What do forward interest and exchange rates tell us?

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In the world of politics, everyone has their own opinion. But if we want to know who is expected to win the next election, we need to know what the population as a whole thinks (one source of such information is the political polls). The same situation applies to the financial world. Most participants, including central banks, are interested in knowing what the market as a whole is thinking. Are interest rates and the exchange rate expected to rise or fall over the next year? How much are they expected to rise or fall by? One popular theory is that forward rates (which are today's prices for transactions that will take place in the future) also represent the average of the actual price that is expected to prevail on that future date. This poses some interesting questions: do these forward rates really reflect what the market expects to happen in the future? Just how good are these forward rates at predicting where the actual rate will be in the future?

This article looks at how one month forward rates for 90 day bank bill interest rates, the $NZ/$US exchange rate, the trade-weighted index (TWI) and the monetary conditions index (MCI) have behaved over the period between January 1989 and March 1998.[1] The results suggest that, for a one month horizon:

- forward rates tell us very little about where the **actual** rate will be. This result is not too surprising and reflects the fact that financial market prices can be volatile and hence difficult to predict, particularly over the short term;

- forward rates have persistently under-estimated actual changes in future market prices in a way that has been linked to the cycles in those prices. Perhaps part of the explanation for this pattern is that both central banks and the financial markets have persistently under-estimated changes in inflation, as they have sought to learn about the process that drives inflation;

- forward **interest rates** and forward MCIs reasonably reflect what the market **expects** to happen;

- forward **exchange rates**, however, do not look like average market expectations. Over the past nine years, forward exchange rates have nearly always priced in a depreciation of the future exchange rate.

1 Introduction

The relationship between forward rates (today's prices for future transactions) and spot rates (today's prices for today's transactions[2]) has been one of the most widely studied topics in the economic literature in the last 20 to 30 years. This article examines this relationship in a New Zealand context, and seeks to uncover what information forward rates provide, as well as gain some insights into financial market behaviour. Section 2 explains what forward rates are, what they are used for, and who typically uses them. Section 3 presents a theoretical framework for thinking about how forward rates are

[1] The TWI is a weighted average of the exchange rates of New Zealand's five largest trading partners. Currently, these are the United States, Australia, Japan, United Kingdom, and Germany. The MCI is an approximate summary measure of the overall level of New Zealand monetary conditions. Specifically, the MCI is a weighted combination of 90 day interest rates and the TWI. The December quarter 1996 average value equals 1000.

[2] This is a convenient shorthand. More precisely, **spot foreign exchange** transactions are actually those agreed today for settlement in two day's time. For example, Monday's **spot foreign exchange** transactions are not settled until Wednesday. Other conventions apply in the bond and money markets.

determined. Section 4 addresses the questions: how well do forward rates predict the future? Are there systematic patterns in the differences between forward rates and the future spot rates that actually prevail? Do forward rates reflect market expectations? Section 5 concludes.

2 What are forward rates and why are we interested in them?

A forward contract is an agreement between two parties today to buy or sell something at a particular date in the future, but where the transaction price is agreed today. The forward contract price is known as the forward rate. Banks will typically offer these forward products to their clients. For example, a one month $NZ/$US forward exchange rate of 0.5000 means that, in a month's time, a customer can exchange a given amount of NZ dollars for US dollars, or vice-versa, using an exchange rate of 0.5000, regardless of what the actual exchange rate is in a month's time, ie the future spot rate.[3] Similarly, a forward interest rate is the rate at which a customer can borrow or lend funds at a particular date in the future, but where the rate is agreed today. Hence, a one month forward 90-day interest rate of 8 percent means that, in a month's time, a customer can borrow or lend a given amount of NZ dollars for 90 days, at an interest rate of 8 percent.

The forward market allows investors, firms, and individuals to avoid the uncertainty associated with changes in financial market prices. For example, the forward exchange rate market provides a way for exporters and importers to protect themselves against exchange rate risk. If an exporter sold goods today knowing that they would be receiving $US1 million from the sale in one month's time, there are two ways to go about exchanging those US dollars into NZ dollars. They could do nothing and wait a month, receive the $US1 million and exchange it for NZ dollars at whatever the spot exchange rate was on that day (ie the future spot rate). The exchange rate may move in their favour, but it might move against them. Because exchange rates are quite volatile, maintaining an 'open position' involves a decision to take a significant amount of exchange rate risk. Alternatively, the exporter could get rid of this exchange rate risk by entering into a forward contract today (at a forward rate of 0.5000 for example). By 'covering' the risk, the New Zealand exporter would know today that $US1 million of export receipts would be converted into NZ dollars in a month's time at an exchange rate of $NZ1 = $US0.5000, giving them $NZ2 million, regardless of what the actual spot exchange rate was in a month's time.

Likewise, the forward interest rate market allows investors and firms to hedge themselves against interest rate risk. A firm, for example, may need to finance an investment project in a month's time. By taking out a forward interest rate contract, that firm knows today the cost of that borrowing, regardless of what happens to interest rates over the next month. Householders who have taken out a fixed rate mortgage in the last few years, in preference to the traditional variable rate mortgage, have also, in effect, been tapping into the forward interest rate market. In effect, they have been **buying insurance** against future movements in variable rates over the course of the fixed-term loan.

What about the forward TWI and forward MCI? These products are simply combinations of products which are themselves already traded. They can also be traded and/or used for hedging purposes. However, very few firms or individuals are directly exposed to movements in the TWI and MCI, so these particular products are not widely used for hedging underlying financial exposures. Instead, they mostly offer a way for market participants – such as large investment funds – to apply their expertise and take a financial position on the future stance of monetary policy. Take for example, a forward MCI trade. This is simply a combination of a forward 90-day rate transaction and a forward TWI

[3] Forward contract terms other than one month are widely available, ranging from one day forward to several years forward.

transaction. As an example, a one month forward 90-day rate of 8.5 percent, and a one month forward TWI of 58.5, produces a forward MCI of 274. If an investor's opinion was that monetary policy would be tightened and that the MCI would be much higher in a month's time, say at 400, then they could back that opinion by buying the one month forward MCI. This would mean that in a month's time, they would buy the MCI at a price of 274. If the actual MCI is higher on the day, they would sell back the MCI at the higher price and make a profit. Of course, the actual MCI could turn out to be lower than the price paid (274), in which case they would lose money. That uncertainty/risk is the nature of taking 'open' or speculative positions.

Financial market participants are interested in forward rates for a number of reasons: banks are in the business of providing forward products to their customers, and can use forward products to hedge their own resulting risk. In addition, forward rates present trading and speculative opportunities for banks and other market participants.

What about central banks? The setting of monetary policy – and expectations about that policy – can have a profound effect on financial markets. Central banks around the world are putting increasing emphasis on understanding what the market as a whole expects them to do. By doing so, they can better assess the likely effect of their actions on market behaviour, and see if financial market prices provide any possible information as to what monetary policy should be. While it is near-impossible to observe market expectations directly, forward rates may offer a reasonable alternative.

