THE NEW ZEALAND FOREIGN EXCHANGE MARKET: SOME EFFICIENCY ASPECTS

The relevance of two potential tests of efficiency, and the results of these tests in relation to the New Zealand foreign exchange market are examined in this article.

Summary

The question of the ‘efficiency’ of the foreign exchange market is addressed in this article. The issue is of interest because it involves examining whether the unfettered or ‘free’ foreign exchange market produces exchange rates which are appropriate or in some sense correct in relation to economic fundamentals. Broadly speaking, markets are ‘efficient’ if they naturally and rapidly produce such prices; more strictly, markets are efficient if prices are set as part of a process which takes profitable account of all available information in a way which avoids systematic departures from economically correct prices.

There are many studies of whether markets are efficient. Developments in New Zealand’s foreign exchange market since the float in March 1985 allow a preliminary examination of the efficiency of that market. The particular interest in the foreign exchange market relates, of course, to the fact that the rationale for a freely floating currency rests heavily on the idea that the unfettered market will on average produce more appropriate (in an economic sense) exchange rates than a market managed by government officials.

Unfortunately, a prerequisite for a complete examination of the issue is a full understanding of what are ‘correct’ exchange rates (in terms of economic fundamentals) in each circumstance. Such knowledge would allow a comparison of actual exchange rates with the correct ones. Given that such knowledge is not in fact available, all that one can do is to see whether the market complies with more limited notions of how an efficient market should behave.

Two such notions are addressed in the main article. One is that similar financial instruments in different countries should yield the same rates of return after riskless currency exchange is taken into account. Riskless currency exchange is achieved by using the current-day (or ‘spot’) and the forward foreign exchange markets simultaneously. A purchase of US dollars for investment in a one year US financial asset is thus made basically riskless in NZ dollar terms by the simultaneous forward sale of US dollars (i.e. purchase of NZ dollars) at the going one-year-forward exchange rate.

The first notion dealt with ‘covered interest parity’ — that is, interest equality after exchange risks have been covered. The second notion, ‘uncovered interest parity’, involves the idea that the forward exchange rate is an unbiased predictor of the relevant future spot exchange rate. If forward rates are not unbiased predictors of future spot rates, then, even if covered interest parity holds, similar assets in different countries might not on average yield the same return after currency exchange is taken into account.

Whereas the evidence from the New Zealand foreign exchange market suggests that the first notion (covered interest parity) is indeed borne out, the evidence suggests that uncovered interest parity does not hold. That is not to say that the New Zealand foreign exchange market is not efficient, as there are many valid reasons why the evidence should not bear out the simple version of the test used. Nor does the result say anything directly about the usefulness of a floating currency regime, since these tests are equally applicable to a fixed exchange rate regime, and many things other than efficiency in the narrow sense examined here are relevant to determining whether freely floating exchange rates are on average more appropriate than fixed exchange rates. However, the results do suggest the need to avoid making extravagant claims about the nature of the market process.

Introduction

This article uses information from the New Zealand foreign exchange market since the March 1985 float to assess the question of the efficiency of that market. The issue of efficiency is important because prices (exchange rates in this case) determined in an efficient market are more likely to reflect underlying economic forces than those set in markets which do not use profitably all the information available. Prices which reflect economic fundamentals are in turn prices which transmit appropriate signals to other sectors of the economy, thereby leading to optimal use of the nation’s resources.

However, it is not possible to assess comprehensively the actual efficiency of the foreign exchange market, since that process would require complete knowledge of exchange rate determination. In the absence of such knowledge, implicit but partial tests of efficiency are provided by two hypotheses concerning the relationship between exchange rates and interest rates likely to be observed in an efficient market.

The article is set out as follows: the first section outlines the broad issues which underlie tests of foreign exchange market efficiency; section 2 outlines the two hypotheses (the covered and uncovered interest parity conditions), and then discusses the tests and their results; and the article concludes with a summary of the results and their implications.

