaries of Japanese corporations, the loophole which enabled Dai-Ichi Kangyo Bank's Singapore branch to lose ¥ 9.7 billion on currency trading in 1982.

**Euro-yen Bond Issues By Non-Residents and Residents.\textsuperscript{24}** Prior to December 1984, only international agencies and foreign governments were permitted to issue Euro-yen bonds. In December 1984, non-Japanese private corporations, state and local governments and foreign-government agencies were authorized to issue bonds in the Euro-yen market. The issuance conditions of Euro-yen bonds were also liberalized. Under the rules, a corporation with an A-rating or better had to meet a number of financial ratios that varied with the size of the corporation and its rating before it was permitted to issue Euro-yen bonds. From April 1985, there are no restrictions on the issuing of Euro-yen bonds by foreign corporations with an AA-rating or better. Rules for issues by foreign corporations with an A-rating were also liberalized.

Since non-residents are free, in theory, to make Euro-yen issues, more liberal authorization by the Ministry of Finance might seem to some extent irrelevant. However, international common law dictates that issues of Euro-yen bonds receive the approval of the Japanese Government. As there were no Euro-yen issues by non-residents unless approved by the Ministry of Finance, the expected result of permitting Euro-yen bond issues would be a depreciation of the yen as these issues increase the supply of yen assets (or reduce the net demand for yen assets). Implicitly, this argument assumes that issuers are switching the currency they are issuing their liabilities in from non-yen-denominated to yen-denominated assets rather

\textsuperscript{23}Komiya and Suda (1980).

\textsuperscript{24}Ollard (1985).
than just issuing some other yen-denominated asset. Alternatively, if the funds raised by Euro-yen issue are then invested in a foreign-currency asset, again a depreciation would be anticipated. As the bonds undermine one fundamental rule of the Japanese financial system that bonds are not issued on an unsecured basis, they might be expected to be imperfect substitutes for other long-term yen-denominated assets so the impact on the yen might be enhanced. The Euro-market is usually considered as a market free of regulation. There is scepticism as to the ability of the Euro-yen bond market to develop if the Japanese authorities continue to impose conditions on the ratings of issues and limit the maturity of issues to five years or more.

In April 1984, the rules banning Euro-yen issues by Japanese residents were lifted and in December 1984, a further liberalization occurred. However, as Japanese withholding taxes still applied to interest payments on these issues, non-residents had no incentive to invest in them vis-a-vis issues by non-residents that were not subject to withholding tax. The United States sought the abolition of withholding tax on interest payments to non-residents to increase the attractiveness of these yen-denominated assets to foreigners. Initially the Japanese government rejected this push because of budgetary considerations and the argument that it would undermine some of the basic principles of Japan's tax system. Despite the deregulation of Euro-yen issues for residents there were no issues by Japanese residents between April 1984 and March 1985. This was largely because of the withholding tax issue and an expectation that Japanese withholding tax would be lifted. The Japanese withholding tax reduced the attractiveness to non-residents of Euro-yen bonds issued by Japanese vis-a-vis bonds issued by non-residents. As from April 1985, the withholding tax on non-residents' interest income from Euro-yen bonds issued by Japanese firms was abolished. Resident holders of the bonds will still have to pay withholding tax. So one can expect yen linked bonds and convertible bonds to be issued by residents in the Euro-yen market to minimise the need for domestic holders to pay withholding tax. As previously indicated, issues of Euro-yen bonds could be expected to create pressure for a depreciation of the yen since an issue increases the net supply of yen assets but again this assumes that issuers are switching the currency denomination of their liabilities (or using the proceeds to purchase foreign-currency assets) rather than switching around their yen-denominated liabilities.

Yen Swapping.\(^\text{25}\) Two types of swapping need to be distinguished. The first

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In April 1984, the rules banning Euro-yen issues by Japanese residents were lifted and in December 1984, a further liberalization occurred. However, as Japanese withholding taxes still applied to interest payments on these issues, non-residents had no incentive to invest in them vis-a-vis issues by non-residents that were not subject to withholding tax. The United States sought the abolition of withholding tax on interest payments to non-residents to increase the attractiveness of these yen-denominated assets to foreigners. Initially the Japanese government rejected this push because of budgetary considerations and the argument that it would undermine some of the basic principles of Japan's tax system. Despite the deregulation of Euro-yen issues for residents there were no issues by Japanese residents between April 1984 and March 1985. This was largely because of the withholding tax issue and an expectation that Japanese withholding tax would be lifted. The Japanese withholding tax reduced the attractiveness to non-residents of Euro-yen bonds issued by Japanese vis-a-vis bonds issued by non-residents. As from April 1985, the withholding tax on non-residents' interest income from Euro-yen bonds issued by Japanese firms was abolished. Resident holders of the bonds will still have to pay withholding tax. So one can expect yen linked bonds and convertible bonds to be issued by residents in the Euro-yen market to minimise the need for domestic holders to pay withholding tax. As previously indicated, issues of Euro-yen bonds could be expected to create pressure for a depreciation of the yen since an issue increases the net supply of yen assets but again this assumes that issuers are switching the currency denomination of their liabilities (or using the proceeds to purchase foreign-currency assets) rather than switching around their yen-denominated liabilities.

Yen Swapping.25 Two types of swapping need to be distinguished. The first

are swap limits, daily limits on the amount Japanese banks and Japanese branches of foreign banks could convert foreign currency into yen in excess of their conversion of yen into foreign currencies. Their intake of Euro-yen was included in these limits. These limits acted potentially to prevent one-way portfolio adjustment of foreign currency into yen. They were eliminated in June 1, 1984. The removal of these foreign currency swap limits enables banks, especially branches of foreign banks with limited access to domestic deposits, to diversify their sources of funds by increasing their ability to procure short-term foreign funds. However at the time of their abandonment, foreign banks had used only about 50 per cent of their swap limits so the limit did not appear to binding for them. Although 'swaps' were only a minor source of their funds, the major beneficiaries of this change were the Japanese city banks who were constrained by these limits. The balance of foreign currencies converted into yen minus yen converted into foreign currencies by city banks has risen from $1.2 billion at the end of May before the regulatory change, to $3.4 billion in June, $4.4 billion in July and $4.9 billion in August 1984. It seems that the funding costs have been lower on funds obtained through these conversions compared to funds obtained in the domestic market and this converted money has been on-lent in the domestic call market. If financial institutions shifted from yen-denominated liabilities to dollar-denominated liabilities an appreciation of the yen could be expected. If instead banks switched from yen-denominated liabilities in the domestic market to yen-denominated liabilities (of the same maturity) in the Euro-currency markets, little impact on the exchange rate might be anticipated. In Table 6-1, it should be noted that there was a lack of funding means for money longer than eight days and shorter than one month. The ability to tap the Euro-currency markets will enable the city banks to overcome these inconveniences. It also enabled banks to use the Euro-currency markets to circumvent interest rate controls on the domestic inter-bank deposit market.

The second type of swap is the currency swap, the purchase of a currency and the simultaneous sale of the same amount of that currency, but with different delivery dates for purchase and sale. Since May 1984, both Japanese residents and non-residents are able to swap non-yen bond issues in unlimited amounts using

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26 The elimination of conversion limits applies to spot transactions only, similar limits still remain on forward transactions.

27 While General Trading Companies could borrow overseas in foreign currencies, if they converted the funds through a Japanese foreign exchange bank these limits could come into play, so that the limits could potentially limit capital inflow and outflows.

28 For a discussion, see Pritchard (1984).
either the forward exchange market or currency swap techniques. The growth of these swaps is in association with assets of long maturities and these swaps can be thought of as long-term forward contracts. Many Japanese companies are taking advantage of these arbitrage opportunities; for example, Japan Air Lines was able to convert a 13.375 per cent 10-year straight Euro-dollar bond to a 6.5 per cent fixed yen loan for the same period, the yen rate being 1.25 per cent below the prime rate at that time. The difference in the interest rate on the swapped asset (6.5 per cent) and the long-term prime rate (7.75%) may reflect unexploited arbitrage possibilities or transactions costs. This results in slack domestic demand for long-term credit causing the Japanese Long Term Credit Banks to make loans to top Japanese corporations at rates well below the long-term prime rate. These swaps can be expected to put increased arbitrage pressure on Japanese domestic loan rates.

The existence of arbitrage possibilities suggests that covered interest arbitrage for long-term assets is not yet satisfied and perhaps that some of the existing capital controls applying to long-term assets or domestic controls on loan rates are effective. Removal of these controls may lead to significant changes in the value of the yen. The current lack of well-developed forward markets for longer-term periods prevents any quantification of the current deviations from covered interest-rate parity for long-term assets. It also leaves in doubt how these deviations may have changed over time and how capital flows have been inhibited.

Bankers’ Acceptance Market.29 The Federation of Bankers’ Association of Japan proposed a Bankers Acceptance Market be introduced with the terms of bills from one to six months, the transaction unit fixed at greater than or equal to ¥100 million and requiring the bills to be transacted through banks. The implementation of this proposal in June 1985 made the characteristics of the BA market very similar to those of the current short-term money markets, the CD and Gensaki markets, described in Table 6-1. For the time being, it is expected that the yen Bankers Acceptance market is not likely to grow into a short-term financial market of a significant size. There are unresolved questions about the role of securities companies, domestic and foreign, and whether there will be in addition a dollar-denominated BA market30. The Bank of Japan has indicated it will enter the BA market for the purpose of open market operations. The Bank of Japan currently uses the call and bill discount markets for its open market operations.


30 Dollar-denominated bills were not included as they were seen to be inconsistent with the objective of increasing yen usage.
But, as was indicated in Chapter 6, only financial institutions can participate in these two markets so the effect of open market operations on the corporate sector is necessarily indirect. Use of the BA market for open market operations could assist monetary policy's penetration since non-banking institutions will also participate in the BA market.

There are three distinct issues raised by the introduction of a BA market: the effect it will have on the yen-denominated share of Japanese exports and imports; the effect it will have on increasing trade, exports or imports; and the effect of a new short-term financial market. The yen-denominated share of Japanese exports is tending to increase and is now between 35 and 40 per cent. In 1983, the percentage of yen-based Japanese export contracts depended very much on the country of destination of the exports and the commodity being exported. While 68 per cent of exports to Australia and New Zealand were yen-based only 14 per cent of exports to North America were yen-based. Only 12 per cent of chemical exports were yen-based as opposed 90 per cent for exports of ships. The share of yen-denominated imports is very low at about 3 per cent. This very low share is due to the fact that Japanese imports are dominated by primary products, like petroleum and coal, whose settlements are made in dollars. The BA market could be expected to increase the yen-denominated share of trade and may alter who is bearing the exchange risk associated with export and import transactions. (a shift from Japanese importers to foreign exporters in the case of Japanese imports).

Predicting how this will affect the exchange rate is a little difficult. Frankel (1984b, p.40) notes that since the net supply of yen (and dollar) assets to the private sector is not altered when a bank lends to an importer in yen rather than in dollars and either party is free to reverse its yen position using forward markets, the shift will not necessarily lead to a positive effect on the yen.

To the extent that the cost of financing trade is reduced and that cost is a significant factor in export and import decisions, the introduction of a BA market should affect both exports and imports. Given the higher share of exports denominated in yen and the likelihood that share of imports denominated in yen will not be greatly affected, it would probably increase the current account surplus and lead to a yen appreciation.

Given the current existence of a number of short-term financial markets governing similar maturity spans with the same minimum transaction unit, the introduction of another market would probably only cause a change in the market in which the funds are borrowed and lent. It should be remembered that the Japanese Trading Companies (Sogo Shosha) have, in the absence of the BA market,
provided many of the services to importers and exporters that a BA market will provide. It is possible that all that will be observed is a switch in the source of finance from the Trading Companies to the BA Market. It is unlikely that the introduction of this market would significantly alter international arbitrage between international and domestic markets or the exchange rate especially since covered interest rate parity has held since December 1980. The market has been almost dormant since it began in June 1985 although it is too early to say whether the reason for this is the transaction tax imposed on BA transactions, the cost of funds in this market vis-a-vis the prime rate or the poor qualities of BA assets relative to other assets. Since this market has not developed, little impact on asset demands or the exchange rate can be expected to have occurred.