3 How are forward rates determined?

Like other financial market prices, forward rates are traded and determined through a competitive process. To understand how forward rates are determined, and the link to spot rates, there are two types of transactions to consider: **arbitrage** and **speculation**. Arbitrage is **riskless**, and it involves the near-instantaneous buying and selling of the same underlying asset to exploit any significant price differences. People who undertake arbitrage have no open position. Speculation, on the other hand, is inherently **risky**: it involves people taking an open position based on their opinion of where market prices will be in the future. Both are vital to the smooth functioning of financial markets. Arbitrage ensures that there are no 'loopholes' in market prices, as the price of the same asset should be roughly the same across all markets. Speculation helps shape market prices so that they should reflect the economic environment. Some well-established theories serve as a guide to what we expect to see.

One widely used theory is that forward rates should represent what the market **expects** the actual rate will be in the future – that is, its expectation of the future spot rate. To see how this works, first consider the interest rate market.

Arbitrage and forward interest rates

Arbitrage ensures that today's one year interest rate equals today's six month rate plus the six month forward six month interest rate. (No, this is not a typing mistake, but the correct market terminology. We will use the less cumbersome term and call it the six month forward interest rate from here on). Now, suppose someone wanted to borrow for one year. There are two ways to go about this. They can choose to pay a fixed rate for the whole period, ie the current one year interest rate. Alternatively, they can borrow at the current six month rate and enter into a six month forward interest rate contract at the same time to 'lock in' the interest rate cost for the second six month period. Suppose the current one year rate was 9 percent, and the current six month rate was 8 percent. People will be indifferent between the two options when the six month forward interest rate is 10 percent. In that case, the average rate of interest for that year is the same no matter which method is chosen. To see this, the average rate of interest that someone would pay

under the second method is: (6/12 x 8%)+(6/12 x 10%) = 9% , the same as today's one year rate. If, in the preceding example, however, the six month forward interest rate was not 10 percent but, say, 9 percent, then the average of the six month spot rate and the six month forward interest rate would be 8.5 percent. This would open up an arbitrage opportunity for people to borrow money for one year at the lower rate of 8.5 percent, and simultaneously lend that money at the higher one year fixed rate of 9 percent. The riskless return from this strategy would be the difference between the two rates (0.5 percent). However, this opportunity would not exist for long, as the competitive market process would very quickly re-align the prices.

Expectations – the link between today's forward interest rate and the future spot interest rate

In the above example, the forward interest rate was given. But what determines forward interest rates? Many people believe that market expectations are an important factor. More specifically, the **expectations hypothesis** serves as a guide. It says that forward interest rates reflect what the market, on average, **expect** interest rates to be in the future. So, in the example above, a six month forward rate of 10 percent implies – according to this hypothesis – that the market, on average, expects six month interest rates to be at 10 percent in six month's time (perhaps reflecting an expected tightening in monetary policy). To further illustrate, suppose market expectations suddenly changed and interest rates are now expected to remain at 8 percent in six month's time (say, monetary policy is now expected to remain unchanged over the period ahead). Investors would now **expect** to earn a higher return by putting their money in a one year term deposit at 9 percent. Similarly, people could **expect** to get a cheaper loan by borrowing at today's six month rate, and then rolling-over that loan in six months time. Hence, the current one year interest rate of 9 percent should attract more lenders than borrowers. This pushes down the one year rate until the expected return and expected cost are equalised at 8 percent. This then produces a six month forward rate of 8 percent, **which is equal to where the market, on average, expects interest rates to be in six month's time.**[4]

Risk considerations may be relevant for these choices, particularly as the time horizon increases. The strategy of rolling over short-term loans is risky because peoples' expectations may turn out to be wrong and interest rates may move against them. Borrowers may prefer the certainty provided by entering into a forward contract, ie borrowing for a longer-term at a fixed rate, and be willing to pay a price for the certainty. If there is a risk premium, (ie a price for obtaining certainty) then forward rates would no longer reflect average market expectations. These risk considerations will be discussed more fully in section 4.

With regard to exchange rates, there are also two relationships to consider, which parallel the relationships in the interest rate market. One is the so-called 'no-arbitrage condition', and the other is a hypothesis about the determination of forward exchange rates.

Arbitrage and forward exchange rates

The no-arbitrage condition is known as **covered interest parity** (CIP). Consider sUS investors, who are faced with the choice of leaving their money in the US, or investing overseas in, say, New Zealand. Suppose New Zealand interest rates were 5 percentage points higher than US interest rates. Investors realise that by putting their money in New Zealand, they expose themselves to exchange rate risk – their actual total returns will depend on movements in the $NZ/$US exchange rate. However, they can get rid of this risk by entering into a forward exchange rate contract. Having done so, would they still invest in New Zealand? Well, CIP says that the total returns under both alternatives should be the same. This means that the forward exchange rate should price in a 5

[4] Think about the current situation where variable mortgage rates are higher than fixed mortgage rates. If forward interest rates do reflect market expectations, then this is saying that variable mortgage rates are expected to fall over the period ahead.

percent depreciation of the NZ dollar relative to the US dollar to offset the interest rate gain. In other words, what they gain on the interest rate side, they should lose on the exchange rate side. If not, there would be riskless arbitrage opportunities to earn very high returns.

$$\text{CIP}: \quad r_t^{US} - r_t^{NZ} = f_t - s_t$$

Today's difference between US and NZ interest rates for, say, one month	=	The percentage difference between today's \$NZ/\$US forward rate (f_t) and today's \$NZ/\$US spot rate (s_t) over the next month

To illustrate, suppose the one year forward \$NZ/\$US exchange rate was only pricing in a 2 percent NZ dollar depreciation. People could then invest in New Zealand (buy a New Zealand bond with NZ dollars) and 'lock in' or guarantee the returns by entering into a forward exchange rate contract to exchange those NZ dollars into US dollars in a year's time. These people would then earn a riskless 3 percent **excess** return, as the 5 percent interest rate gain would not be fully offset by the 2 percent exchange rate loss. Again, these situations could not exist for long because riskless opportunities are generally exploited. There would be a flood of foreign capital wanting to invest in New Zealand without taking any exchange rate risk. As this happens, New Zealand interest rates would fall until the interest differential was reduced to 2 percent, at which point the riskless arbitrage opportunity would vanish. **CIP means that interest rate differentials are almost always a very good guide to where forward exchange rates are in the market.**

Expectations – the link between today's forward exchange rate and the future spot exchange rate