Floating Exchange Rates and Efficiency

The move to adopt a floating exchange rate regime in New Zealand, while considered consistent with the overall thrust of other economic policies, was supported more generally by the view that the setting of exchange rates is a role best performed by the market. The rationale was that realistic or appropriate prices are best set in a
flexible, unfettered market, because that market can be expected to take profitable account of all information available, and build such information into prices. The availability of any unexploited profitable opportunities is supposed to motivate actions by market participants which will, in the process of generating profits, create the pressures necessary to shift prices in the right direction. In other words, supposedly, the market incorporates the incentives required for participant (including professional arbitragers and speculators, as well as traders) to behave in a way which produces economically appropriate prices. In contrast, while officials and politicians might have access to a considerable volume of relevant information, it is argued that administered or 'targeted' exchange rates are less likely to be economically appropriate because the incentives facing officials and politicians are not necessarily consistent with foreign exchange market equilibrium.

Exchange rates consistent with foreign exchange market equilibrium are, of course, of more general relevance to the performance of the economy. Importantly, exchange rates act as vital signals to international traders and their domestically oriented competitors. Freely determined exchange rates were thus expected to contribute strongly to achieving the best use of New Zealand’s resources. Over time, as domestic distortions and imbalances were resolved, appropriate price signals could be expected to ensure that the necessary economic adjustments occurred, thereby enabling the most efficient use of resources. Flexible exchange rates then, were seen as a means of underpinning other policies for structural adjustment and price stability, and of maintaining and promoting economic growth over the medium term.

However, much international debate has occurred recently on the merits and performance of the current system of freely floating rates, with two concerns in particular being expressed. First, exchange rates have exhibited a persistent, high degree of volatility. This volatility, it is argued, increases the risk or the uncertainty associated with international trade, and thus reduces economic welfare by reducing the volume of trade and by discouraging international investment. Secondly, real exchange rates (nominal exchange rates adjusted for inflation differentials) have shown extended periods of misalignment. This misalignment can imply substantial costs, through distortions engendered in the domestic economy in the allocation of resources and investment.

The latter concern is the more serious, with regard to the issues being addressed in this article, for two reasons. First, volatility is not necessarily a product of freely determined exchange rates; nor is it necessarily as damaging as is sometimes made out. For instance, although exchange rates have been volatile over the period since the major economies abandoned fixed parities, this has been true to an equal (if not greater) extent of other key asset prices. Exchange rate volatility in the short term might pose additional difficulties for traders, but the presence of forward markets and other institutions can provide the necessary mechanisms for covering or hedging risk. There has been little success in establishing any significant relationship between exchange rate volatility and the volume of international trade. More importantly, though, the sources of asset price volatility over the last five years or so worldwide, include major factors such as significant switches in economic policy which would also have generated difficulties under different exchange rate regimes.

Secondly, on the issue of misalignment, real exchange rates have indeed appeared to diverge substantially from their equilibrium rates, although assessing the net costs of this to the economy is not a straightforward exercise. Most fundamentally, if the misalignment represents underlying economic distortions, it does not necessarily follow that the economic costs would be any less under an alternative exchange rate regime — the domestic imbalance would be transmitted via some alternative channel such as the overall level of prices. Nevertheless, protracted misalignment of real exchange rates suggests that, at least on one level, unfettered foreign exchange markets do not in fact have the supposed strong tendency to produce economically optimal prices.

Overall, these concerns about the performance of free foreign exchange markets motivate a closer examination of the issues. Ideally, such an examination would start from an agreed theory on what determines exchange rates, thereby allowing the researcher to calculate economically appropriate exchange rates for each circumstance. However, exchange rates are at the nexus of a whole range of considerations. For instance, even if the appropriate medium term level of the exchange rate was known, in the short term there may be more than one appropriate adjustment path.