**Withholding Tax Introduction.** The Ministry of Finance has proposed the introduction of a 20 per cent withholding tax on interest and dividends received by Japanese investors from the investment in foreign securities. This is to eliminate the inequality where domestically-paid interest and dividends are normally subject to withholding tax at source at the rate of 20 per cent but foreign-sourced dividends and interest are not. Under the previous arrangements, foreign dividends and interest were subject to tax (when declared), but for individuals, the tax was not payable until 15 March of the year following receipt of the interest or dividend. For corporations, the time for tax payment is dependent on the accounting period used by the company. This withholding tax would lower slightly the rate of return on the foreign securities. The loss arises from not having the tax money from the time of receipt of the dividend or interest until the time for payment of the tax. Since income declared for tax purposes is on a self-assessed basis, the declaration of foreign sourced income and dividends may also increase. The result of such a change can be expected to cause a shift away from foreign assets into domestic assets and, provided that means a swap in the currency denomination of the assets, an appreciation of the yen.

**Treasury Bill Market.** Currently, the Treasury Bill market is a very underdeveloped market with rates of return below market rates (see Figure 6-1). Around 95 per cent of the outstanding short-term government securities are held by the government, government related organizations or public corporations. Occasionally Treasury Bills are sold at the market level to alleviate seasonal liquidity problems. In the past year, sales seem to have been far larger than previously. The development of a Treasury Bill market could be expected to have

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31For example, the Bank of Japan and the Trust Fund Bureau; see Bank of Japan (1984).
little effect on the exchange rate given the existence of the highly substitutable Gensaki and CD market where foreigners are very active participants, and the quantities of bonds issued in the mid-1970s that are now close to maturity.\(^{32}\) It will, however, provide a market (in addition to the BA market) for Bank of Japan's Open Market Operations. Given the existence of one market for this purpose only minor increases in the effectiveness of open market operations could be expected from the introduction of another.\(^{33}\) One further impact could result if associated with the development of the Treasury Bill market there is a shift in the government securities issued from long-term bonds to short-term bonds. Fukao and Okubo's (1982, 1984) model suggests this could bring about an appreciation of the yen provided the two types of bonds are imperfect substitutes.

The expected high degree of substitutability between the Gensaki assets and Treasury Bills could be offset by three factors: the treatment of the assets for tax purposes; a desire for government paper by some investors; and the size of the market. One of the drawbacks of the Gensaki market for investors is that when they sell bonds they have to pay a security-transaction tax which is relatively heavy for short-term investors. Treasury Bills, however, are exempt from this tax and so will be more attractive to investors. One potential aspect of this change is that it partially provides a short-term government security which would be seen to be highly safe and liquid. It is this sort of asset that foreign governments would want to use for the purpose of holding their foreign-exchange reserves.\(^{34}\) Government securities offer a less risky investment than say certificates of deposit which are issued by the private banks. Some Gensaki transactions are based on government issued paper but the repurchaser is not necessarily the government. However, the Treasury Bill market would have to be sufficiently wide to ensure that large purchases/sales by central banks did not cause massive price fluctuations. The supposed thinness of existing markets (including the Gensaki market) is alleged to prevent large investors, for example Saudi Arabia, from moving large amounts of funds in and out of the market quickly because of the disturbances it would cause.

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\(^{32}\) This stress on the substitutability between the existing asset and the new asset is reinforced by Blake's (1984) work. Blake (1984) has used the characteristics model of portfolio behaviour, a model where the demand for assets depends on the characteristics of the different assets when combined in the portfolio, to suggest how financial innovations might affect existing asset demands. He concludes that innovations in the form of new assets are more highly demanded the more negatively correlated they are with existing assets and is less highly demanded the more positively correlated it is with existing assets.

\(^{33}\) Given that the Bankers' Acceptance Market has not developed as desired, the Treasury Bill Market may be important for the execution of monetary policy.

\(^{34}\) See, for example, Group of Thirty (1982) which contains a discussion of a survey conducted of central banks concerning their foreign exchange reserves.
The agreements operating between central banks in relation to portfolio adjustments in respect to their holdings of foreign exchange reserves aim to minimise such disturbances.

**Offshore Financial Market.** It has been proposed that an offshore financial market be set up in Tokyo. Interest payments to non-residents will be exempt from withholding tax and deposits will be exempt from reserve requirements. There will be a separation of accounts for residents and non-residents for deposits and lending along the lines of New York’s International Banking Facilities (IBFs). Interest rates on loans and deposits will be free from any of the administrative ceilings on domestic rates. Although the currency of transactions is not clear, the Japanese proposal seems to be modelled on the American system, in that it is designed to attract foreign-owned yen deposits back from their overseas havens. So it seems that the transactions would be in both yen and foreign currencies. As Hewson (1982) has pointed out, the impact of an offshore financial market on the exchange rate and the domestic monetary system will vary dramatically with the type of system adopted, the participation of residents and the currency denomination of the transactions.

It should be noted that most of the conditions necessary for an offshore currency market, in foreign currencies, are already satisfied in Japan: most exchange control has been removed; there are foreign banks domiciled in Japan; foreign banks can deal in both yen and foreign-currency deposits and loans; foreign-currency deposits can be held by residents and foreign-currency loans can be made to residents. The major impediments are interest-rate controls on yen-denominated deposits under ¥1 billion and yen-denominated loans, reserve requirements and the taxation of interest payments.

If the market were to be a purely offshore one, dealing only with non-residents and in non-yen currencies, it would be neutral with regard to the Japanese balance of payments, the exchange rate and monetary policy. There would be no transactions with residents, no capital inflow/outflow and no involvement at all of the domestic currency. The geographical location of the transactions would be shifted from some Euro-currency centre to Tokyo.

Problems will arise even if the market is confined to non-residents and the transaction currency is yen because of the regulated state of the Japanese capital markets. Given the Euro-yen market, it is to be expected that some of these

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35 Discussions of various aspects of offshore banking are contained in McKinnon (1981), Hewson (1982) and Valentine (1985). Frankel (1984b, pp.42-43) argues the IBF would have a negative effect on the value of yen because more capital would flow out than in.
transactions would shift to the new Tokyo centre. Maintenance of the side-by-side existence of these regulated and unregulated markets could be difficult. Non-residents include the overseas subsidiaries of Japanese corporations which will be able to undermine to some extent the regulated part of the Japanese banking system by switching their borrowing and lending between the regulated and unregulated markets to take advantage of arbitrage possibilities. Japanese agents can also be expected to attempt to establish themselves as non-residents to take account of the more attractive conditions in the offshore market further undermining the domestic regulatory structure.

One of the concerns expressed by McKinnon (1981) about the setting up of an offshore currency market based on foreign currencies and open to residents is that non-bank agents will be able to move freely between the highly-regulated banking system and the unregulated banking system based on the foreign currency. He is concerned about the potential for currency substitution created by offshore centres, large capital movements between domestic- and foreign-currency assets in response to interest-rate differentials and exchange-rate expectations.

Much of the force of this argument is dissipated in the Japanese case by the fact that Japanese residents are already able to open and operate foreign currency deposits with domestic banks and obtain foreign-currency loans in the domestic capital market. Table 7-1 provides information on the relative size of foreign-currency deposits with Japanese banks in relation to two money supply estimates. The upward trend in the ratio of foreign-currency deposits relative to M1 probably reflects a trend away from yen demand deposits to yen time deposits rather than any currency substitution. This hypothesis seems to be borne out by the M2+CDs figures, although the proportion of foreign currency deposits to M2+CDs does seem to rising slightly over time. The estimates for resident holdings of yen-denominated money in Chapter 5 suggested that this demand was not sensitive to foreign interest rates or expected changes in the exchange rate. While the potential for currency substitution already exists, taxation incentives for individuals certainly favour the holding of domestic-currency deposits.

By combining foreign-currency deposits in such an offshore market with a swap transaction it can be possible to obtain a slightly better yield than is obtainable in the domestic market. This is because of the lack of reserves in the offshore market.

36 A shift of funds from the Euro-markets to the American International Banking Facilities seemed to be the principal result of the development of those Facilities: Key (1982).

37 This is reinforced by the fact that American International Banking Facilities do not seem to have attracted a substantial amount of new business: Key (1982).
Table 7-1: Foreign-Currency Deposits and Domestic Deposits

<table>
<thead>
<tr>
<th>Time</th>
<th>Foreign-Currency Deposits</th>
<th>M1</th>
<th>M2+CDs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>69.6 (9.5)</td>
<td>209.0 (3.2)</td>
</tr>
<tr>
<td>80:12</td>
<td>6.6</td>
<td>69.6 (9.5)</td>
<td>209.0 (3.2)</td>
</tr>
<tr>
<td>81:3</td>
<td>7.1</td>
<td>68.8 (10.4)</td>
<td>208.0 (3.4)</td>
</tr>
<tr>
<td>81:6</td>
<td>6.6</td>
<td>71.2 (9.3)</td>
<td>217.8 (3.0)</td>
</tr>
<tr>
<td>81:9</td>
<td>7.8</td>
<td>68.7 (11.4)</td>
<td>219.2 (3.6)</td>
</tr>
<tr>
<td>81:12</td>
<td>7.9</td>
<td>76.5 (10.3)</td>
<td>232.0 (3.4)</td>
</tr>
<tr>
<td>82:3</td>
<td>9.3</td>
<td>74.5 (12.5)</td>
<td>230.5 (4.0)</td>
</tr>
<tr>
<td>82:6</td>
<td>7.9</td>
<td>75.9 (10.4)</td>
<td>238.0 (3.3)</td>
</tr>
<tr>
<td>82:9</td>
<td>10.0</td>
<td>74.4 (13.4)</td>
<td>240.2 (4.2)</td>
</tr>
<tr>
<td>82:12</td>
<td>9.0</td>
<td>80.9 (11.1)</td>
<td>250.5 (3.6)</td>
</tr>
<tr>
<td>83:3</td>
<td>10.3</td>
<td>78.6 (13.1)</td>
<td>247.9 (4.2)</td>
</tr>
<tr>
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<td>9.7</td>
<td>78.8 (12.3)</td>
<td>255.8 (3.8)</td>
</tr>
<tr>
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<td>11.4</td>
<td>76.8 (14.8)</td>
<td>257.2 (4.4)</td>
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</tr>
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<td>84:3</td>
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<td>80.5 (15.6)</td>
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<td>279.2 (5.1)</td>
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<tr>
<td>84:12</td>
<td>13.9</td>
<td>86.4 (16.1)</td>
<td>289.7 (4.8)</td>
</tr>
</tbody>
</table>

Notes:

1. The units of measurement are trillions of yen and the figures in brackets are the ratio of foreign-currency deposits to that money supply multiplied by 100.

2. M1 and M2 are defined in Appendix A. CDs are Certificates of Deposit issued by Japanese banks.

3. Data on Foreign-Currency Deposits is not available prior to December 1980.
Opening the offshore market in foreign-currency assets to residents who could use this swap technique could undermine the domestic monetary system. Again the potential for this is limited in the Japanese case as the maximum reserve ratio in the banking system is 2.0 per cent. However a reserve ratio of only 0.5 per cent is applied to time deposits over ¥ 100 billion and 0.25 per cent for time deposits of less than ¥ 100 billion with banks and Long-Term Credit Banks.

**Administrative Guidance.** Administrative guidance (gyosei shido) has been a widely used policy tool of the Japanese Ministry of Finance. Difficulties in the interpretation of administrative guidance lead to problems in predicting its effect on the investment behaviour of the institution on which it is imposed and the exchange rate. For example, in September 1985, the Ministry of Finance drew the attention of the securities and insurance companies to the exchange risk consequences of their large holdings of foreign-currency assets in their portfolios. Three possible interpretations of this guidance are: that it was a warning about the impending G5 meeting with its push to appreciate the yen; that it was to signal an intention to impose capital outflow controls unless capital outflows were curtailed; or it was designed as an appeasement measure, to give the appearance of doing something about the yen/dollar problem. The first interpretation could have led Japanese investors to attempt to switch their investments from foreign-currency denominated assets to yen-denominated ones with the result being a yen appreciation. The second interpretation may have led to a switch from yen-denominated to foreign-currency denominated assets in a bid to “beat” the new capital controls. The last interpretation may have led to no impact on investors.

### 7.3 Conclusion

The effect on the exchange rate of a number of measures, like the foreign exchange decontrol in 1980 and the establishment of a BA market and offshore markets, is ambiguous. For those measures that encourage the holding of yen assets (or issuing of foreign-currency liabilities), like permitting foreigners to transact in the Gensaki market and the establishment of a Treasury Bill Market or that discourage (or prohibit) the holding of foreign-currency assets\(^\text{38}\) like the taxation of zero-coupon bonds or the proposal to impose withholding tax on foreign-sourced interest and dividend income can be expected to lead to an appreciation of the yen. Measures that encourage the holding of foreign-currency assets (or issuing of yen-denominated liabilities) can be expected to lead to a depreciation of the yen.