Uncovered interest parity (UIP) is the exchange rate equivalent of the expectations hypothesis for interest rates. UIP is a hypothesis as to how interest rate differentials (and hence, forward exchange rates) are related to expectations about the future path of the exchange rate. It says that any difference in the interest rates between two countries is associated with a market expectation that the currency of the higher interest rate country will depreciate against the currency of the lower interest rate country to the extent of the interest differential. So if New Zealand's interest rate is 5 percent higher than the US interest rate, then the market must expect a 5 percent NZ dollar depreciation against the US dollar. UIP, in effect, is saying the **expected** returns on similar assets should be roughly the same, regardless of which currency they are denominated in, even if the foreign exchange rate risk has not been covered using a forward contract.[5]

$$\text{UIP}: \quad r_t^{US} - r_t^{NZ} = E_t s_{t+1} - s_t$$

Today's difference between US and NZ interest rates for, say, one month	=	The percentage difference between today's \$NZ/\$US forward rate ($E_t s_{t+1}$) and today's \$NZ/\$US spot rate (s_t) over the next month

If this were not the case, so the hypothesis goes, people could expect to make a lot of money by speculating on interest rate differentials. For example, suppose NZ interest rates were 5 percent higher than US rates, and the market was expecting a 5 percent NZ dollar depreciation. Then expectations suddenly change and the NZ dollar is expected to depreciate by only 2 percent. Investing in New Zealand would now result in an expected 3 percent excess return. In principle, people would move into New Zealand assets pushing interest rates down until that differential was reduced to 2 percent, at which point investors would be indifferent between investing here or in the US. **Hence, the implied depreciation priced in by the forward rate (as per CIP) should be equal to the market's expectation of the future path of the exchange rate**.

[5] CIP, on the other hand, is saying that if a forward contract has been used to eliminate the exchange rate risk, the returns should be the same regardless of currency denomination.

However, the potential returns from taking advantage of interest rate differentials are inherently risky, because to do so, an investor maintains an open (ie uncovered) exchange rate position. For US investors considering investing in New Zealand, CIP tells us that 'covering' the exchange rate risk, via a forward contract, eliminates the opportunities for excess returns. If the exchange rate risk is not covered, then any excess returns that might seem to be available from higher New Zealand interest rates comes at a price in terms of exposure to risk. The actual returns will depend on the actual future movement in the spot $NZ/$US exchange rate. If, in the above example, the NZ dollar fell by 10 percent, having been expected to fall by only 2 percent, then a US-based investor would have lost money. If the NZ dollar ended up rising by 5 percent, then the investor would have made 10 percent.

It is also important to note that the determination of interest rates and exchange rates is a simultaneous process. Because interest rates are directly observable and exchange rate expectations are not, UIP is often thought of as a hypothesis about exchange rate expectations. It would be equally valid to think of it as a theory of interest rate determination. That is, the expected exchange rate change between two currencies should be reflected in a corresponding interest rate differential between those two countries.

4 What does the evidence show?

The relationship between spot rates and forward rates (in particular, for exchange rates) has been one of the most widely studied topics in the economic literature in recent decades, as people have sought to understand how the world works under floating exchange rates. These studies have sought to test how efficient financial markets are – whether they offer consistent opportunities for investors to make above-normal returns. Typical tests have been whether forward rates have, on average over time, equalled the spot rates at the future dates to which the forward rates related – that is, whether forward rates provided unbiased predictions of future spot rates.

Despite many formal studies, these questions – particularly the unbiasedness hypothesis of forward rates – remains largely unresolved.[6] The limited number of studies on New Zealand's financial markets have produced somewhat mixed results as well.[7] Given how volatile financial market prices can be, it can often be difficult to determine the answers to these questions using formal statistical techniques.[8]

The analysis in this article takes a rather less ambitious approach. It asks the questions: how well do forward rates predict future spot rates? Are there any systematic patterns in the differences between forward rates and future spot rates? Do forward rates reflect market expectations? One month forward rates for 90-day rates, the $NZ/$US exchange rate, the TWI, and the MCI are examined over the period January 1989 to March 1998. The period prior to 1989 was one of greater volatility, and as such, was unlikely to give too much insight into forward rate behaviour today. It would be even more interesting to study longer term forward rates, say, one to two years ahead, but one month-

[6] Early studies supported the notion that forward rates were unbiased predictors of future spot rates (Levich (1979) and Frenkel (1981)). Prominent studies during the 1980s resoundingly rejected the unbiasedness proposition (See Froot and Thaler (1990) for a review). More recent studies, which have used more powerful statistical procedures, have been supportive of unbiasedness (Naka and Whitney (1995), Phillips et al (1994)).

[7] Results by the Reserve Bank of New Zealand (1987), Gibbs, Grimes and Harrison (1990), Margaritis and Teo (1991), and Rae (1997) found that forward rates were biased predictors of future spot exchange rates. Krippner's (1997) study found that interest rate futures were unbiased predictors of future 90-day interest rates.

[8] In formal studies, the null hypothesis is that forward rates are unbiased, and the test is whether there is sufficient evidence to reject this proposition. The truth can be quite difficult to uncover if there is a lot of volatility. Not rejecting the null hypothesis statistically is not the same thing as accepting the economic proposition that forward rates are unbiased predictors of future spot rates. The nature of the difficulty is like trying to hear the phone ring in the middle of a rock concert. Because there is so much noise, there may be no easy way to conclude that the phone is not ringing, but that does not necessarily mean that the phone is ringing.

Table 1:
The difference between the forward rate and the actual future spot rate – the 'forecast error'

	90 day rate (basis points)	$NZ/$US (%)	TWI (%)	MCI (basis points)
Average (absolute) difference[11]	37	1.4	1.2	61
Standard deviation	50	1.9	1.5	82
Smallest difference	0	0	0	1
Largest difference	153	6.8	4.8	261
Picking the direction	56%	49%	44%	57%
Explanatory power[12]	0.7%	0.9%	0.8%	6%

ahead rates are more practical to study as they allow us to use more data.[9]

How well do today's forward rates predict future spot rates?[10]

The answer is: not very well. Table 1 presents summary statistics for the difference between today's forward rate and the actual future spot rate. This difference can be thought of as a 'forecast error' if forward rates really do represent market expectations of future spot rates, and are defined as the actual spot rate minus last month's forward rate. In theory, January's forward rate should be a prediction of the spot rate in February. Hence, the actual spot rate in February minus the forward rate back in January can be thought of as the forward rate 'forecast error' for January.

Basically, forward rates are not very accurate at predicting the future **level** spot rates – whether or not they are unbiased. For example, it took a range of +/- 100 basis points to encompass around 95 percent of all forward 90-day interest rate 'forecast errors', and the average size of the of the monthly 'forecast errors' was 37 basis points.[13]

This inaccuracy is not too surprising. Financial market prices are volatile and therefore difficult to predict. To put this into perspective, the nature of the difficulty is similar to a getting a panel of rugby experts together to pick the winner *and* exact winning margin of a Super 12 rugby match – something that is unlikely to be done with great success.

A less stringent measure of accuracy is to see how well forward rates picked whether spot rates would go up or down, rather than picking both the direction and by how much. Using the rugby analogy, the experts need only pick the winner, as opposed to the winner and the winning margin. Forward rates do not do this too well either. Statistical tests showed that, in all cases, the directional accuracy was not significantly different from 50 percent accuracy. This means that, on average, in picking whether rates would go up or down over the next month, we could have done just as well as the

[9] To illustrate, with nine years of data, trying to look at two year-ahead expectations gives us only four independent observations.