Similarly, equilibrium exchange rates are determined by the interaction of goods and asset markets. Exchange rates, thus, reflect both the relative prices of internationally traded goods and services, and the relative price of internationally substitutable financial assets. If flows in goods markets dominate exchange rate determination, then rates will adjust to equilibrate international demand for flows of national goods. Alternatively, exchange rates will adjust to equilibrate the markets for national assets, if the flows of assets across borders are more important in the determination of rates. Given the relative ease with which assets can move across borders (in the absence of restraining capital controls), exchange rates will tend to be dominated in the short term by asset flows, and will exhibit higher variability compared to a situation where flows of goods are the dominant force. A range of theoretical ‘models’ of exchange rate determination has been formulated to help account for, or explain, movements in floating exchange rates. With the increased importance of capital flows in the world economy since exchange controls have been unwound and fixed exchange rate
regimes abandoned, many of the more recent theoretical models have been asset models (in which exchange rates are seen as determined by asset flows and financial markets), with specific parity relationships between interest rates and exchange rates being key components of these models. There remains disagreement, however, on the usefulness or completeness of these models as explanations of how exchange markets work.

The lack of consensus on the level of equilibrium exchange rates, and on ways to assess it, has obvious implications for an attempt to assess the efficiency of foreign exchange markets. It means that a widely acceptable definition of foreign exchange market efficiency remains a matter for ongoing debate. Because of the complexity of taking account of distinctions between the short-term and medium-term, between real and nominal equilibrium rates, and between goods market and asset market equilibrium rates, empirical analyses of the question of foreign exchange market efficiency have tended to focus attention on testing specific aspects of foreign exchange market efficiency.

The concept of market efficiency employed is defined in a particular, technical sense in that market prices should fully reflect profitably available information. In this sense, competitive market prices are set efficiently if greater than normal profit opportunities are quickly eliminated via arbitrage or speculation. Testing this hypothesis requires no explicit assessment to be made of the implications of these prices for the rest of the economy. This is the approach taken in the remainder of this article, where two aspects of the above hypothesis about the behaviour of an efficient market are examined more closely.

The Covered Interest Parity Condition

Arbitrage in foreign exchange markets occurs when opportunities arise to exploit differences in the prices of essentially similar assets. For example, if it is possible to borrow US dollars, invest in NZ dollars, cover the resulting exchange risk (say by using the forward exchange market), and still generate a profit, arbitrage between the two currencies can be expected.

Diagram 1 illustrates such an investment scenario and explains what is meant by 'covered interest parity'. Within the diagram, the burgundy

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1 Arbitrage is to be distinguished from speculation. Unlike speculation, arbitrage involves buying and selling something which has an unwarranted price difference between different locations, markets, times, etc. Because a simultaneous buying and selling leg are involved, arbitrage does not involve taking a risk.
Box 1
CIP - Covered Interest Parity

The CIP relationship is depicted in equation (1) below:

\[ r_t - r_f = \ln(F_{t+1}) - \ln(S_t) \]  
\[ r_t - r_f = a + b \ln(F_{t+1}/S_t) + c \]  

Where \( r_t \) and \( r_f \) are the domestic and foreign rates of interest, \( F_{t+1} \) and \( S_t \) (both in natural logs) are the \( t+1 \) period ahead forward exchange rate formed at time \( t \) and the current spot rate at time \( t \). Under assumptions of perfect capital mobility and substitutability, negligible transaction costs, and the absence of other significant constraints on the availability of funds, CIP implies that there is no risk premium, that is, that the coefficient \( a \) equals zero, and the coefficient \( b \) equals one.

Tests for CIP with equation (1) were carried out using daily observations of interest rate differentials between New Zealand and US weekly and monthly deposit rates, for the period 3 January 1986 to 3 October 1986. The equation was estimated using two interest rate series for New Zealand weekly deposit rates (those quoted by one particular institution and a market average weekly deposit rate. The two series showed remarkably similar results when used as dependent variables in equation 1. The daily indicative forward rates of weekly and monthly maturities are those posted by the main foreign exchange dealers.