\(^{38}\) The reversal of measures that discourage the holding of foreign-currency assets could be expected to lead to a depreciation of the yen.
Measures like changing the lot size for CDs cannot be expected to have any significant effect on the exchange rate.

The simple analytic paradigm used to link specific changes and the exchange rate was whether the regulatory change would increase the demand for yen-denominated assets or foreign-currency denominated assets. An examination of a number of changes suggested a number of important qualifications to this paradigm. These qualifications related to: the degree to which highly substitutable assets denominated in the same currency of the same maturity were already available; the binding nature of the regulatory constraint; and the extent to which highly substitutable assets denominated in the same currency of different maturities are available. Factors potentially influencing the substitution between assets in the same currency of similar (or different) maturities were: the tax treatment of the asset, the size of the market for existing assets of similar maturities and the nature of the underlying asset. The time between the announcement and the implementation of these measures has the potential to prevent econometric techniques being able to detect their effect. In addition, an increased demand for a certain type of asset implies a reduced demand for other assets, it is important to establish the currency denomination of the latter asset to determine the impact of the change on the exchange rate.

Given the apparent desire of the United States and Japan to have a strong yen, one possible measure to achieve that end would be to encourage the use of the yen as an international reserve currency thereby increasing the demand for yen assets by central banks and appreciating the yen. The use of the yen as a reserve currency has risen from 0.1 per cent of the total identified official holdings of foreign exchange in 1973 to 0.8 per cent in 1976 to 3.9 per cent in 1982. The noticeable preference of less developed countries and petroleum exporters for yen reserves in the early and mid seventies seems to have largely disappeared by 1982. The yen still lags significantly behind the share of the dollar in 1982 of 71.4 per cent and the Deutsche mark of 11.6 per cent.39

Japan has accepted the need to encourage the development of the yen as an international reserve currency. Japan sees the development of the Treasury Bill market, the European CD market and the yen-denominated BA market, and the payment of market-determined interest rates on central bank holdings of yen deposits with Japanese banks as promoting this aim. Oba (1984, p. 64), a Vice Minister in the Japanese Ministry of Finance, predicts the yen's share of foreign

39Figures are taken from International Monetary Fund (1983, p.72).
exchange reserves could rise as high as 12 per cent, although he does not specify a time frame.

Despite Japanese requests, the United States has said it will not buy yen-denominated assets for its foreign exchange reserves\textsuperscript{40}. These purchases if funded by sales of Treasury Notes would be equivalent to sterilized intervention and may have been potentially the most effective short-term (regulatory) measure to alter the yen/dollar exchange rate. The American Treasury has indicated to the Japanese Ministry of Finance that it wishes to issue $1 billion (about ¥ 250 billion) yen-based Treasury Bonds in the Tokyo market. Two reasons advanced by the American Treasury for doing this were that long-term bond rates were cheaper in Tokyo and also the issue would alleviate pressure on American capital markets. However, the policy of issuing yen-based Treasury Bills could be interpreted as a means to accelerate liberalization of the Japanese capital market since most issues in the samurai market to date have been for less than ¥ 20 billion and by governments of developing countries. Support for this latter interpretation is derived from the likelihood that an increase in the supply of yen-denominated Treasury Bills would be expected to depreciate the yen/dollar exchange rate.

\textsuperscript{40}Working Group of the Yen/Dollar Exchange Rate (1984, p.20).
CHAPTER 8
ECONOMETRIC ISSUES IN RATIONAL EXPECTATIONS MODELS

In this Chapter, econometric techniques that are relevant to some of the problems encountered in Chapters 4 and 5 of the thesis are developed. These problems were: how to test whether the explanatory variables in a regression model with serially correlated errors are predetermined or strictly exogenous (Chapter 5); what are valid instruments in an equation that contains a proxy for an expectations variable (Chapters 4 and 5); and how to test for serial correlation in the errors of an equation that contains a proxy for an expectations variable (Chapters 4 and 5). The last two problems arise because expectations of future values of the log of the exchange rate were replaced by their realised values. These problems were avoided in Chapter 3 as the vector autoregression model itself was used to generate predictions of future values of the log of the exchange rate.

Some investigators have presumed that the application of rational expectations type arguments to regression models means that the regressors in the model cannot be strictly exogenous but must be predetermined. Making the assumption that regressors are predetermined but not strictly exogenous can lead to different properties of various estimators. The estimators required when the predeterminedness assumption is made are typically more difficult to compute than those required for the strictly exogenous regressor case. A test of the assumption that the regressors are strictly exogenous as opposed to predetermined is developed in section 8.1.

The approach used in Chapters 4 and 5 to solve the problem of generating expectations for future values of the log of the exchange rate is to replace the expectations by their realised value. Where the period over which the expectations are taken is greater than the sampling period it has been argued in the literature that a moving average error structure will be introduced into the equation’s error. In estimating the standard dynamic linear regression model with a moving average error by an instrumental variable method, it is well-known that some lagged

\footnote{For example, Hansen and Hodrick (1980).}
dependent variables will be invalid instruments because they are correlated with the
equation's error\(^2\). The application of this argument to the rational expectations
models suggests that certain variables like lagged dependent variables will be invalid
instruments. In section 8.2, the question of valid instruments in a specific class of
rational expectations models is investigated. It is found that the simple application
of results from the standard dynamic linear regression model will lead to misleading
answers as to what variables will be valid as instruments in these rational
expectations models.

In these rational expectations models after the substitution of the realised
value for the expected value of a particular variable, it is possible though not
necessary that the equation's error will be serially correlated. In the standard
linear regression model, much attention has been focused on the question of testing
for serial correlation and the interpretation of significant values of tests for serial
correlation. In contrast, in these rational expectations models, no attempt is made
to test for serial correlation. Even if a test statistic were calculated and a
significant value resulted the presumption would be that this significant value was a
direct consequence of the rational expectations hypothesis. However, the significant
test statistic may merely reflect the fact that the equation is incorrectly specified.
This failure of investigators to test for serial correlation and rather assume its
existence may reflect the strength of investigators' faith in the rational expectations
hypothesis and its implications, or it may reflect a belief that the standard tests for
serial correlation are invalid. The aim of section 8.3 is to show that one of the
standard tests for serial correlation in a regression model estimated by the
instrumental variable method will also be a valid test for serially correlated residuals
in a class of rational expectations models.

8.1 Testing Strict Exogeneity in Models with Serial Correlation

In this section, two results relevant to the estimation of linear regression
models with serially correlated errors where the regressors are not strictly exogenous
are derived. The first theorem indicates how a consistent estimate of the variance-
covariance matrix of the least squares coefficient estimates from a model where the
errors are not independent and identically distributed can be obtained from an
instrumental variable estimation package. The second proposition provides a method
of testing whether the regressors in the model are strictly exogenous as opposed to
predetermined.

The model is assumed to be a linear regression model:

\[ y = X\beta + u \quad u \sim N(0, \Sigma), \]  

(8.1)

where \( X \) is a \( T \) by \( k \) matrix of explanatory variables, \( y \) and \( u \) are \( T \) by 1 vectors, \( \beta \) is a \( k \) by 1 vector of coefficients, \( \Sigma \) is a \( T \) by \( T \) positive definite matrix, \( T \) is the number of observations and \( N(0, \Sigma) \) denotes a normal distribution with mean zero and variance-covariance matrix \( \Sigma \). It is well-known that the ordinary least squares (OLS) and the generalized least squares (GLS) estimates of \( \beta \) in equation (8.1) are \( b_{\text{OLS}} = (X'X)^{-1}X'y \) and \( b_{\text{GLS}} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}y \) respectively. In addition, their corresponding variance-covariance matrices are \( V(b_{\text{OLS}}) = (X'X)^{-1}(X'XX)(X'X)^{-1} \) and \( V(b_{\text{GLS}}) = (X'\Sigma^{-1}X)^{-1} \). Given the positive definite nature of \( \Sigma \) there exists a \( T \) by \( T \) matrix \( P \) such that \( PP' = \Sigma \) and \( P'P = I \). The first proposition provides a way of calculating \( V(b_{\text{OLS}}) \) from an instrumental variable regression.

**Theorem 1:** For the model given in equation (8.1), the OLS estimates of \( \beta \) and consistent estimates of their variance-covariance matrix can be obtained from estimating \( \beta \) in the model:

\[ P'y = P'X\beta + \nu, \]

by the method of instrumental variables where \( P'X \) are used as instruments for \( P'X \).

**Proof:** Denote the instrumental variable estimates of \( \beta \) by \( b_{\text{IV}} \) then:

\[
\begin{align*}
(i) \quad b_{\text{IV}} &= (X'PP'X)^{-1}(X'PP'y) \\
&= (X'X)^{-1}(X'y) \\
&= b_{\text{OLS}}, \\
(ii) \quad V(b_{\text{IV}}) &= (X'PP'X)^{-1}(X'PP'X)(X'PP'X)^{-1} \\
&= (X'X)^{-1}(X'\Sigma X)(X'X)^{-1} \\
&= V(b_{\text{OLS}}).
\end{align*}
\]

This theorem is a generalization of the result contained in Messer and White (1984) for a diagonal variance-covariance matrix. The statement of theorem has presumed that \( \Sigma \) (and consequently \( P \)) are known, Theorem 1 still provides a valid method to obtain a consistent estimate of \( V(b_{\text{OLS}}) \) if \( \Sigma \) (and \( P \)) are replaced by consistent estimates.
For the model given in equation (8.1), when X is strictly exogenous\textsuperscript{3}, it is well-known that both OLS and GLS estimates of $\beta$ are consistent with the latter estimates being efficient. When X is not strictly exogenous but say predetermined\textsuperscript{4}, it has been argued that the application of OLS will lead to consistent estimates of $\beta$ but that the application of GLS leads to inconsistent estimates of $\beta$\textsuperscript{5}. An example of a situation where the regressors are said to be strictly exogenous is in testing the extent to which current forward rates can predict future spot rates by regressing the future spot rate on the current forward rate\textsuperscript{6}. In Chapter 5, the problem of whether the regressors were strictly exogenous arose when the ability of current information to predict future movements of the risk premium was investigated. Without testing the assumption of the strict exogeneity of the regressors, many investigators have assumed the regressors are not strictly exogenous. This has meant that it has been necessary to use either OLS estimates with corrected standard errors since the calculated OLS standard errors are incorrect or other estimation techniques rather than GLS estimates.

Given the differing performance of OLS and GLS estimates of $\beta$ under the differing assumptions about the stochastic nature of X, a test of the assumption that X is strictly exogenous based on the difference between the OLS and GLS estimates of $\beta$, a la Hausman (1978), seems quite natural. Given the efficiency of the GLS estimates under the hypothesis of strictly exogenous regressors, the statistic calculated in this way would be:

$$q=(b_{\text{OLS}}-b_{\text{GLS}})'[V(b_{\text{OLS}})-V(b_{\text{GLS}})]^{-1}(b_{\text{OLS}}-b_{\text{GLS}}).$$

(8.2)

Theorem 2 provides an alternative asymptotically equivalent way of calculating the test statistic using an OLS regression package.

**Theorem 2:** An asymptotically equivalent way of calculating $q$ under the hypothesis of strictly exogenous regressors can be obtained from the test of $H_0: \alpha=0$ when OLS is applied to:

$$P'y=P'X\beta+P'X\alpha+v,$$

(8.3)

or when GLS is applied to:

\textsuperscript{3}Strictly exogenous in this context means that $E(u_t X_{t-1} X_t X_{t+1})=0$, or equivalently $E(u_t X_{t+j})=0$ for all $j$.

\textsuperscript{4}Predetermined in this context means $E(u_t X_{t-1} X_t X_{t+1})=0$ or equivalently $E(u_t X_{t+j})=0$ for $j \leq 0$.

\textsuperscript{5}See Hansen and Hodrick (1980). For the inconsistency of GLS estimates of $\beta$ to arise, certain restrictions on the form of $\Sigma$ (and $P$) are required namely that $P$ be such that $P'X$ and $v$ be correlated. This prevents, for example, $\Sigma$ being diagonal ($P$ diagonal).