[10] A non-overlapping data set was used. Observations for each month were taken as the last Wednesday of that month. The one month forward rates were then matched up to the spot rate on the last Wednesday of the following month. This should ensure that all observations are independent of each other so any 'forecast error' in January, will not carry through into the 'forecast error' in February, and so on.

[11] This ignores whether the difference is positive or negative. Hence, this gives us an idea of the average size of the forecast errors.

[12] The explanatory power is determined from a regression in which we try to explain the actual monthly changes in spot rates from the expected changes in spot rates implied by last month's forward rates (the R^2).

[13] +/-100 basis points equates to +/-2 standard deviations, assuming that the forecast errors are normally distributed. One basis point is defined as one hundredth of a percent. So, 1 basis point equals 0.01 percent, and 100 basis points equals 1 percent.

so-called experts (the forward rates) by flipping a coin.

Forward rates also explain only a very small portion of the **actual changes** in spot rates (less than 6 percent, and in most cases less than 1 percent - see the explanatory power row in table 1). In other words, the bulk of actual changes in spot rates are caused by information not embodied in forward market prices at the time the forward rates were determined. This raises the question: to what extent was this information 'not known', as distinct from being 'not reflected' in forward rates. In other words, did forward rates get it wrong because the market failed to take into account relevant information at the time, or because events unfolded in a way in which it genuinely could not have predicted?[14] As an analogy, consider the last two Rugby World Cups. Those who predicted that the All Blacks would win in 1991, **could have realised** that the they were a team in decline, and that the Australians were the in-form team. However, those who predicted that the All Blacks would win in 1995, **could not have known** that the team was to suffer a mysterious bout of illness before the final!

To put everything into perspective, the above results are not too surprising given that we are dealing with a reasonably short horizon. Numerous studies have documented the fact that economic fundamentals exert themselves more strongly over the longer-term.[15] That is, what should happen according to theory, does tend to happen, but it takes time. The short-term, however, is characterised by a lot of 'noise' and hence, volatility. Returning to the rugby example, it is probably easier to pick the winner of the entire Super 12 tournament than trying to pick the winner of every single game.

The very fact that future spot rates are difficult to predict explains the value and popularity of forward contracts – they offer certainty in an uncertain world. The paradox is that if forward rates were good at predicting future spot rates – so that markets knew where spot rates would be in the future – there would be little demand for forward products. To shift analogies, if people knew that their own car would never be stolen, then there would be no need to buy insurance!

All in all, there is no point in looking at forward rates to know what **will** happen, but central bankers are still interested in whether forward rates reflect market expectations, and if so, whether they appear to make persistent mistakes.

Are there systematic patterns in the forward rate 'forecast errors'?

Figures 1 to 4 plot the actual future spot rates and today's forward rates (ie the prediction of the actual spot rates) against the 12 month moving average of the forward rate 'forecast errors'.[16] One noticeable feature is that spot rates themselves seem to trend, and that forward rates have made 'forecasting errors' which appear to be systematically linked to the cyclical pattern in market prices. That is, when actual spot rates were trending upwards, forward rates seem to have persistently under-estimated the extent to which spot rates would rise, resulting in positive 'forecast errors'. Similarly, when spot rates were in a downtrend, forward rates seem to have systematically under-estimated the extent of the fall, resulting in negative 'forecast errors'. In other words, forward rates tended to under-estimate the actual **changes** in future market prices in a systematic way.

While this feature is puzzling, it is not unique to New Zealand. This systematic pattern suggests that one could have made better forecasts of future spot rates by examining past forward rate forecast errors, rather than just ignoring

[14] While this is an interesting question, there is no easy way to answer it.

[15] In some respects, this is why studying longer-term forward rates would be more interesting and enlightening.

[16] Plotting the individual errors could look random, especially if there was a lot of volatility (as is the case in all these series). The moving average approach is another way of seeing if there is anything behind the noise.

Figure 1:
Today's forward 90 day rate, the actual future spot 90 day rate, and the difference between the two (the future spot rate less today's forward rate)

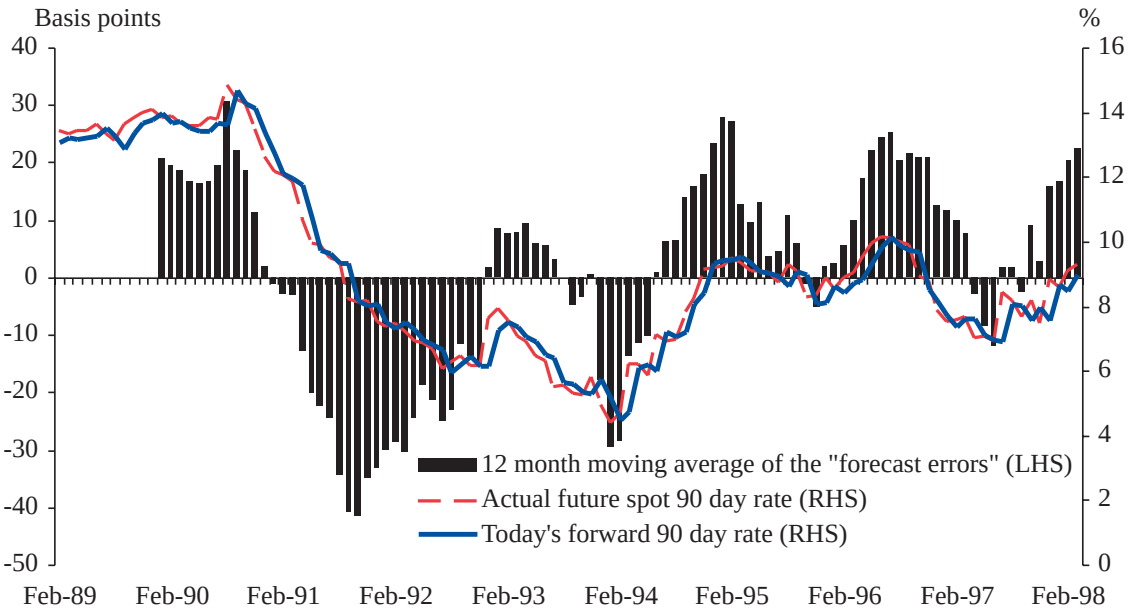


Figure 2:
Today's forward $NZ/$US exchange rate, the actual future spot $NZ/$US exchange rate and the difference between the two (the future spot rate less today's forward rate)