The tests have been carried out between NZ and US dollar denominated assets only because New Zealand data is not readily available for currencies other than the US dollar and also since a proportionately high volume of transactions (both spot and forward) is carried out in US dollars.

The results are:

**Weekly contracts**

\[ \ln(F_{t+1}) - \ln(S_t) = 0.0002 + 1.23(i^w - i^n) \]
\[ (2.566) \quad (26.762) \]
\[ R^2 (adj) = 79.3\% \quad F = 716.19 \quad DW = 1.293 \]

**Monthly contracts**

\[ \ln(F_{t+1}) - \ln(S_t) = 0.0004 + 1.04(i^w - i^n) \]
\[ (1.529) \quad (38.637) \]
\[ R^2 (adj) = 88.9\% \quad F = 1492 \quad DW = 1.467 \]

Where \( S_t \) = current spot exchange rates
\( F_{t+1} \) = \( t \) period ahead forward exchange rate at time \( t \)

N.B. 't' statistics are reported in brackets.

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Lines labelled US and NZ represent the two countries respectively; the bur- gundy lines labelled \( t \) and \( t \) represent points in time (i.e. now and some date in the future, say one year ahead), and the vertical burgundy lines represent dollar magnitudes in the respective countries. Solid black lines show exchanges of currency in the direction of the arrows, while dashed black lines show interest rate gains over time, in the respective currencies. The slopes of the black lines indicate rates of change in values over time.

An example of arbitrage refers to a decision choice facing investors at point A — i.e. a New Zealander at time \( t_0 \).

Investors could make an investment for a specific period in a New Zealand currency denominated asset yielding the going New Zealand interest rate — shown by the line AD. Alternatively, investors could exchange their New Zealand currency for US dollars (AB), make an investment in an equivalent asset (denominated in US dollars and yielding the going US interest rate (BC)) and simultaneously make the US dollar to NZ dollar exchange required, once the investment expired at time \( t_0 \), by selling US dollars (i.e. buying NZ dollars) forward (CD). Using the forward contract entered into at exactly the same time as transactions AB and BC are made, investors lock in the exchange rate CD and therefore know with certainty their overall rate of return ABCD.

Clearly, because the alternatives (AD and ABCD) are both known with certainty at the time of investment \( [t_0] \), if either of the options results in a higher D than the other, that option will be taken. Because a mass of investors would, in the absence of barriers preventing free action, all take advantage of any discrepancy between the overall rates of return (e.g. by borrowing in the country with the lower overall interest rate and investing in the other), pressures would be placed on the relevant interest rates and the exchange rates (both spot and forward). In principle, such arbitrage pressures should ensure that the lines ABCD and AD always meet at the same point D.

The covered interest parity test of whether the market is performing as expected is a test of whether the lines do indeed meet at the same D. The mathematical representation of this test is presented in the shaded box, along with the results for the NZ/US case over the period January 1986 — October 1986. These results are also shown graphically in figure 1.
Another way of explaining covered interest parity is by numerical example. With reference to Table 1, a New Zealand investor faces the choice of investing in a New Zealand asset yielding say 16 per cent, or a United States asset yielding say 6 per cent. To make the comparison, the investor must calculate the effect of exchanging NZ dollars for US dollars at the current spot exchange rate - and making the reverse exchange at the point of maturity of the investment. Using the forward exchange market, the investor can actually contract to make the latter exchange now, at a specified exchange rate - i.e. the investor need not wait and see what happens to the exchange rate in the future.

Whether the investor is better off choosing the United States investment rather than the New Zealand investment depends on how the numbers work out. In the examples shown, if the difference between the spot and forward exchange rate is not enough to offset the loss in interest rate from choosing the United States investment, the preferred option would be the New Zealand investment. At a forward rate of 0.5117 (US dollars per NZ dollars), the investor would break even. At this point the implied depreciation is the same as the interest rate gap. A more rapid depreciation, such as that implied by a forward rate of 0.5000, would make the United States investment the preferred choice.