\textsuperscript{6}Hansen and Hodrick (1980).
\[ y = X\beta + \Sigma X\alpha + w. \] (8.4)

**Proof:** Obviously equations (8.3) and (8.4) are equivalent in that (8.4) is obtained from (8.3) by premultiplication by \( P \). Rewrite equation (8.3) as:

\[ y_t = X_t\beta + Z\alpha + \nu, \] (8.5)

where \( y_t = P^{-1}y \), \( X_t = P^{-1}X \) and \( Z = P'X \). If \( Q_X = I - X_t(X_t'X_t)^{-1}X_t' \), then the OLS estimate of \( \alpha \), \( a_{\text{OLS}} \), in (8.5) is:

\[ a_{\text{OLS}} = (Z'Q_XZ)^{-1}(Z'Q_Xy_t) \] (8.6)

and the calculated estimate of the variance of \( a_{\text{OLS}} \) is given by:

\[ V(a_{\text{OLS}}) = s^2(Z'Q_XZ)^{-1}. \] (8.7)

\( s^2 \) is the OLS estimate of the residual variance. Writing \( a_{\text{OLS}} \) as \( B^{-1}c \) then:

\[ c = Z'Q_Xy_t, \]
\[ = Z'y_t - Z'X_t(X_t'X_t)^{-1}X_t'y_t, \]
\[ = (Z'X_t)[(Z'X_t)^{-1}(Z'y_t) - (X_t'X_t)^{-1}(X_t'y_t)] \]
\[ = (Z'X_t)b_{\text{OLS}} - b_{\text{GLS}}, \]
\[ B = Z'Q_XZ, \]
\[ = Z'Z - Z'X_t(X_t'X_t)^{-1}X_t'Z, \]
\[ = (Z'X_t)[(Z'X_t)^{-1}(X_t'Z)(Z'Z)^{-1}(X_t'X_t)^{-1}(X_t'Z)] \]
\[ = (Z'X_t)[V(b_{\text{OLS}})]V(b_{\text{GLS}})(X_t'Z). \]

It is easily shown that, under the null hypothesis, \( \text{plim } s^2 = 1 \) so that:

\[ a_{\text{OLS}} V(a_{\text{OLS}})^{-1}a_{\text{OLS}} \]
\[ = (b_{\text{OLS}} - b_{\text{GLS}})[V(b_{\text{OLS}}) - V(b_{\text{GLS}})](b_{\text{OLS}} - b_{\text{GLS}}). \]

*q.e.d.*

In stating the theorem, it was presumed that \( \Sigma \) (and \( P \)) was known, replacement of \( \Sigma \) by a consistent estimate of \( \Sigma \) is valid under \( H_0 \), so that the results of Theorem 2 are still valid even when Feasible Aitken estimates are used.

The results in Theorem 2 are not surprising when Hausman's (1978) results are recalled. Hausman showed that in the model:
\[ y = W\beta + u \quad \text{and} \quad u \sim N(0,\sigma^2I_T), \]  
\text{(8.8)}

A test of whether \( W \) and \( u \) are correlated can be constructed by testing \( H_0 : \sigma = 0 \) in the regression model:

\[ y = W\beta + \bar{W}_\alpha + u, \]  
\text{(8.9)}

where \( \bar{W} = P_Z^TW, \ P_Z = Z(Z'Z)^{-1}Z' \) and \( Z \) are a set of instruments uncorrelated with \( u \). The results in Theorem 1 indicate that the issue of uncorrelatedness in equation (8.1) is a question of whether to use an OLS estimator (GLS) or an IV (OLS) estimator. In Hausman's framework (equations (8.8) and (8.9)), letting \( y = y_*, \ Z = P'X \) and \( W = P^{-1}X \), then given the properties of \( P \), \( \bar{W} = P'X(X'PP'X)^{-1}X'PP^{-1}X = P'X \). Hence the test of uncorrelatedness of \( P^{-1}X \) and \( v \) in (8.3) appears as a simple application of Hausman's procedure.

As an illustration of the calculations required for the test in Theorem 2 suppose that \( u \) was a moving average process of order 1 with parameter \( \theta \). \( X_\ast \) (and \( y_\ast \)) can be calculated from the recursions beginning at \( t=1 \):

\[ X_{\ast,1} = X_1, \]
\[ X_{\ast,t} = X_t - \theta X_{\ast,t-1} \quad t \geq 2, \]

where \( X_{\ast,t} \) and \( X_t \) are the \( t \)-th observation of \( X_\ast \) and \( X \) respectively. The variables \( Z \) can also be calculated recursively beginning at \( t=T \):

\[ Z_{T} = X_T, \]
\[ Z_{t} = X_t - \theta Z_{t+1} \quad t < T, \]

where \( Z_t \) is the \( t \)-th observation of \( Z \).

### 8.2 Valid Instruments in Models with Future Expectations

In linear rational expectations models, it is often the case that the expected value of a variable conditional on an information set is replaced by its realised value to permit single equation estimation\(^7\). Various econometric problems result from this substitution. One of the problems is that if the period over which expectations are taken is longer than the sampling period, a moving average error may be induced. In order to estimate the equation by instrumental variable methods

\( ^7\text{McCallum (1976).} \)
it is necessary to determine which variables are valid instruments. It has been argued that there are restrictions on the extent to which lagged dependent variables can be used as valid instruments\(^8\). In particular, if the moving average induced by the substitution is of order \(N\) then lagged endogenous variables dated after time \(t-N-1\) are invalid instruments. In the money demand functions estimated in Chapter 5, lags of the dependent variable were found to be significant explanatory variables and were used as instruments when determining whether the expected change of the log of the exchange rate was a significant explanatory variable. Lags of the actual change of the exchange rate were also used as instruments. The purpose of this section is to clarify the restrictions on the use of lagged dependent variables as instruments in models that contain future expectations, and shows that the use of lagged dependent variables and lags of the actual change of the log of the exchange rate as instruments in Chapter 5 was correct.

Suppose the system of structural equations including rational expectations variables is given by:

\[
y_tA_0 + \sum_{s=1}^{S} y_{t+s} A_s + \sum_{q=1}^{Q} y_{t-q} C - q + x_tC = u_t
\]

\[
u_t = u_{t-1} R + z_t,
\]

where \(y_t\) is a 1 by \(g\) vector of endogenous variables, \(x_t\) is a 1 by \(k\) vector of exogenous variables and \(z_t\) is a 1 by \(g\) vector of serially independent random variables that are distributed as \(N(0,\Sigma)\). \(A_j\) (\(j=-Q,...,S\)), \(R\) and \(C\) are respectively \(g\) by \(g\), \(g\) by \(g\) and \(k\) by \(g\) matrices of coefficients to be estimated. \(y_{t+j/t}\) is the expected value of \(y_{t+j}\) conditional on the information set available at time \(t\). It is assumed that there are sufficient restrictions on \(A_j\) (\(j=-Q,...,S\)), \(R\) and \(C\) to identify the model\(^9\).

The rationality assumption implies that:

\[
y_{t+j} = y_{t+j/t} + v_{t+j/t} \quad j=1,...,S,
\]

where \(y_{t+j/t} = E(y_{t+j}/I_t)\) and the innovation, \(v_{t+j/t}\), is serially independent satisfying \(E(v_{t+j}/I_t) = 0\). The information set at time \(t\), \(I_t\), is assumed to include the values of

---


all variables known to the agent at time t as well as the the value of the coefficient matrices $A_j$ ($j=-Q,\ldots,S$), R and C.

In the investigation of the validity of various variables as instruments, the separate cases of $R=0$, no autoregressive structural error, and $R \neq 0$, an autoregressive structural error, are considered to illustrate the differences that arise when different specifications of the structural error are adopted.

8.2.1 No Autoregressive Structural Error ($R=0$)

Setting $R=0$ in (8.10) and using (8.11) to eliminate all $y_{t+j/t}$ ($j=1,\ldots,S$) in (8.10) yields:

$$\sum_{s=-Q}^{S} y_{t+s} A_s + x_tC = w_t,$$

where $w_t = u_t + \sum_{s=1}^{S} v_{t+s}/t A_s$. The error $w_t$ is potentially a moving average of order $S$ as $v_{t+s}/t$ is potentially correlated with $u_{t+s}$. A single equation from the system described by (8.12) is often used as the estimating equation and the issue under discussion is what will be a valid instrument for $y_{t+j}$ in this equation. Intuitively, it would seem that if the error is an MA($S$) then lagged dependent variables $y_{t-1},\ldots,y_{t-S}$ could not be used as instruments because they appear to be correlated with the error while lagged endogenous variables $\ldots y_{t-S-2}, y_{t-S-1}$ would be valid instruments$^{10}$. To determine the answer to this question it is necessary to solve for $y_t$ in terms of the exogenous variables and the disturbances to ensure the rational expectations restrictions are imposed. Here we follow the method of solution suggested by Wickens (1982).

Equation (8.12) can be rewritten as a first-order difference equation:

$$Y_t P_1 = Y_{t+1} P_2 + X_t P_3 + W_t,$$

where $Y_t = [y_{t+S-1}, y_{t+S-2}, \ldots, y_{t-Q}]$, $X_t = [x_t, 0, \ldots, 0]$, $W_t = [w_t, 0, \ldots, 0]$, $P_2 = \text{diag}[-A_S I_g, \ldots, I_g]$, $P_3 = [-C, 0]$, $P_1$ is non-singular and the model is stable which requires that the eigen

---

values of $P_2^{-1}P_1^{-1}$ are less than one in absolute value, then (8.13) can be rewritten as:

$$Y_t = \sum_{j=0}^{\infty} X_{t+j} P_3 D_j + \sum_{j=0}^{\infty} W_{t+j} D_j$$

(8.14)

where $D_j = P_1^{-1}(P_2 P_1^{-1})^j$. From the relationship given for $Y_t$ in (8.14) it would appear that $y_{t-j}$ would in fact be correlated with $w_t$ in (8.12) since $y_{t-j}$ appears to be a function of $w_{t-j}, w_{t-j+1}, \ldots$. This is a mistaken impression. Leading (8.14) one period and taking expectations of $Y_{t+1}$ conditional on the information at time $t$ implies:

$$Y_{t+1/t} = \sum_{j=0}^{\infty} X_{t+j+1/t} P_3 D_j$$

(8.15)

since $E(W_{t+j}/I_t) = 0$ for $j \geq 1$. If a selection matrix $K_q$ is defined so that $Y_{t+1/k} = y_{t+q}$ then

$$y_{t+k/t} = \sum_{j=0}^{\infty} X_{t+j+1/t} P_3 D_j K_k, \quad k=1, \ldots, S.$$  

Substituting this statement of $Y_{t+k/t}$ into (8.10) gives:

$$y_t A_0 + \sum_{s=1}^{S} \sum_{j=0}^{\infty} X_{t+j+1/t} P_3 D_j K_s A_s + \sum_{q=1}^{Q} y_{t,q} A_{-q} + x_t C = u_t.$$  

(8.16)

$y_t$ in (8.16) satisfies (8.10) as well as (8.11), that is, it satisfies the rational expectations assumption and is a solution of the structural model. For $y_{t+k}$ ($k \geq 1$) to be a valid instrument in (8.12), it must be correlated with $y_{t+j}$ ($j=1, \ldots, S$) and uncorrelated with the error $w_t$. The correlation between $y_{t+j}$ and $y_{t+k}$ arises because either $y_{t+k}$ is directly a function of $y_{t+j}$ or $X_{t+j+1/t}$ is in all likelihood dependent on $y_{t-1}$, $y_{t-2}$ since these are all elements of $I_t$ the information set on which these forecasts of $X_{t+j+1}$ are made. Provided $u_t$ is serially uncorrelated $w_t$ and $y_{t+k}$ ($k \geq 1$) will be uncorrelated. This is because $y_{t+k}$ is a function of $x_{t+k}, x_{t+k-1/t-k}, x_{t+k-2/t-k}, \ldots, y_{t-k+1}, y_{t-k-2}, \ldots$ and $u_{t+k}$ and all these are elements of or can be constructed from the elements of $I_t$ and since $u_t$ is serially uncorrelated then $E(y_{t+k} w_t) = 0$ for $k \geq 1$. Hence all lagged dependent variables are valid instruments in this situation. Since this result is independent of the value of $S$, it is easily seen that the instrument set need not be altered as the value of $S$, the number of future expected variables included, increases. It is, however, necessary, to decide what variables are endogenous and therefore included in $y_t$ and which variables are exogenous and therefore included in $x_t$.

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11The only non-zero element of $W_{t+j}$ is $w_{t+j} = u_{t+j} + \sum_{s=1}^{S} v_{t+j+s/t+j} A_s$. Examining this in two parts: (a) $E(u_{t+j}/I_t) = 0$ because $u_t$ is serially uncorrelated by assumption; and (b) $E(v_{t+j+s/t+j}/I_t) = 0$ because $I_t \subseteq I_{t+j}$ and by assumption $E(v_{t+j+s/t+j} x_{t+j}) = 0$. 