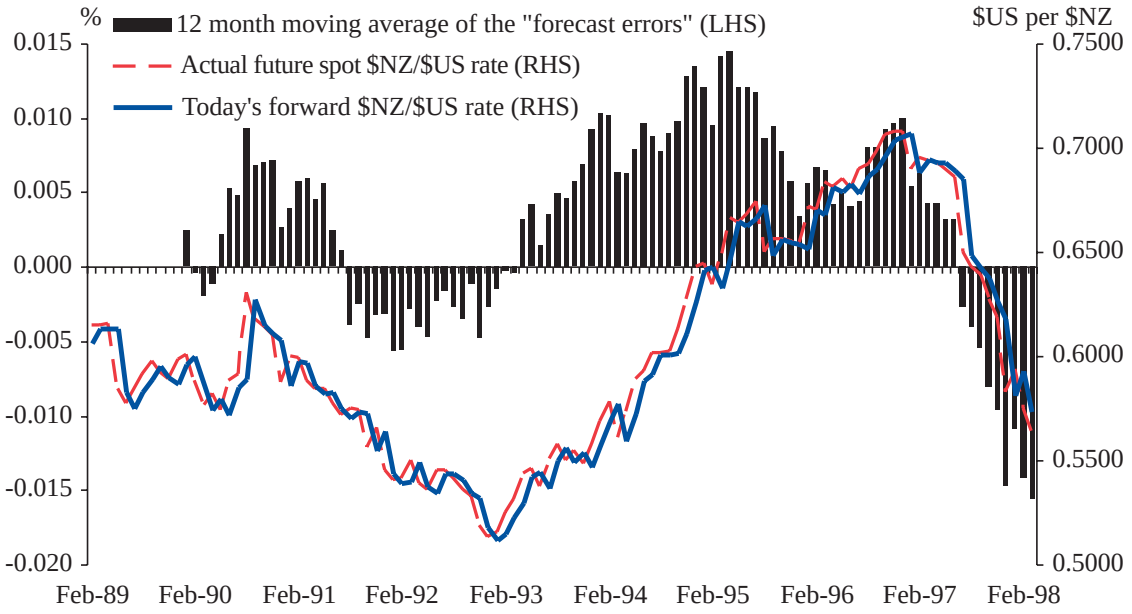


Figure 3:
Today's forward TWI, the actual future spot TWI, and the difference between the two (the future spot rate less today's forward rate)

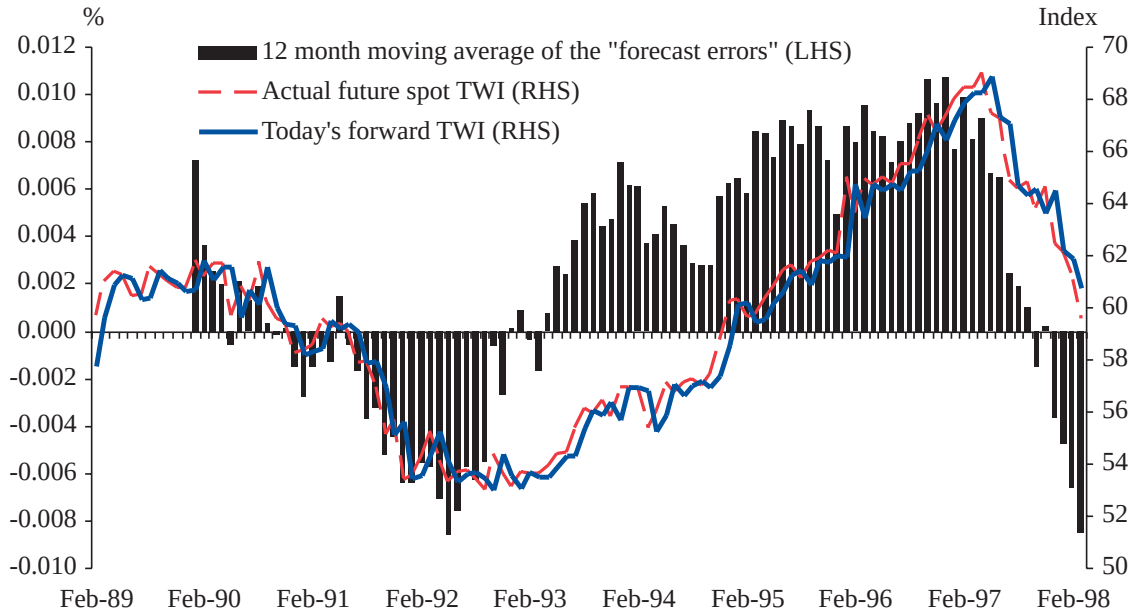
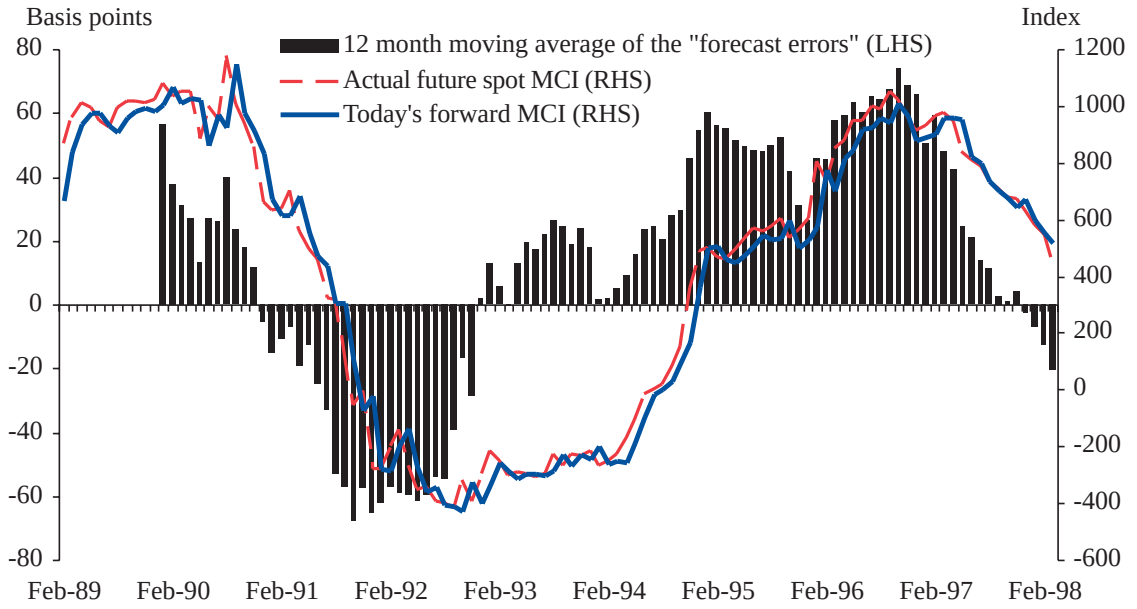


Figure 4:
Today's forward MCI, the actual future spot MCI, and the difference between the two (the future spot rate less today's forward rate)



them. This behaviour also suggests that investors could have made excess returns on a consistent basis over the past nine years by using simple 'trading rules' that exploited the trends. For example, when the NZ dollar was appreciating against the US dollar over January 1993 to October 1996, the $NZ/$US forward rate persistently understated the extent of the rise. So a profitable strategy would have been to buy forward contracts on the NZ dollar, as the actual future spot $NZ/$US exchange rate would have been persistently higher than the forward exchange rate. Hence, at the maturity of the forward contract, the NZ dollars would have been bought at the forward rate, and could have been sold at the higher spot rate for an immediate profit. Similarly, when the NZ dollar was depreciating, a profitable strategy would have been to sell forward contracts on the NZ dollar, as the actual future spot $NZ/$US exchange rate would have been persistently lower than the forward exchange rate. These strategies, however, are inherently risky. The actual returns depend on the actual future movement in the spot exchange rate, which can be extremely volatile at times. For investors to profitably exploit the systematic patterns in the data, they would need to successfully identify the trend, and be prepared to live with the risk.[17]

Can an insurance risk premium story explain the facts?