Again, if a discrepancy exists, forces should be set up which put pressure on the relevant exchange rates and interest rates to bring them back into line so that covered interest parity (CIP) would be restored.

It follows that if the market is efficient, the prices of spot and forward foreign exchange, and domestic and foreign interest rates should be related in such a way that abnormal or excessive profits from arbitrage are quickly eliminated. This hypothesis, states that the discount or premium on a forward exchange contract (the difference between the current exchange rate and the forward rate) should be equal to the difference in interest rates between two comparable (in terms of maturity, risk, and so on) instruments denominated in different currencies. Under ideal 'textbook' circumstances, when there are no restraints at all on international movements of capital and when bonds are free of default risks both in the domestic market and abroad (meaning that bonds are perfect substitutes), there should be strong forces at work ensuring that CIP holds.

Since interest rate differentials cannot account for all the variation in forward discounts or premia, there is no reason to expect covered interest parity to hold exactly. Factors such as transaction costs, the responsiveness of demand and supply in securities and foreign exchange markets, the lags in executing arbitrage, balance sheet considerations, and capital controls in some overseas countries (which inhibit the free movement of capital across frontiers), make it more sensible to assess covered interest parity in relation to a band within which arbitraging transactions are not profitable. Expecting precise parity at all times is unrealistic. Tests of this proposition have been extensively researched and confirmed in overseas markets and while the analysis here has not accounted for these factors explicitly, the conclusions are consistent with the overseas evidence. There is strong evidence indicating that the New Zealand foreign exchange market is efficient in the technical sense outlined above.

Domestic interest rate differentials between New Zealand and US denominated assets, and the forward discount on the US/NZ exchange rate for weekly and monthly contracts are shown in figures 1 and 2. It is clear that there is a close correlation between the two variables, as the CIP hypothesis suggests. The regression results (given in the boxes) are strongly in favour of the market efficiency hypothesis, indicating that between 80 and 90 per cent (adjusted R^2) of the variation in forward discounts reflects changes in interest rate differentials. Statistical tests (t' tests) on the significance of the latter variables as explanatory variables of the former, as well as other tests (F tests) on the overall significance of that specification, are strongly in favour of the CIP hypothesis.

The Uncovered Interest Parity Condition

The second aspect of the hypothesis about the behaviour of prices in a competitive market addressed in this article concerns the linkage between spot and forward exchange rates. In contrast to a risk free form of investment such as covered interest arbitrage which uses the forward exchange market, a speculative position can be adopted in which the overall rate of return is dependant on the actual future movement in the spot rate. Clearly, such a position is inherently risky. An investor who adopts an exposed (i.e. not covered) position in foreign currency faces the risk of an adverse exchange rate movement when the position reaches maturity. The profits or losses from an uncovered net foreign currency position therefore depend on actual spot rates in the future.

Referring back to diagram 1, the foreign exchange transaction at time t (i.e. in the future) was conducted at
Figure 1
Weekly forward discount and interest rate differentials

Figure 2
Monthly forward discount and interest rate differentials
the current point in time using the forward market. If, however, investors expected spot exchange rates at the later time period \( (t_2) \) to be lower than the corresponding current forward rates, then they would be disadvantaged by locking their future earnings to current forward rates. Instead, investors may wish to take the risk by not taking out a forward exchange contract. Given the uncertainty associated with movements in exchange rates, expected overall returns cannot be guaranteed. It would depend crucially on what actual exchange rates turn out to be at time \( t_2 \). Referring to the example in table 2, if expectations turned out to be correct (that actual exchange rates a year later will be lower than a forward rate of 0.5117 which guarantees a return of 16 per cent), returns would be higher than they would have been with a forward contract. On the other hand, if expectations turn out to be wrong, returns would be less than