8.2.2 Autoregressive Structural Error \( (R 
eq 0) \)

When \( R 
eq 0 \), equation (8.10) can be rewritten as:

\[
y_t A_0 + y_{t-1} A_0 R + \sum_{s=1}^{S} (y_{t+s/t} A_s - y_{t+s-1/t-1} A_s R) + \sum_{q=1}^{Q} (y_{t-q} A_q - y_{t-q-1} A_q R) + x_t C x_{t-1} CR = z_t.
\]

The effect of the autoregressive transformation is to introduce expectations taken at two different time periods into the equation. This has important consequences for the validity of \( y_{t-1} \) as an instrument for \( y_{t+j} \) \( (j \geq 1) \). Using (8.11) to eliminate \( y_{t+j/t} \) and \( y_{t+j-1/t-1} \) \( (j = 1, \ldots, S) \) in (8.17) yields

\[
\sum_{s=1}^{S} (y_{t+s} A_s - y_{t+s-1} A_s R) + x_t C x_{t-1} CR = w_t,
\]

where \( w_t = z_t + \sum_{s=1}^{S} (v_{t+s/t} A_s - v_{t+s-1/t-1} A_s R) \).

Proceeding as before, (8.18) can be written in the first-order difference equation form of (8.13) where the definitions of the variables are now:

\[
Y_t = [y_{t+S-1}, y_{t+S-2}, \ldots, y_{t-Q}], \quad X_t = [x_t, x_{t-1}, 0, \ldots, 0], \quad W_t = [w_t, 0, \ldots, 0], \quad P_2 = \text{diag}(-A_S I_k, \ldots, I_k),
\]

\[
B_{s-1} = A_{s-1} A_s R \quad \text{for} \quad s = 1-Q, \ldots, S \quad \text{and}
\]

\[
P_1 = \begin{bmatrix}
B_{s-1} & \vdots & I_{(Q+S)k} \\
0 & B_1-Q & 0 \\
-A_{Q} R & 0 & 0
\end{bmatrix}, \quad P_3 = \begin{bmatrix}
-C & 0 \\
CR & 0 \\
0 & 0
\end{bmatrix}
\]

Given the same conditions on \( P_1 \) and \( P_2 \) as previously stated this first-order difference equation can be rewritten in a similar way to (8.14). Proceeding as before:

\[
Y_{t+1/t} = \sum_{j=0}^{\infty} X_{t+j+1/t} P_3 D_j
\]

\[
Y_{t+1/t-1} = \sum_{j=0}^{\infty} X_{t+j+1/t-1} P_3 D_j.
\]

Defining a selection matrix, \( K_q \) as before and using the definitions in (8.19), equation (8.17) can be rewritten as:
\[ y_t A_0 y_{t-1} A_0 R + \sum_{q=1}^{Q} \left( y_{t-q} A_q y_{t-1} A_q R \right) + x_t C x_{t-1} CR + \sum_{s=1}^{S} \left( \sum_{j=0}^{\infty} X_{t+j+1/t-1} P_3 D_j K_s A_s - \sum_{j=0}^{\infty} X_{t+j+1/t-1} P_3 D_j K_s A_s R \right) = z_t. \]  

(8.20)

So \( y_{t-1} \) is a function of \( y_{t-2}, y_{t-3} \) and some forecasts based on the information set at time \( t-1 \) and \( t-2 \). Since \( y_{t-1} \notin I_{t-1} \), it will potentially be correlated with \( v_{t+s+1/t-1} \) and hence it will potentially be correlated with \( w_t \) in (8.18). So \( y_{t-1} \) is not a valid instrument. However \( y_{t-j} \in I_{t-1}, j \geq 2 \) and so they are valid instruments. If it is assumed that \( x_t \in I_{t-1} \), then \( x_t \) will not be a valid instrument either as it will be correlated with \( v_{t+s+1/t-1} \). \( x_{t-s} (s \geq 1) \) will be valid instruments.

Using similar arguments, the effect of higher order autoregressive error processes of order say \( p \) can be shown to be that \( y_{t-1}, \ldots, y_{t-p} \) become invalid instruments. The invalidity of these instruments is independent of the value of \( S \) provided \( S \geq 1 \). For similar reasons \( x_{t-1}, \ldots, x_{t-p} \notin I_{t-p} \) and will not be valid instruments. Lagged endogenous variables \( y_{t-k} (k \geq p) \) will be valid instruments.

The results derived here indicate the conditions for valid instruments when a single equation that contains an expectations variable is estimated using McCallum's (1976) method. The system from which the single equation came was presumed to be linear in parameters and linear in variables. The risk premium equation in Chapter 4 derived from the demand for yen-denominated bonds contained the log of the exchange rate as part of the dependent variable and the level of the exchange rate as a component of one of the explanatory variables \((SP/P)\) and so this equation is non-linear in the variables. In particular, the non-linearity is with respect to the variable which appears in expected form. The results shown here apply only to linear models but it is presumed that similar results with respect to the validity of instruments will hold in non-linear models.

### 8.3 Testing for Serial Correlation in Models with Future Expectations

As discussed in Chapter 4, the substitution of realised variables for their expected values introduces the possibility that the equation under investigation has an error that will be serially correlated. This is especially likely when the forecast period is greater than the sampling period. Given this serial correlation, the use of the usual Cochrane-Orcutt (GLS) type transformations will lead to inconsistent parameter estimates if the errors are serially correlated. This is because the usual
GLS transformations introduce a correlation between the transformed regressor matrix and the transformed error\textsuperscript{12}. Given this inconsistency, it is an open question as to whether the usual tests for serial correlation will be valid in this context. It is the purpose of this section to demonstrate their validity.

Suppose that a single equation from (8.12) is taken with no lagged dependent variables, no serial correlation and $S=1$ and that after normalization the equation can be written as:

$$y_t = y_{2t} \alpha_1 + y_{2t+1} \alpha_2 + z_t \gamma + w_t$$

$$w_t = u_t + v_{t+1} \alpha_2$$

(8.21)

where $V(u_t) = \sigma_u^2$, $V(v_{t+1} \alpha_2) = \sigma_{\alpha_2}^2$, $V(w_t) = \sigma_w^2 = \sigma_u^2 + \sigma_{\alpha_2}^2$ and $Cov(u_t, v_{t+1} \alpha_2) = 0$. Equation (8.21) covers the situation found in Chapter 5, where $y_t$ represents the real money stock, $\alpha_1 = 0$, $y_{2t+1}$ is the realised change of the exchange rate and $z_t$ contains the rest of the explanatory variables in the model. The exclusion of lagged dependent variables and the setting of $S=1$ are made for expositional purposes. The results still carry over if either or both these assumptions is relaxed. The arguments in Chapter 4 suggest that it is possible that $w_t$ has a MA(1) structure because $u_{t+1}$ and $v_{t+1} \alpha_2$ are potentially correlated. The correlation between $w_t$ and $w_{t-1}$ is denoted by $\sigma_{uv}$. Suppose the model is rewritten as:

$$y_t = x_t \beta + w_t$$

(8.22)

where $x_t = [y_{2t}, y_{2t+1}, z_t]$ and $\beta = [\alpha_1, \alpha_2, \gamma]^\top$, or in the obvious matrix notation:

$$y = X \beta + w$$

(8.23)

$$w = u + v \alpha_2$$

(8.24)

where $X$ is a $T$ by $k$ matrix. The hypothesis we wish to test is $H_0: \sigma_{uv} = 0$ against the hypothesis that $H_1: \sigma_{uv} \neq 0$, that is, whether $w_t$ is serially correlated. Under the hypothesis that the disturbance is an MA(1), equation (8.24) can be rewritten as:

\textsuperscript{12}See, for example, Hansen and Hodrick (1980) and Hayashi and Sims (1983).
where \( u \) is a white-noise process.

In the usual simultaneous equations model, the tests of Godfrey (1976, 1978) and Pagan and Hall (1983) for testing whether the disturbances are autoregressions of a particular order can be shown to be equally valid as tests of whether the error is a moving average of a similar order. Suppose we have a valid set of \( g \geq k \) instruments\(^{13}\), say \( Z_1 \), then one of Pagan and Hall's (1983) tests for whether the disturbances are an AR(1) (or MA(1)) error in the simultaneous equations model can be calculated as follows:

1. estimate (8.23) by GIVE\(^{14}\) using \( Z_1 \) as instruments to obtain an estimate of \( \beta \), say \( b_1 = (X'W_1X)^{-1}X'W_1y \) and \( w = y - Xb_1 \) where \( W_1 = Z_1(Z_1'Z_1)^{-1}Z_1' \);

2. estimate the equation:

\[
y = X\beta + w_1\delta + w
\]

or rewriting this more compactly by denoting \( S = [X, w_1] \):

\[
y = S\psi + w
\]

by the GIVE method using \( Z = [Z_1; w_1] \), where \( w_1 \) is \( w \) lagged once, as instruments to obtain estimates of \( \beta \), \( \delta \) and \( \sigma_w^2 \), say \( b_2 \), \( d \) and \( s^2 \); and

3. calculate the test of the null hypothesis of no serial correlation from the t-test of whether \( \delta = 0 \) in (8.26).

The problem is to show that this t-test is a valid test of the MA(1) hypothesis in the rational expectations model (8.21). To do this it is necessary to show that the t statistic associated with the estimated coefficient, \( d \), is asymptotically \( N(0,1) \) under the hypothesis of no serial correlation and also that the test is consistent. Similar arguments can be used to show that tests for higher order moving averages are also valid.

Let \( y_{-1}, w_1 \) and \( X_{-1} \) refer to \( T \) by 1, \( T \) by 1 and \( T \) by \( k \) matrices whose t-th

\(^{13}\)Here we suppose that the instruments are valid under the null hypothesis of no serial correlation and the alternative hypothesis that the errors have a correlation at lag 1. The arguments in section 8.2 suggest that the validity of the instruments does not depend on the length of the moving average induced by substituting the realised values for the expected values of the variables.

\(^{14}\)The Generalised Instrumental Variable Estimator, for an explanation, see Harvey (1981, pp.80-81).
rows are $y_{t-1}$, $w_{t-1}$ and $x_{t-1}$ respectively. A number of assumptions concerning the moment matrices of the data are necessary for the proofs:

1. $T^{-1}Z'Z^P \rightarrow Q_1$,
2. $T^{-1}X'Z^P \rightarrow Q_2$,
3. $T^{-1}X'X^P \rightarrow Q_3$,
4. $T^{-1}S'Z^P \rightarrow Q_4$, and
5. $T^{-1}X'_w^P \rightarrow Q_5$.

where $Q_j$, $j = 1, 2, 3, 4$ are finite matrices, $Q_1$ and $Q_3$ are non-singular and $P \rightarrow$ indicates "tends in probability".

**Lemma 3:** $b_1 \overset{P}{\rightarrow} \beta$

**Proof:** Since $Z_1$ is by assumption a valid set of instruments for $X$, then $T^{-1}(Z'_1w)^P \rightarrow 0$ so that, given assumptions 1 and 2, $b_1 \overset{P}{\rightarrow} \beta$, that is $b_1$ is consistent estimate of $\beta$. q.e.d.

Lemma 3 indicates that $b_1$ is a consistent estimate of $\beta$ under both the null and alternative hypotheses relating to the serial correlation exhibited by $w$. This results from the assumption that $Z_1$ are a valid set of instruments under both hypotheses.

**Lemma 4:** $T^{-1}u'_1w^P \rightarrow 0$ under $H_0$

$P \rightarrow \sigma_{uv} \neq 0$ under $H_1$

**Proof:**

$$T^{-1}u'_1w = T^{-1}(y'_1 - X'_1b_1)'w$$
$$= T^{-1}X'_1(b_1 - b_1)'w$$
$$= T^{-1}((\beta - b_1)'X'_1w + w'_1w)$$
$$P \rightarrow 0 \quad \text{since under } H_0 \quad (w'_1w/T)^P \rightarrow 0, \quad b_1 \overset{P}{\rightarrow} \beta,$$
and, by assumption 5, $T^{-1}X'_1w^P \rightarrow Q_5$.

$$P \rightarrow \sigma_{uv} \neq 0 \quad \text{since under } H_1 \quad (w'_1w/T)^P \rightarrow \sigma_{uv}, \quad b_1 \overset{P}{\rightarrow} \beta,$$
and, by assumption 5, $T^{-1}X'_1w^P \rightarrow Q_5$.

q.e.d.

This lemma together with assumption 4 implies that, under $H_0$, $u_1$ is a valid instrument for itself in the GIVE regression.