How can we explain this feature of forward rate behaviour? Can the pattern of seemingly unexploited systematic 'errors' be explained by risk considerations? Forward rates offer certainty in an uncertain world. As mentioned in section 3, if people are risk averse, they may be willing to pay a price for obtaining certainty, ie a risk premium. If there is an 'insurance-type' risk premium embedded into forward rates, then we no longer expect forward rates to equal future spot rates on average over time. Hence, any systematic pattern in the differences between today's forward rates and the actual future spot rates may reflect an insurance-type risk premium, rather than systematic 'forecasting errors.'

In principle, if such a risk premium exists, we would expect to see a relatively stable margin between forward rates and future spot rates. However, this is not what we see. In order to generate these forecast error patterns, the risk premium would need to have been negative when spot rates were trending up, and positive when trending downwards. Also, financial markets are two-sided. If people are risk averse, then presumably borrowers would be prepared to pay a bit more for certainty (a positive risk premium), but lenders would be willing to receive a bit less for certainty (a negative risk premium). These forces should cancel each other out to some degree, so it is not immediately obvious that a significant insurance-type risk premium should exist, particularly at the relatively short horizon of a month.[18] Furthermore, it is certainly not obvious why such a risk premium should have been related to the trend of the spot rate.

What about an inflation expectations story?

So how can we explain this behaviour? One possible reason is that, perhaps the errors were not being made in the forward market itself, but in the market's forecasts of inflation, and hence monetary policy.[19]

In other words, when inflation was rising, inflationary pressures turned out to be stronger than both central banks and markets expected, so monetary policy ended up tightening by more than expected. Consequently, both short-term interest rates and the exchange rate end up rising by more than expected. And if markets make the same kind of mistake period after period, then the data will show forward rates consistently under-predicting the future spot

[17] It is worth noting that identifying the trend is always easy with the benefit of hindsight. The trend may not have been obvious at the time and it may not be the same in the future.

[18] There is fairly strong evidence across a wide variety of countries that there is a term risk premium in the interest rate yield curve, but, except for the US, this is usually found over horizons much greater than one month.

[19] Rae (1997) makes the same point.

rate. This is consistent with New Zealand's experience over 1995/96. Throughout that period, inflation turned out to be persistently stronger than what the Reserve Bank and the markets expected. Likewise, when inflation falls, it ends up falling by more than expected, resulting in larger-than-expected falls in interest rates and exchange rates. In other words, both central banks and financial markets persistently under-estimated **changes** in inflation, resulting in the persistent under-estimation of **changes** in future financial market prices.

Systematic inflation forecast errors can be attributed to people **learning** about the process that drives inflation. While this 'slow learning' explanation fits with the facts, it remains a puzzling feature. One possible reason for persistent lagging behaviour is that, in an uncertain world, being cautious is perhaps a natural, and/or an optimal way to behave. In an uncertain world, central banks may prefer to change policy in an incremental way as they wait for further evidence to confirm their view on the inflation outlook. Another possible reason is that the world is constantly changing, so that both central banks and markets are having to constantly re-learn how the world behaves.

But all the analysis so far has been on an ex-post basis - that is, comparing actual outcomes with what was the forward rates implied. While it has provided some interesting insights, it has implicitly assumed that forward rates were, in fact, a reasonable approximation of market expectations. Is there another way of assessing whether that is so?

Do forward rates really reflect average mean market expectations?

One practical – but only indicative – way of doing this is to compare forward rates with survey data from the Reserve Bank's *Survey of Expectations* (this is more an ex-ante approach). This survey has been in place for 11 years and each quarter asks over 100 businesses or market participants where, inter alia, 90-day rates are expected to be at the end of the current quarter (approximately a two month forecast), and where the exchange rate will be at the end of the following quarter (approximately a five month forecast).[20]

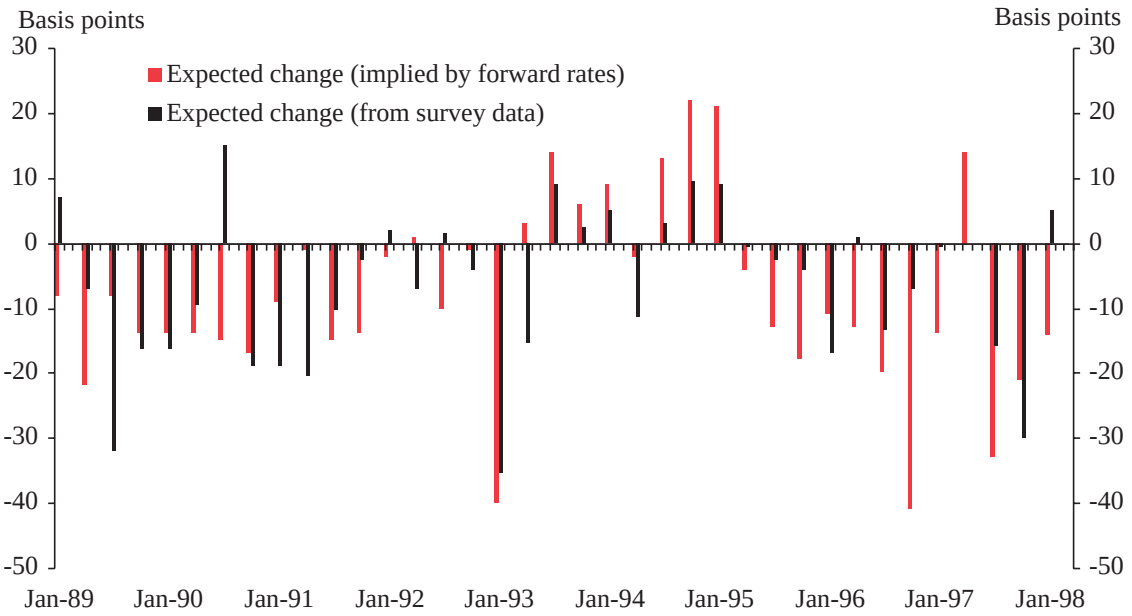
Forward interest rates seem to be consistent with surveyed expectations, which suggests they are a reasonable guide of market expectations. Figure 5 (overleaf) plots the expected change implied by forward rates against the expected change implied from survey data. The two seem to be reasonably similar, both directionally and quantitatively. This suggests that, while the **ex-post** directional accuracy of forward 90-day rates is not significantly greater than 50 percent, they seem to provide a reasonable guide to what the market did **expect** to happen over the next month.