<table>
<thead>
<tr>
<th>NZ Interest Rate</th>
<th>US Interest Rate</th>
<th>NZ/US Exchange Rate at Time ( t_2 )</th>
<th>NZ Dollar Investment Return on US Uncovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>16%</td>
<td>6%</td>
<td>0.5600</td>
<td>0.5200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5117</td>
<td>0.5177</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5000</td>
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contrast, the latter is associated with an uncertain return; the incentive for investors to undertake such risks depends on their views concerning the accuracy of forward rates in estimating corresponding future spot rates. It is easy to see that if forward rates are indeed accurate predictors of future spot rates, then expected returns from both covered and uncovered investments are approximately equal. The numerical example in table 2 above presents a simple illustration of such a situation.

As explained in the case of covered
**Box 2**

**UIP - Uncovered Interest Parity**

The UIP relationship is depicted in equation (2) below:

\[ r_i - r_f = E \left[ \ln \left( \frac{S_{t+i}}{S_t} \right) \right] \]  

(2)

Combining (2) and (1) implies (2a):

\[ E \left[ \ln \left( \frac{S_{t+i}}{S_t} \right) \right] = \ln \left( F_{t+i} \right) - \ln \left( S_t \right) + \epsilon_{t+i} \]  

(2A)

\[ \ln \left( S_{t+i} \right) = a + b \ln \left( F_{t+i} \right) + \epsilon_{t+i} \]  

(2B)

For the UIP hypothesis to hold, more stringent conditions must be satisfied. In addition to the requirements of perfect capital mobility and substitutability as in tests for CIP, it is also assumed that traders' attitudes towards risks be characterised as 'risk neutral'. In such a world, speculation will ensure that the forward premium (or discount) on foreign exchange equates with the expected appreciation (or depreciation) of the foreign currency. UIP therefore requires both (1) and (2) to hold. The twin assumptions of market efficiency and risk neutrality are referred to in the economic literature as the joint hypothesis of speculative efficiency, implying that the forward rates themselves are the best predictors of future spot rates. UIP implies the following testable restrictions: \( a = 0 \), \( b = 1 \), and \( \epsilon_{t+i} \) (the forecast error) is, under rational expectations, assumed to be normally distributed with mean zero and uncorrelated with information available at the end of period \( t \). In an empirical sense, if the above restrictions cannot be rejected, then the market is considered efficient and the forward rate is an unbiased predictor of future spot rates. If the statistics do not support the existence of these relationships it can be interpreted to mean any one of the following:

(i) that the market is inefficient (in the abovementioned sense), and consistent profits can be made by exploiting the discrepancies between forward and future spot rates;

(ii) that agents are not risk neutral, and we cannot therefore expect UIP to hold exactly; or

(iii) that there are significant transaction costs or constraints on the availability of funds.

The tests for UIP were estimated using data from 12 April 1985 to 3 October 1986. Equation 2A was estimated using non-overlapping data (i.e. with the sampling period equalling the forecasting horizon) in order to get around possible serial correlation in the error terms. This leads to a substantial loss of observations, in view of the very short period since the NZ dollar was floated. The results are as follows:

**Weekly forecast**

\[ \ln \left( S_{t+i}/S_t \right) = -0.02 - 6.70 \ln \left( F_{t+i}/S_t \right) \]

\[ (-1.766) \]  

\[ R^2 \text{ (adj)} = 3.88\% \]  

\[ F = 3.906 \]  

\[ DW = 1.875 \]

**Monthly forecast**

\[ \ln \left( S_{t+i}/S_t \right) = -0.07 - 6.00 \ln \left( F_{t+i}/S_t \right) \]

\[ (-2.087) \]  

\[ R^2 \text{ (adj)} = 20.0\% \]  

\[ F = 5.256 \]  

\[ DW = 1.974 \]

where \( S_t \) = current spot exchange rates

\( F_{t+i} \) = \( i \) period ahead forward exchange rate at time \( t \)