**Corollary 5:** $T^{-1}Z'w^P \rightarrow 0$ under $H_0$. 

Corollary 5 together with assumption 4 implies that \( Z \) is a valid set of instruments for \( S \), under \( H_0 \). The results in Lemma 4 and Corollary 5 are interesting because \( X_{-1} \) would not be a a valid set of instruments because it contains \( y_{2t} \) (resulting from the expectations term) which could be correlated with \( w_t \). However, the particular linear combination of \( y_{-1} \) and \( X_{-1} \) that is used in \( \hat{u}_1 \), together with the assumption that the model in (8.21) is correctly specified, ensure that \( \hat{u}_1 \) is a valid instrument.

**Theorem 6:** If (8.26) is estimated by GIVE, then under \( H_0 \), \( b_2 \to \beta \) and \( d^n \to 0 \) while under \( H_1 \), \( b_2 \to \beta^* \neq \beta \) and \( d^n \to \delta^* \neq 0 \).

**Proof:** Letting \( c=(b, d)' \), \( f=[0 \sigma_u'] \), \( \phi=[\beta', 0]' \) and \( W=Z(Z'Z)^{-1}Z' \),

\[ c=[S'WS]^{-1}[S'Wy] \]

\[ =\phi+[S'WS]^{-1}[S'Ww] \]

\( \to \phi \) under \( H_0 \)

\( \to \phi+[Q_2Q_1^{-1}Q_2^{-1}][Q_2Q_1^{-1}f] \neq \phi \) under \( H_1 \).

The result under \( H_0 \) arises because by assumption \( Z_1 \) is a valid instrument and because, by Lemma 4, under \( H_0 \), \( \hat{u}_1 \) is also a valid instrument. The result under \( H_1 \) arises because, by Lemma 4, \( \hat{u}_1 \) is not a valid instrument.

q.e.d.

Theorem 6 indicates that the estimate of \( \beta \), \( b_2 \) is consistent under the null hypothesis and is inconsistent under the alternative hypothesis.

**Lemma 7:** \( T^{-1}\hat{u}_1 w_1 \to \sigma_w^2 \) under \( H_0 \)

**Proof:**

\[ T^{-1}\hat{u}_1 w_1 \]

\[ =T^{-1}(y_{-1}-X_{-1}b_1)(y_{-1}-X_{-1}b_1) \]

\[ =T^{-1}[X_{-1}(\beta-b_1)+w_1][X_{-1}(\beta-b_1)+w_1] \]

\[ =T^{-1}[(\beta-b_1)'X_{-1}X_{-1}(\beta-b_1)+2w_1X_{-1}(\beta-b_1)+w_1w] \]

\( \to \sigma_w^2 \)

where the last line follows because all elements except \( T^{-1}w_1 w \) tend in probability to zero under \( H_0 \).

q.e.d.

**Theorem 8:** The estimate of the error variance \( \sigma_w^2 \) is a consistent estimate of \( \sigma_w^2 \) under \( H_0 \), that is, \( \sigma_w^2 \to \sigma_w^2 \).
Proof:

\[ s^2 = T^{-1}(y - Xb_2)^\top(y - Xb_2) \]
\[ = T^{-1}(w + X(\beta - b_2) - u_1)^\top(w + X(\beta - b_2) - u_1) \]
\[ = T^{-1}[w'w + (\beta - b_2)X'X(\beta - b_2) + 2w'u_1 + 2w'X(\beta - b_2) - 2w'u_1 - 2d'X(\beta - b_2)] \]
\[ \Rightarrow \sigma_w^2 \]

where the last line follows because all elements except \( T^{-1}w'w \) tend in probability to zero under \( H_0 \) given the results in Lemmas 3, 4 and 7, and Theorem 6.

For Theorem 9 an additional assumption is required:

6. \( (Z'w/\sqrt{T}) \xrightarrow{D} N(0, \sigma_w^2 Q_4) \) under \( H_0 \).

where \( \xrightarrow{D} \) indicates "tends in distribution".

**Theorem 9:** Under \( H_0 \), \( \sqrt{T}(c-\phi) \xrightarrow{D} N(0, \sigma_w^2 V^{-1}) \), where \( V = Q_4 Q_4^\top Q_4^\top \).

**Proof:** From Theorem 6:

\[ \sqrt{T}(c-\phi) = \sqrt{T}[S'WS]^{-1}[S'Ww] \]
\[ = [(S'/T)(Z'/T)^{-1}((S'/T)^{-1}(Z'/T)(Z'/T)^{-1}(Z'w/\sqrt{T})] \]
\[ \xrightarrow{D} [Q_4 Q_4^{-1} Q_4^{-1} (Z'w/\sqrt{T})] \]
\[ \xrightarrow{D} N(0, \sigma_w^2 [Q_4 Q_4^{-1} Q_4^{-1}]. \]

The last line follows because by assumption 6, under \( H_0 \), \( \sqrt{T}(c-\phi) \xrightarrow{D} N(0, \sigma_w^2 Q_4) \).

Theorem 9 implies that the t-test of \( \phi \), say \( t_6 \) will be normally distributed under the null hypothesis.

**Theorem 10:** \( t_6 \) is a consistent test of the null hypothesis.

**Proof:** To show that \( t_6 \) is a consistent test, it is necessary to show that \( \text{plim} \ t_6 \neq 0 \) under \( H_1 \). The t-test, \( t_6 \), can be written as:

\[ t_6 = u_1'WQ_{W'X}Ww/\sqrt{s^2w_1'WQ_{W'X}Ww_1}, \quad (8.27) \]

where \( Q_{W'X} = I - P_{W'X} \) and \( P_{W'X} = W(X'W'W)X'W' \). Examining the numerator:
\[ \bar{w}_1 W_{QW}Ww/T = (X_{-1}(-W_0) + w_1) W_{QW}WxWx/T \]

\[ p \to \text{plim}(w_1 W_{QW}Ww/T) \quad \text{since } \beta - b_1 p \to 0. \]

\[ = \text{plim}[(u_1 + \pi u_2) W_{QW} W(u + \pi w_1)/T] \text{ using } (8.25) \]

\[ p \to \pi \text{plim}(w_1 W_{QW}Ww_1/T) \quad (8.28) \]

The sign of the expression in (8.28) depends on the sign of \( \pi \) but since the probability limit is not equal to zero the test of \( H_0 \) against \( H_1 \) based on (8.27) is consistent in that the null hypothesis will be rejected with probability one in large samples when the alternative hypothesis is true. 

q.e.d.

In the results proved above it was assumed that the error caused by the substitution of the realised value of a variable for its expected value was possibly an MA(1) and the test used sought to test for an MA(1). The key to these results was Lemma 4 which indicated that lagged values of the estimated instrumental variable residuals were valid instruments under the null hypothesis of no correlation in the error. In the case where \( S > 1 \), the forecast period is greater than the sampling period, a similar result will hold under the null hypothesis. In Chapter 4, the expectations variable formed part of the dependent variable and the results shown here might seem to be inapplicable. Again Lemma 4 is the key and it is easily shown that a variant of Lemma 4 will be true. Hence using tests for serial correlation in instrumental variable models, it is possible to test for serial correlation in the models in both Chapters 4 and 5.

8.4 Conclusion

In this chapter, a number of techniques have been suggested that will assist in the estimation and evaluation of models that contain expectations variables. Firstly, a method of how to test whether regressors are strictly exogenous as opposed to predetermined was suggested. Secondly, the issue of what are valid instruments in models that contain future expectations was explored and the differences that arise from the presence or absence of serial correlation in the structural equation were indicated. Thirdly, the validity of a test for serial correlation in models with future expectations was shown.

The tests developed in sections 8.1 and 8.3 are only valid asymptotically and no evidence has been presented concerning their small sample properties. As with all tests that are only asymptotically valid it will be necessary to investigate their finite sample behaviour, both in terms of the empirical size of the tests compared to
their nominal size and their power against a variety of alternatives. For example, should the test for serial correlation have low power even when the errors are serially correlated, the appropriate response may be to always use an estimator that makes a moving average correction.
CHAPTER 9
CONCLUSION

This thesis has examined three issues in exchange rate policy, sterilized intervention, currency substitution and financial change, in the context of the yen/dollar rate. The importance of these issues depends on three critical assumptions of exchange rate theory. These assumptions relate to: the degree of substitution between bonds denominated in different currencies; the degree of substitution between monies denominated in different currencies and the stability of asset demand functions. Here the broad conclusions of the thesis with respect to these issues and the policy implications of the conclusions are discussed. Some areas of potentially fruitful research are also indicated.

The results in this thesis suggest that there is still a great deal of uncertainty concerning the extent to which the Bank of Japan can use sterilized intervention to systematically and significantly influence the yen/dollar exchange rate. Effective sterilized intervention usually requires that bonds denominated in different currencies be imperfect substitutes. Three methods were used to investigate the issue of whether bonds denominated in yen and dollars are perfect substitutes. One method used the uncovered interest rate parity hypothesis to derive restrictions on the coefficients of a three-variable vector autoregression and these restrictions were then tested. Another method was based on portfolio theory and used an aggregate yen-denominated bond demand equation to derive the testing equation. The third method used portfolio theory to suggest the important explanatory variables but was based on a market-efficiency type of test. Notwithstanding the differences between the methods, they provided evidence consistent with yen and dollar bonds of three-month maturities being imperfect substitutes. For one-month bonds, the evidence was a little more confusing. Its consistency with imperfect substitution depended on the testing method and the estimation period.

Only the portfolio model suggested strong theoretical links between sterilized intervention and the observed imperfect substitution. However, the evidence on this link was very weak as very few variables were individually significant and the coefficients on a number of variables were found to have signs that differed from
those theoretically predicted. The evidence in favour of the portfolio model is therefore not strong. This is consistent with Frankel's (1985) conclusion suggesting that the portfolio model is not a useful paradigm to explain movements of the risk premium.

When sterilized intervention is effective, open market operations and unsterilized intervention can be expected to lead to different impacts on interest rates and exchange rates. The uncertainty about the usefulness of sterilized intervention as a policy tool also means there is uncertainty about the extent to which open market operations and unsterilized intervention differ in their effects on the exchange rate and interest rates.

There is still the possibility that sterilized intervention can influence the exchange rate through expectations effects but this channel would seem to rely on the government being able to confuse the public about the extent to which its intervention is sterilized. The degree of that confusion and the effect it would have on private sector asset holdings are not easy to predict. Hence this channel of expectations also does not seem to provide a reliable basis on which to use sterilized intervention as a policy instrument. A government attempting to influence the exchange rate in a more certain and systematic way would need to rely on an instrument other than sterilized intervention.

One of the assumptions made in the portfolio theory used was that all bonds denominated in one currency of different maturities were perfect substitutes. The different observed outcomes for one- and three-month bonds could be the result of imperfect substitution between one- and three-month bonds denominated in the same currency. If bonds of different maturities denominated in the same currency are imperfect substitutes, the possibility arises that the Bank of Japan can alter the term structure of interest rates by changing the outstanding quantities of bonds with different maturities.

If the assumption of perfect substitutability between bonds of different maturities denominated in the same currency is incorrect, an investigation of the degree of substitution between longer-term bonds denominated in different currencies would be warranted. The methods employed in Chapters 3 or 4 could be used to test this possibility. The possibility that bonds denominated in different currencies of maturities greater than three months provides another possible avenue for effective sterilized intervention. One of the difficulties in dealing with bonds having maturities longer than one year is the lack of well developed forward markets for those terms. This will create problems in interpreting any deviations from uncovered interest parity as evidence is not available about whether covered interest
parity for long-term assets is being impeded by capital controls. Chapters 3 and 4 stress the importance of this type of evidence.

Money demand functions have traditionally not incorporated foreign variables. Currency substitution arguments suggest that the traditionally estimated money demand functions are potentially misspecified. In addition, it is suggested that the demand function will also tend to be unstable if political and economic events generate large degrees of currency substitution. Quite apart from arguments about the currency substitution, the stability of the money demand function has been an important area of controversy in the economics literature. The possible effect of currency substitution and general regulatory change reinforce these concerns about the stability of the money demand function. The empirical evidence derived from Japanese money demand functions suggests that currency substitution is not a problem for monies issued in Japan. That is, substitution between yen money and dollar money, and yen money and dollar bonds does not appear to be significant. The two foreign variables used to capture these influences, the expected change of the log of the yen/dollar exchange rate and a Euro-dollar interest rate, did not appear to be significant influences on the demand for Japanese M1 or on resident demand for yen-denominated M2.

There is the possibility that currency substitution occurs but is not being captured by the variables employed or that it occurs between the yen and currencies besides the dollar. The observed stability of the money demand functions when one-step ahead predictions are calculated provides negative evidence with respect to these two possibilities over the period 1981-1984.