Forward exchange rates, however, do not seem to be consistent with surveyed market expectations. Furthermore, they do not even look like plausible measures of average market expectations. Figure 6 shows that the forward $NZ/$US exchange rate has been pricing in a depreciation of the NZ dollar on every occasion over the past nine years – that is, the current forward exchange rate has always been **below** the current spot exchange rate. The forward TWI behaves similarly (figure 7). It seems unlikely that these are true reflections of average market expectations. If they were, then this is saying that the market expected a NZ dollar depreciation, month after month, over the last nine years – even during 1993 to late 1996 when the exchange rate was clearly in an uptrend.

That does not seem likely. Figures 8 and 9, which plot the expected exchange rate changes implied from forward exchange rates, against the surveyed measure of expected changes, help reinforce this sense. There are some divergences between the two sources, particularly between 1992 and 1995. Surveyed expectations anticipated the rise in the exchange rate,

[20] While the *Survey of Expectations* cannot be considered as fully reflecting financial market expectations due to the limited coverage of participants, it nevertheless provides an alternative way to compare forward rates. Also, the surveyed expectations were interpolated in order to line up with the forward rate horizon.

Figure 5:
Forward 90 day rates and surveyed expectations



while forward rates continued to imply a depreciation.[21]

The forward MCI does seem to be a reasonable approximation of market expectations of the future MCI - or future settings of monetary policy.[22] Given that New Zealand's interest rates have been relatively high over the period, the trade-weighted interest rate differential would naturally result in the forward TWI pricing in a depreciation of the exchange rate. As the forward MCI is simply a weighted combination of the forward TWI and the forward 90-day rate, the forward MCI might also have been expected to naturally price in an 'easing' in monetary policy. This, however, does not prove to be the case to any material extent. Figure 10 shows that the forward MCI's reflect the composite survey measures of MCI expectations reasonably well.[23]

[21] Rae (1997) also compares forward exchange rates with surveyed expectations and finds that forward exchange rates do not represent pure expectations of future spot rates.

[22] Note that the expected level of the MCI was not actually surveyed, but that we have simply combined the 90 day rate expectation with the TWI expectation to produce a proxy MCI expectation. The survey did ask about 'monetary conditions,' but in a qualitative sense, rather than a numerical one.

[23] This in turn suggests that forward MCIs are largely dominated by forward 90 day rates.

Why don't forward exchange rates reflect average market expectations?

So, why has the forward exchange rate nearly always priced in a NZ dollar depreciation when, in fact, the NZ dollar has had its ups and downs, but has not shown a clear long-term trend? Given that forward exchange rates are effectively the same as interest rate differentials (as CIP holds), this question is the same as asking why New Zealand short-term interest rates have been consistently and substantially higher than US interest rates (see figure 11). This appears somewhat surprising given our better inflation performance over most of the period. In this respect, however, New Zealand is far from unique. For example, over the past eight years, Canadian inflation has been lower than US inflation. For the bulk of that period, however, Canadian interest rates have been higher than US rates.

So why are New Zealand interest rates higher than US interest rates?

This question, in itself, is quite complex, and a variety of reasons have been suggested. One possible explanation is that there is simply a greater risk of losing one's money investing in

Figure 6:
What forward $NZ/$US exchange rates implied compared to what was actually happening

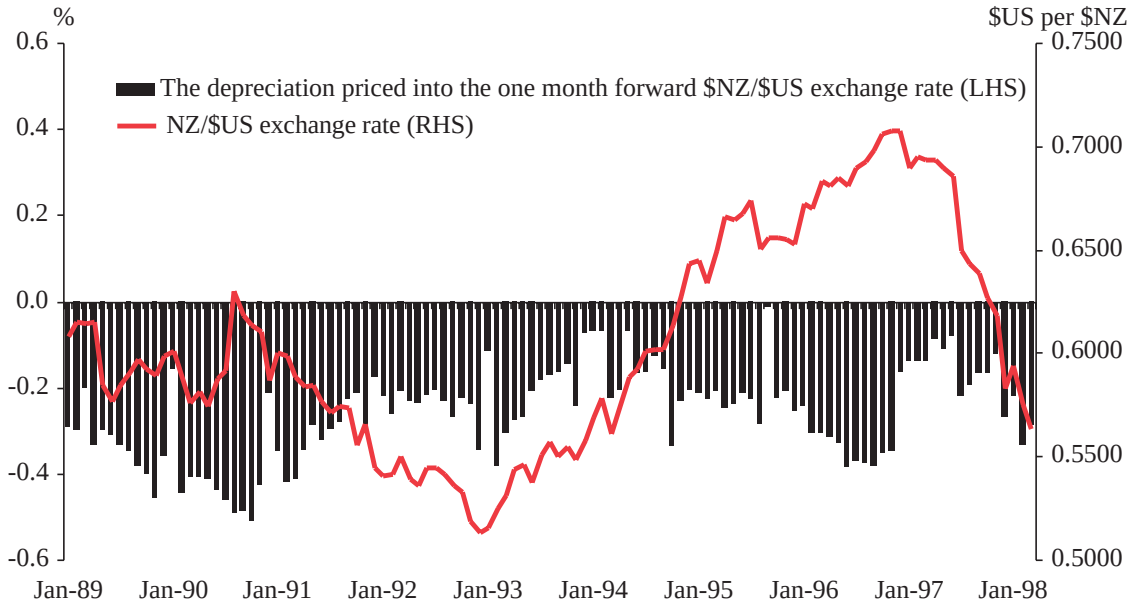
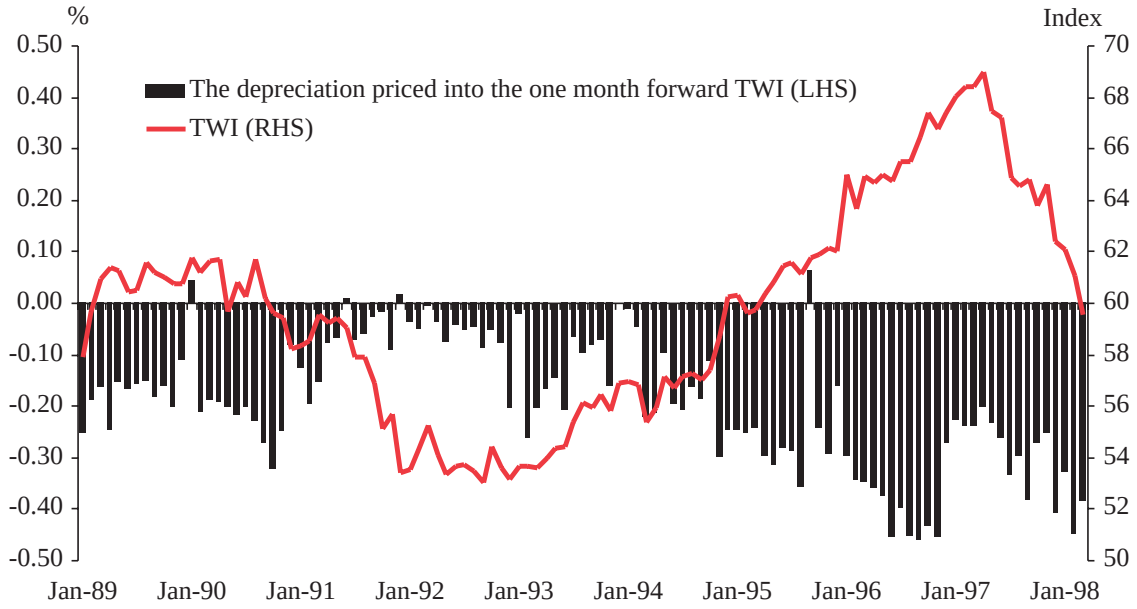