N.B. 't' statistics are reported in brackets

Interest parity, there will be opportunities for arbitrage whenever forward rates are out of line with interest rate differentials. A forward rate of 0.5117 would cause investors to be indifferent as to whether to invest in New Zealand or United States denominated assets — either options both yielding a return of 16 per cent. But a return of 16 per cent will also result if the actual spot exchange rate in time \( t \) is exactly equal to 0.5117 in the absence of forward cover being taken. However, suppose in time \( t \), if the actual spot rate was 0.5200, then investors would have clearly been better off to have taken a forward contract at the forward rate of 0.5117 since exchanging their US dollar investment at the spot rate of 0.5200 yields a lower return (14.2 per cent). The reverse situation can also occur if spot rates in time \( t \) turn out to be 0.5000; a return of 18.7 per cent will be obtained which is higher than a certain 16 per cent with forward cover.

In an efficient market, speculation in forward foreign exchange should not return consistent profits. The hypothesis of uncovered interest parity (UIP) requires that forward exchange rates be, on average, 'unbiased' predictors of future spot rates. By 'unbiased' it is meant that forward exchange rates should not consistently either overpredict or underpredict future spot rates. For this to hold, the expected change in future spot rates should be a function of interest rate differentials. If this is the case, forward exchange rates, which are formed on the basis of the interest rate differential, and therefore fulfil a CIP efficiency criteria, will also remove the opportunity for abnormal profits through forward market speculation.

The approach in testing the UIP hypothesis thus centres on analysing the relationship between forward exchange rates and corresponding future spot exchange rates. The higher the discrepancy between the two
rates, the higher the potential profits or losses for the speculator. Figures 3 and 4 compare movements in the actual spot US/NZ exchange rate and corresponding forward exchange rates of one week (5 trading days) and one month (20 trading days) previously. As can be seen from both graphs, forward exchange rates show signs of systematic forecast errors. Such errors appear to occur:

— first, when actual spot rates are trending upwards (for instance, between June 1985 and the end of September 1985), forward exchange rates consistently underestimate the appreciation of the NZ dollar;
— secondly, during periods of exchange rate depreciation (for example between mid-April 1986 and early October 1986), forward exchange rates consistently underestimate the depreciation of the NZ dollar.

Again, to gain more insight into the relationship between forward and spot exchange rates, a mathematical representation of the test for unbiasedness, equation 2A (see the second shaded box), was estimated with simple regression techniques. The results generally confirmed that forward exchange rates are not accurate or unbiased predictors of future spot rates. Only a very low proportion of the rate of change in the actual spot rate is explained by corresponding forward discounts formed one week and one month in advance, and statistical ('t' and 'F') tests in the regression lead to a rejection of the UIP hypothesis.

Given that covered interest parity generally holds, but that future spot exchange rates can systematically deviate from the prediction of that rate contained in the corresponding forward exchange rate, it appears possible that investors could systematically profit by investing in New Zealand currency assets while the New Zealand exchange rate is tending to appreciate, and by investing in foreign currency assets while the exchange rate is tending to depreciate.

Such a result is suggestive that the foreign exchange market is not efficient. However, a number of possible explanations must first be taken into account.

1. The analysis underlying the test assumed that transaction costs are either negligible or negligibly different as between CIP arbitrage and UIP speculation. Similarly, the analysis assumed that domestic and foreign assets of the same maturity and riskiness are regarded as equally attractive by arbitragers and speculators, which may not be the case. Nevertheless, a departure from either of these assumptions would be more consistent with a relatively stable margin between arbitrage and speculative returns, rather than a margin which varies with the exchange rate trend as indicated by the evidence.

2. Secondly, the analysis was implicitly based on a world in which institutional constraints such as exposure limits placed on dealers for prudential reasons, or such things as liquidity constraints do not impact materially on the workings of the market. If in reality speculators reach constraints on how much risk they can take on, the failure of the market process to prevent the systematic existence of unexploited profit opportunities may simply reflect the fact that insufficient speculative pressure is being brought to bear. Nevertheless, the prolonged existence of such portfolio constraints in the face of unexploited opportunities remains suggestive of some inefficiencies.