Account was taken of the relaxation of rules governing the use of foreign currency deposits in December 1980 and the possibility that the degree of currency substitution increased as a result. However, this change does not appear to have had any significant impact on the demand for M1. A significant one-off upward shift in the demand for yen-denominated M2 was detected which may be due to this change. Conflicting evidence was obtained for the impact of this change (together with other changes introduced by the Foreign Exchange and Foreign Trade Control Law of 1980) on the risk premium equations from a yen-denominated bond demand function. It is possible that in response to the new rules governing foreign-currency deposits, investors merely rearranged their holdings of foreign-currency assets with no impact on the money demands or risk premium equations resulting.

McKinnon (1982) has claimed that the demand for individual currencies has been destabilized and that instead there is a stable demand for world money. Contrary to one of these claims, the evidence in this thesis suggests that the
holdings of yen money (whether M1 or resident demand for yen-denominated M2) do not appear to have been significantly destabilized in the floating exchange rate period. As a result, it would seem that the Bank of Japan could still use a purely national monetary aggregate when formulating macroeconomic policy.

An issue not dealt with in the thesis is the extent to which other currencies like the mark are substitutable for dollars and whether there is a stable demand for mark-denominated money. The method used in Chapter 5 of estimating a standard closed economy money demand function and testing for the impact of foreign variables like the expected rate of change of the log of the exchange rate and the foreign interest rate could be used. Information on the mark’s substitutability for the dollar would, together with the findings for Japan, provide further evidence on McKinnon’s (1982) claims about the degree of substitutability between the monies of the major economies. As well, evidence on the mark’s substitutability with other currencies could have important consequences for the conduct of German monetary policy.

These results on a lack of currency substitution for the yen suggest the introduction of an offshore currency market into Tokyo that deals in foreign currencies and is open to residents is not likely to cause any significant increase in the degree of currency substitution by residents. Since December 1980, residents have been able to use foreign currency deposits with domestic banks to engage in currency substitution if they desired but they do not appear to have done so in any significant way. It follows that the ban on residents holding overseas accounts denominated in foreign currencies does not seem justifiable by reference to currency substitution arguments.

Given a high degree of currency substitution between the dollar, yen and mark, McKinnon (1982) has recommended that the Bank of Japan, the Bundesbank and the Federal Reserve engage in a degree of co-ordination to control the growth of world money rather than the growth of their national monies. The findings here would undermine the currency substitution justification for the Bank of Japan following this policy strategy rather than its current practice of forecasting domestic money growth. In the absence of significant currency substitution, the benefits to Japan from controlling the world money supply rather than forecasting domestic money growth would also need to be demonstrated more fully before that course was followed. Evidence on the currency substitution issue for Germany would also be useful in judging the extent to which the Bundesbank should engage in policy co-ordination with the Federal Reserve.

In the econometric work in Chapters 3-5, the importance of taking account of
regulatory changes for the choice of estimation period, for determining the stability of the econometric models and for the interpretation of the results was stressed. Regulatory changes may alter the interpretation of econometric results if the changes alter whether a fundamental arbitrage condition is satisfied. For example, knowledge of whether covered interest parity holds and how deviations from this parity condition are affected by changes in capital controls proved to be valuable in interpreting deviations from uncovered interest rate parity. Regulatory changes that cause large asset demand shifts or alter investor sensitivities to interest rate changes may cause the econometric models to become more unstable or cause changes in the variables to which investors are responding. For example, changes in the rules governing the use of foreign currency deposits suggest that currency substitution may be more important after this change. No evidence of increased currency substitution following the change was found.

Limitations on the degree to which structural changes can be captured by econometric methods motivated a qualitative examination of the impact of the regulatory changes on the exchange rate. The arguments in Chapter 6 suggested that liberalization of international capital flows may lead to increased demand for foreign-currency assets; that liberalization of time deposit rates in Japan was not likely to be relevant for foreigners investing in yen and that it was not likely to disturb the portfolios held by Japanese residents; and that changes in Japanese savings behaviour could have strong impacts on the exchange rate. The difficulty was linking financial deregulation with changes in savings behaviour.

Both domestic and international pressures still exist for liberalization of Japanese financial markets. Two key sources of domestic pressure are the huge outstanding issues of government debt and the arbitrage possibilities between the 'fixed' and 'free' domestic interest rate markets, and the international markets. Although the yen has appreciated substantially since the release of the first report of the Working Group on the Yen/Dollar Exchange Rate in May 1984, the size of Japan's current account surplus and the United States' current account deficit still leads to some pressure being applied to the Japanese authorities for further changes.

Given these pressures and the likelihood of further changes, it is useful to have a framework for understanding and predicting how these changes might impact on the exchange rate in the short-term. The analytic starting point was to determine whether the demand for yen-denominated assets or foreign-currency denominated assets would increase as a result of the change. The examination of a number of changes suggested a number of qualifications to this proposition. These qualifications related to the availability of an existing highly substitutable asset (of a similar or
different maturity), the binding nature of the constraint and the degree to which covered interest rate parity holds for assets of different maturities.

One of the major conclusions of that discussion was that liberalization of the financial system may not lead to an appreciation as an increased demand for foreign-currency assets was the possible result of some of the liberalizations. Consequently liberalization may not lead to any significant reduction in Japan's trade surplus or the United States' trade deficit. However, liberalization moves may be useful in other ways by serving to overcome American-Japanese economic and political disputes by giving the appearance that concrete measures are being taken to alleviate trade problems between the United States and Japan.

A more careful study of the impact of capital controls on particular Japanese institutions may be warranted. Privatization of the postal savings system and a relaxation of the constraints on its portfolio behaviour could result in significant changes in its investment behaviour. Given the size of the funds in the postal savings system and the possibility that a sizeable proportion of its funds could be invested in foreign-currency assets, this change could have strong impacts on the yen. Market segmentation is one of the fundamental characteristics of the Japanese financial system and it is likely that the restrictions it introduces lead to differences in the portfolio behaviour of various institutions. The relaxation of segmentation rules, if it leads changes in portfolio behaviour, could impact on institutions' investment in foreign assets and consequently the exchange rate. These possibilities would certainly seem worthy of further investigation.

Economic theory, especially in the exchange rate literature, relies quite strongly on the hypothesis that expectations are formed rationally. Many of the conclusions derived in the empirical work were based on the assumption that expectations of the future value of the exchange rate were formed rationally. Some of the evidence presented here is consistent with the hypothesis that investor expectations of the exchange rate are not formed rationally. The degree to which observed expectations are actually rational is an issue that has been investigated in other areas by using price expectations survey data and perhaps the rationality of exchange rate expectations should be investigated. Lovell (1986, p.122) has gone as far as suggesting that the evidence to date is "sufficiently strong to compel us to suspend belief in the hypothesis of rational expectations" and that more attention should be given to testing the rational expectations hypothesis.

The lack of long enough time series on observed exchange rate expectations has prevented investigations of the rationality of exchange rate expectations. The greater availability of exchange rate expectations series from both forecasting
companies and forecasting contests between Forex dealers suggests that sufficiently long series may soon be available to investigate the rationality of these forecasts. Frankel and Froot (1985) represents one study in this direction\(^1\). Survey data on exchange rate expectations also represents an alternative exchange rate expectation measure that might be used in econometric work to test the robustness of econometric tests of hypotheses like uncovered interest rate parity to the choice of the expectations variable employed. On the assumption that the survey data is not measured with error, it would not be necessary to use an instrumental variable estimation technique as in Chapter 5 and the problems of low correlations between the instruments and the realised change of the exchange rate could be avoided. One further advantage of results based on this procedure would be that they would not be jointly testing the rational expectations and uncovered interest parity hypothesis jointly. However, a different question arises about the extent to which the survey series represent market expectations.

The bilateral focus in this thesis on the yen/dollar rate could be questioned given that investors in Japan and the United States are not restricted in their asset choices to only yen and dollar assets. The inclusion of interest rates on assets denominated in other currencies and other exchange rates in the vector autoregressive models in Chapter 3 would enable tests to be conducted with respect to hypotheses about the degree of substitutability between assets denominated in different currencies either jointly or separately. The inclusion of more variables in the vector autoregression as suggested, two for each new asset denominated in a different currency (the return on the new asset and the appropriate exchange rate), could potentially create degrees of freedom problems given the amount of monthly data available since 1973, and the necessity to take account of regulatory changes and whether covered interest rate parity holds. One obvious solution to the degrees of freedom problem is to shorten the observation period from a month to either a week or a day as all the variables used in Chapter 3 are available on a daily basis. Estimation of the models using daily observations or the estimation of models using discrete approximations to continuous time models because for some variables like the exchange rate there is (nearly) 24 hour continuous trading (Monday to Friday) might be worthy of consideration. If the underlying data generating process for the interest rates and exchange rates applied to daily observations (rather than weekly or monthly observations) or was a continuous time process, it would be useful to investigate how the choice of a different (longer) observation period could affect the

\(^1\)Bilson (1983) contains an evaluation of the forecasts produced by a number of exchange rate forecasting services.
results obtained. The use of daily data could create concerns about how to deal with missing observations caused by market closures on holidays and weekend effects. However techniques for solving missing value problems are sufficiently well developed, especially for vector autoregressions, that missing value problems are no longer insurmountable².

The importance of evaluating econometric models by use of diagnostic tests is a theme stressed in the thesis. Some of the existing diagnostic tests for serial correlation were shown to be useful in the evaluation of models involving expectations of future variables. In models where these expectations variables are included, the period of prediction is longer than the measurement period and significant serial correlation has been detected, few valid diagnostic testing procedures have been developed and this would seem to be a useful area of research.

The econometric techniques used substantially in Chapters 3-5 rely on asymptotic (large sample) arguments for their validity. Little is known about the small sample properties of some of these estimating and testing procedures. For example, there is some dispute about the effectiveness of criterion to choose the lag lengths in vector autoregressions³. This is a critical dispute when alternative choices of lag lengths can lead to quite different results with respect to the uncovered interest rate parity hypothesis. Monte Carlo work on the small sample properties of diagnostic tests in models estimated by instrumental variable methods is only just beginning to emerge⁴. Certainly more analytic and Monte Carlo research on the small sample properties of the estimators and testing techniques is required.

With respect to the degree of substitution between bonds denominated in different currencies, in the thesis it was found that assuming expectations are rational, three-month bonds denominated in yen and dollars were imperfect substitutes while there was some uncertainty about the extent to which one-month bonds denominated in yen and dollars were imperfect substitutes. With an allowance for dynamic behaviour, traditionally estimated money demand functions adequately explained movements in Japanese M1 and M2 and foreign influences did not appear to be significant influences on the demands for these monies. Financial liberalization and changes in the regulatory structure in Japan have the potential to influence the exchange rate.


³See, for example, Penm and Terrell (1982) and Nickelsburg (1985).

⁴See Kiviet (1985).
APPENDIX A
DATA DEFINITIONS AND SOURCES

Unless otherwise stated: (i) all interest rates and asset stocks are end of period and (ii) all variables are seasonally unadjusted. Where used, subscripts t refer to monthly observations. The units of measurement for each variable is in brackets. In the construction of some variables, it was necessary to splice a number of series together because of changes in base numbers. This is indicated by [S: X1], where X1 denotes the point(s) where splicing occurred.

Sources:

BH  Bisignano and Hoover (1980, Appendix Page 10)
BIS  Bank of International Settlements; Annual Report
EPA  Economic Planning Agency Data Base
ESA  Bank of Japan; Economic Statistics Annual
ESM  Bank of Japan; Economic Statistics Monthly
FRB  Federal Reserve Bulletin
IMFPS International Monetary Fund (1981); Supplement on Price Statistics
IFS  International Monetary Fund; International Financial Statistics
KZJ  Kinyu Zaisei Jijo
SA  Securities Dealers Association of Japan
SCB  Department of Commerce; Survey of Current Business
WFM  Morgan Guaranty Trust; World Financial Markets

Data Definitions:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAGG</td>
<td>Net supply of yen-denominated interest bearing bonds available to the private sector, constructed as DEBT-BHOLD: (¥100 billion).</td>
</tr>
<tr>
<td>BASE</td>
<td>Net external assets of Japan at the end of 1971: BH ($billion).</td>
</tr>
<tr>
<td>Bibold</td>
<td>Total National Government debt held by the Bank of Japan: ESM (¥100 billion).</td>
</tr>
<tr>
<td>CASCIR</td>
<td>‘Cash in Circulation’ in Japan, the amount of banknotes issued, minus the amount of cash currency held by financial institutions surveyed by the Bank of Japan: ESM (¥100 million).</td>
</tr>
<tr>
<td>CURDEP</td>
<td>‘Deposit Money’ in Japan, the total of demand deposits (current deposits, ordinary deposits, deposits at notice, special deposits and deposits for tax payments) among public and private deposits with financial institutions surveyed by the Bank of Japan minus the checks and bills held by them: ESM (¥100 million).</td>
</tr>
<tr>
<td>CURDEP</td>
<td>Total demand deposits at large commercial banks reporting to the Federal Reserve System at the Wednesday nearest the end of the month: SCB ($billion).</td>
</tr>
<tr>
<td>DEBT</td>
<td>Total indebtedness of the Japanese public sector denominated in...</td>
</tr>
</tbody>
</table>
Indebtedness of the rest of the world's public sector proxied by the gross outstanding amount of United States' Federal Government debt held by the public: SCB ($billion).

**DEBT**

**DER1**

$$1200^*(\log S_{t+1} - \log S_t).$$

**DER3**

$$400^*(\log S_{t+3} - \log S_t).$$

**DFE**

Dummy variable taking the value zero until November 1980 and then unity thereafter.

**DGEN**

Dummy variable taking the value zero until April 1979 and then unity thereafter.

**FB**

Foreign-currency bonds issued by the Japanese public sector, constructed as the stock of German mark bonds issued by Local Government Authorities + stock of dollar-denominated bonds issued by Japanese Government Public Corporations + foreign-currency bonds issued by the National Government (all converted to yen at the appropriate end of period exchange rate): ESM (¥100 billion).

**FCD**

Foreign-currency deposits with all banks in Japan (available only from December 1980): ESM (¥100 million).

**GDP**

Gross National Product at Constant Prices (annual rate, seasonally adjusted): I.M.F. line 99ar (¥billion) [S: 1974:1, 1980:1].

**GDPNOM**

Gross National Product at Market Prices (annual rate, seasonally adjusted): I.M.F. line 99a (¥billion).

**INF**

Japanese annual inflation rate, calculated using Gross National Product price deflator as $$(P_{t} - P_{t-12}) / P_{t-12}.$$ United States' annual inflation rate calculated using U.S. consumer price index as $$(P'_{t} - P'_{t-12}) / P'_{t-12}.$$ Japanese (real) M1 constructed as $$\frac{M1NOM}{PGDP}.$$

**M1NOM**

Japanese (nominal) M1 constructed as $$CASCIR + CURDEP$$ (¥100 million).

**M2**

Resident (real) holdings of yen-denominated M2 constructed as $$\frac{M2YNOM}{PGDP}.$$

**M2NOM**

Japanese (nominal) M2 constructed as $$M1NOM + TIMDEP$$ (¥100 million).

**M2YNOM**

Resident (nominal) holdings of yen-denominated M2, constructed as $$\frac{M2NOM - NRYFCD}{100}$$ (¥100 million).

**ND**

Japanese banks’ investible funds, constructed as $$\frac{(CURDEP + TIMDEP - RES)}{1000}$$ (¥100 billion).

**ND’**

ROW banks’ investible funds, constructed as $$\frac{(CURDEP' + TIMDEP' - RES')}{100}$$ ($billion).

**NRY**

Non-resident yen deposits with all banks in Japan (only available from December 1980): ESM (¥100 million).

**NRYFCD**

Prior to December 1980, free-yen deposits and foreign-currency deposits with Japanese banks, since December 1980, NRY + FCD: ESM (¥100 million).

**P**

Consumer Price Index for Japan: IMFPS and IMF line 64 [S: 1982:6].

**P’**

Consumer Price Index for USA: IMFPS and IMF line 64 [S: 1982:6].

**PGDP**

Gross National Product price deflator, calculated as $$\frac{100 \times GDPNOM}{GDP}.$$ Bank of Japan’s discount rate for commercial bills and interest
rate on loans secured by government bonds, specially designated bonds and bills corresponding to commercial bills: ESM (per cent p.a.).

RD* Federal Reserve Bank of New York’s interest rate on short-term adjustment and seasonal credit: FRB (per cent p.a.).

RES Reserve deposits of the Japanese banking system: ESM (¥100 million).

RES* Reserve deposits with member banks of the Federal Reserve System, average of daily figures: SCB ($billion).

REU Three-month Euro-dollar rate: WFM (per cent p.a.).

RF One-month Euro-dollar Rate: WFM (per cent p.a.).

RFt1 Three-month Euro-dollar Rate: WFM (per cent p.a.).

RJt1 One-month Gensaki Rate: SA and KZJ (per cent p.a.).

RJt3 Three-month Gensaki Rate: EPA and KZJ (per cent p.a.).

RP1 One-month risk premium constructed as RFt1 + DER1t - RJt1 (per cent p.a.).

RP3 Three-month risk premium constructed as RFt3 + DER3t - RJt3 (per cent p.a.).

RT Three-month time deposit rate with Japanese banks: ESM (per cent p.a.).

S3 Three-month Gensaki rate: EPA and KZJ (per cent p.a.).

TIMDEP 'Quasi-Money' in Japan, the total of private deposits, public deposits and installments of Sogo banks minus demand deposits with financial institutions surveyed: ESM (¥100 million).

TIMDEP* Total time deposits of large commercial banks reporting to the Federal Reserve System, Wednesday nearest the end of the month: SCB ($billion).

W Net financial wealth of the Japanese private sector, calculated as (WP.S/100) + FB + DEBT (¥100 billion).

WP Net financial wealth of Japan, constructed as BASE + accumulated current account since January 1972: ESM ($billion).

W* Net financial wealth of the rest of the world non-financial private sector, constructed as -WP* - DEBT* ($billion).

WP* Net financial wealth of the rest of the world, constructed as -WP ($billion).


APPENDIX B
IMPORTANT JAPANESE POLICY CHANGES 1973-1984

1973

May
- Relaxation of restrictions on non-resident purchases of shares in individual companies.
- Expansion of limits on foreign-currency loans to residents.

November
- Prohibition on purchases of short-term (< 6 months) foreign-currency securities by Japanese residents.
- Acquisition by non-residents of Japanese bonds/shares no longer required to take place through securities dealers or foreign-exchange banks.
- Permission for residents to cover foreign-currency deposits with forward contracts.

December
- Termination of prohibition on the net acquisition of Japanese stocks and bonds by non-residents.
- Reduction of reserve ratios (from 50 per cent to 10 per cent) on additions to non-resident free-yen liabilities.
- Restrictions imposed on purchases by foreign-exchange banks of United States’ Treasury Bills.

1974

January
- Prohibition on purchases of short-term (1 year or less) foreign-currency securities by Japanese residents.
- Ceilings placed on the outstanding balances in residents’ foreign-currency accounts; ceilings relate to balances held in the last quarter of 1973.
- Banks, securities companies and investment trust companies voluntarily agree to restrain their investment in foreign securities to a zero net increase.
- Banks and securities companies agree not to encourage individuals to purchase foreign securities.
- Relaxation of regulations on foreign borrowing by domestic companies.

April
- Removal of withholding tax on interest payments on foreign-currency bonds issued abroad.

July
- Request to banks to refrain from excessive lending to non-residents.

August
- Restrictions lifted on holdings by non-residents of short-term government securities.

September
- Prohibition lifted on the acquisition by non-residents of unlisted bonds and debentures.
- Permission given to the acquisition by non-residents of newly-issued Japanese bonds and securities (previously subject to individual screening).
- Suspension of reserve ratios on non-resident free-yen liabilities.
1975

June - With the exception of banks, discontinuance of voluntary restraint of January 1974 on investment in foreign securities.

July - Domestic capital market re-opened to foreign borrowers, issues of yen bonds by national governments permitted.

1976

June - Doubling of account limits on residents' foreign-currency accounts with banks. Lifting of the prohibition on opening new foreign-currency accounts.

1977

March - Discontinuance of voluntary restraint by banks on investment in foreign securities.

May - Abolition of controls over short-term loans to non-residents by Japanese foreign-exchange banks.

June - Abolition of ceilings on foreign-currency deposits held by residents.
          - Liberalization of rules governing non-resident holdings of shares and debentures.
          - Abolition of regulations as to maturity and amount of short-term foreign securities that Japanese security companies, insurance and trust companies could hold.
          - Imposition of reserve ratios of 0.25 per cent on foreign-currency deposits and non-resident free-yen liabilities.

July - Greater freedom for foreign-exchange banks to extend medium/long-term loans in foreign currencies.

September - Foreign borrowing in Japan encouraged.

November - Suspension of public offerings of short-term government (Treasury Bills) securities (prevents non-residents purchasing Treasury Bills).
          - Introduction of 50 per cent reserve ratios on additions to non-resident free-yen accounts.

1978

March - Increase in reserve ratios (50 per cent to 100 per cent) on additions to non-resident free-yen accounts.
          - Reintroduction of public offerings of government short-term securities.
          - Prohibition on purchase of yen bonds and debentures by non-residents, where the bond or debenture had a term to maturity of less than 5 years and one month.

June - First competitive tender for the purchase of government bonds.

1979

January - Partial liberalization of the prohibition of March 1978 on non-residents purchasing yen bonds (prohibition applicable to bonds whose term to maturity is less than one year and one month).
          - Reduction in reserve ratios (100 per cent to 50 per cent) applying to additions to non-resident free-yen liabilities.

February - Lifting of the prohibition on non-residents' purchasing yen bonds.
          - Abolition of reserve ratios applying to non-resident free-yen liabilities.
May  -Non-residents granted access to the Gensaki market.
      -Certificates of Deposit introduced and non-residents granted access.
      -Prohibition on short-term impact loans lifted.
      -Bank of Japan engages in active purchasing operations of government bonds.

1980

March  -Liberalization of interest rates on free-yen deposits held by foreign official institutions.
       -Japanese banks permitted to make medium/long-term foreign-currency (impact) loans to domestic customers.

December  -New Foreign Exchange and Foreign Trade Law came into operation (passed the Diet in December 1979).
           -Notification requirements lifted for foreign-exchange banks issuing and purchasing foreign-currency securities.
           -Liberalization of resident foreign-currency deposits held with Japanese foreign-exchange banks; market rates of interest can be paid.

1981

January  -Increase in reserve ratios on foreign-currency deposits, differential increase on fixed-term deposits.
March  -Reduction in reserve ratios on foreign-currency deposits.
May  -Banks and securities companies authorized to buy/sell in the domestic market Commercial Paper (CP) and Certificates of Deposit (CD) issued abroad by law to have effect from April 1982. Implementation delayed until April 1984.

1982

March  -Voluntary restraint on purchase of foreign-currency zero-coupon bonds with a Ministry of Finance announcement of an intention to establish reporting requirements for holders of zero-coupon bonds to limit tax avoidance.
June  -Permission for life-insurance companies to purchase foreign CPs and CDs.
July  -Permission for general-insurance companies to purchase foreign CPs and CDs.

1983

February  -Purchase of zero-coupon foreign-currency bonds permitted.
May  -Postal Life-Insurance Fund permitted to purchase foreign-government bonds.
June  -Abolition of the rule that short-term (less than 1 year) Euro-yen lending by Japanese to non-residents be for trade-related purposes.

1984

January  -Minimum lot size for CDs reduced from ¥ 500 million to ¥ 300 million (announced November 1983).
April  -Domestic sale of foreign CPs and CDs permitted.
        -Abolition of the real demand rule for making forward contracts
(announced November 1983).
-CD issue limits enlarged (announced November 1983).
-Elimination of non-prudential limits on overseas lending from Japan by Japanese and foreign banks.
-Liberalization of rules governing resident issues of Euro-yen bonds (announced November 1983).

May
-Legislation abolishing the designated company rule passed Diet (intention to abolish announced November 1983).

June
-Removal of the ban on making short-term (less than 1 year) Euro-yen loans to residents (announced May 1984).
-Elimination of overall limits on the spot foreign-exchange position of foreign-exchange banks (announced May 1984).

December
-Liberalization of rules governing non-resident issues of Euro-yen bonds (announced May 1984).

APPENDIX C

IMPORTANT UNITED STATES POLICY CHANGES 1973-1984

1974

January -Interest equalization tax (0.75 per cent p.a.) payable by American citizens or residents when purchasing foreign stocks and debt obligations from foreigners abolished.
-Elimination of remaining United States' Capital Controls on foreign direct investment and repayments of outstanding foreign borrowings.

1979

October -Change in FRB's operating procedure, new emphasis on the supply of bank reserves and less emphasis on the Federal Funds rate in order to attain monetary aggregate objectives.

1984

June -Removal of 30 per cent withholding tax on interest earned by non-residents on certain investments in the United States.

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