3. Thirdly, it might be argued that the presence of risk could legitimately cause a systematic departure of returns from speculation relative to those from arbitrage. The uncertainty as to the overall rate of return involved in an uncovered position would be expected to motivate speculators to transact only when anticipated returns show a substantial gain to be made from adopting a risky position. On the other hand, two factors undermine this explanation. First, risk premia should in principle generate consistently higher returns from speculation, whereas the evidence shows higher returns to New Zealand speculators investing in foreign assets only when the exchange rate is tending to depreciate. Secondly, foreign exchange markets are two-sided. United States investors, for example, will be making the same rate of return calculations, and seeking a risk premium to cover any exposure to New Zealand currency risk. In principle the two sides of the market should tend to cancel out any secular effect of risk on rates of return from speculation via a risk rates of return from arbitrage.

4. Finally, even though consistent unexploited profit opportunities from speculation show up in the data, the data is being assessed in this article with the benefit of hindsight. For the UIP test result to indicate market inefficiency, it would have to be concluded that those unexploited profit opportunities were expected at the time and that nothing external to the market prevented exploitation of the opportunity. Examination of figures 3 and 4 suggests that prevailing forward exchange rates tend to maintain a reasonably stable margin relative to prevailing spot rates, that margin reflecting, for example, interest rate differentials. If the spot rate moves up or down as a result of, say, new information becoming available to the market, it appears that the forward rates move sympathetically. In effect, the market seems typically to expect that the new circumstances revealed by the new information remain relevant for the period covered by the forward contract (i.e. one week and one month in figures 3 and 4). Such behaviour may be entirely consistent with the efficient incorpora-
tion of new information into market prices.

Further it is likely that good news at the start of a newly emerging trend will be followed by further good news, and vice versa for bad news. Unless markets fully anticipate as-yet-unannounced further information which supports the new trend, markets will tend to be 'surprised' in the same direction by a run of new information. The UIP result, therefore, may simply be a product of the natural tendency of economic conditions to go through cycles, instead of being evidence of market inefficiency.

Conclusion

Preliminary tests of efficiency in the New Zealand foreign exchange market indicate that profitable covered interest arbitraging opportunities are on average limited, with forward discounts closely reflecting the interest rate differentials between United States and New Zealand money markets. However, there is also evidence that these discounts may not fulfill a second efficiency requirement — that of limiting the opportunities for abnormal profits through exchange rate speculation.

Forward exchange rates appear to consistently underpredict or overpredict future spot rates, hence opening up opportunities for profitable speculation. It is not entirely clear, though, that the reason for such a result is market inefficiency. Instead the evidence may be consistent with normal cyclical factors at work in economic conditions.

The analysis in this article takes a relatively narrow view of foreign exchange market efficiency and, although the failure of the statistical test for uncovered interest parity may leave some unanswered questions about the efficiency of the New Zealand foreign exchange market, the same result also appears to be the case for the major foreign exchange markets of the world. It must be noted that the exchange rate is subject to a broad range of influencing factors — of which interest rates are only one. One conclusion which can be drawn is that New Zealand exchange rate movements cannot be associated in any simple way with movements in interest rates — or other asset, factor or product prices. In a newly deregulated environment, with a rapidly-paced process of structural change underway, stable relationships between underlying economic variables can be even more difficult to detect. The New Zealand foreign exchange market itself has changed significantly in size and structure in recent years, further complicating the analysis.

The process of testing the efficiency of the foreign exchange market — of assessing how well it responds to and reflects underlying factors — involves more than merely testing simple relationships between a small number of variables. As a broader range of tests is made feasible by greater data availability, these questions may be examined in greater depth. Tentative findings from the line of inquiry adopted in this paper suggest that more work has to be done. In particular, an attempt to pinpoint the exact nature of the failure of the UIP hypothesis will be an appropriate further stage of study.