Figure 7:
What forward TWIs implied compared to what was actually happening



New Zealand than in the US. The default risk story, however, does not seem to explain very much. For instance, the interest rate the New Zealand Government pays when borrowing in the same currency as the US Government is only slightly higher than that paid by the US government[24] – and the difference between the two should be a rough guide to the difference in market perceptions of each country's default risk.

A more likely explanation is that there is a currency-related risk premium embedded into NZ interest rates – something that makes investors relatively less willing to invest in NZ dollar

[24] More specifically, New Zealand's credit rating is AA+, compared to the US Government rating of AAA. This difference in credit rating is worth around 15 basis points, ie 0.15 percent. So if the US Government can borrow at 5 percent, the New Zealand Government can borrow at around 5.15 percent.

Figure 8:
Forward $NZ/$US exchange rates and surveyed expectations

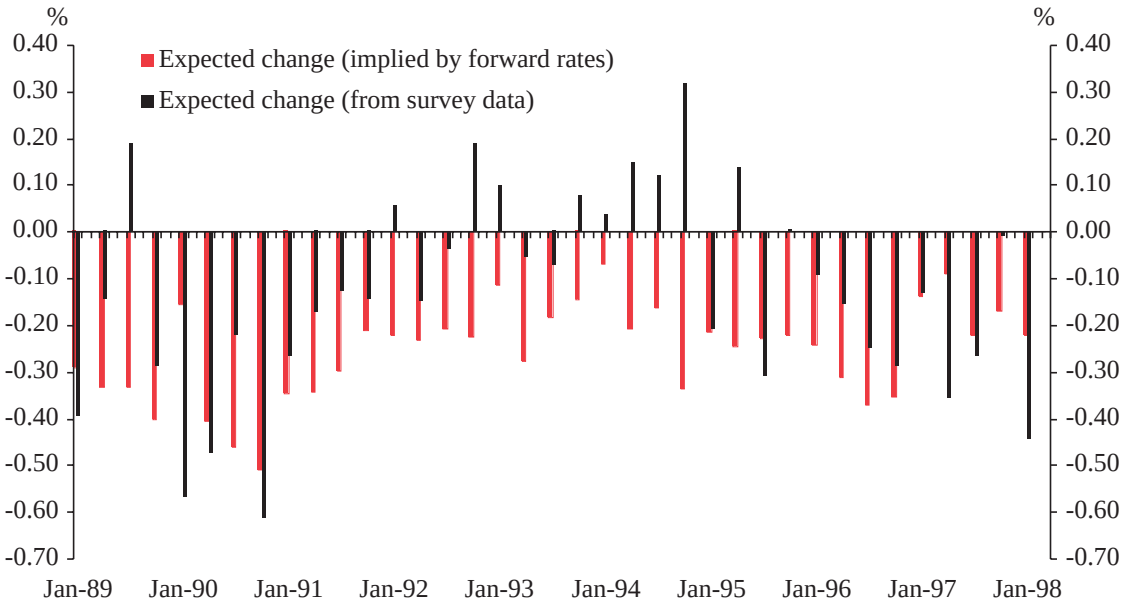
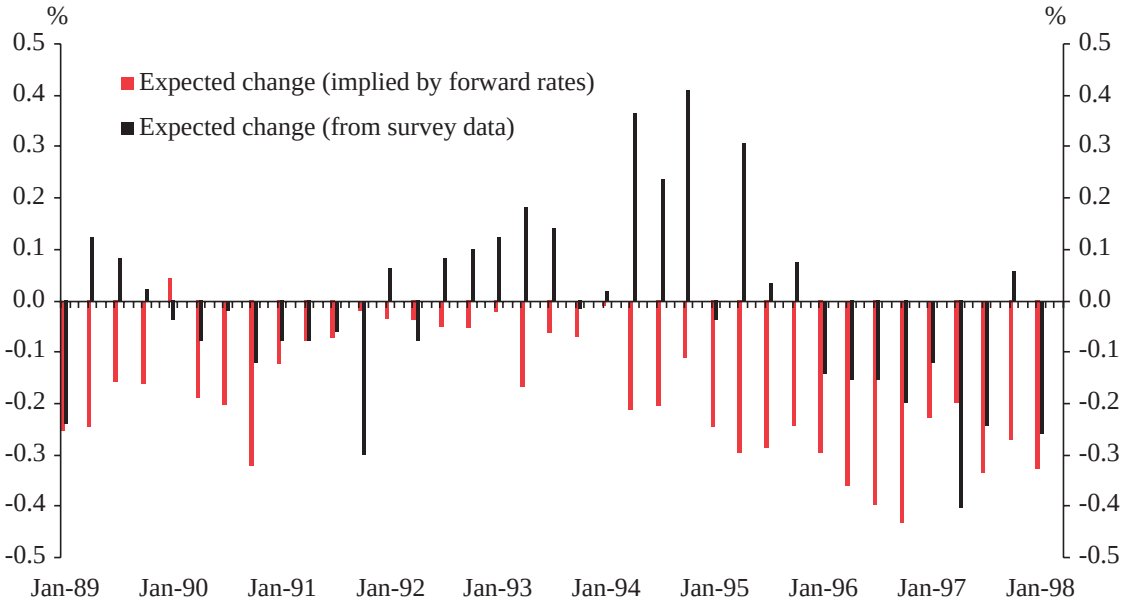


Figure 9:
Forward TWIs and surveyed expectations



assets than US dollar assets for any given level of interest rates.[25] In other words, NZ dollar assets are not seen as perfect substitutes for US dollar assets.

What are the reasons for this premium? It seems to reflect a global preference for US dollar assets and risk, which possibly stems form the structure of the world's financial markets. The US is at the heart of the world's financial system, and the largest portion of central banks' reserves are held in US dollar-denominated assets. Also, very few reserves are held in

[25] Rae (1997) finds evidence of a time-varying risk premium in New Zealand interest rates.

Figure 10:
Forward MCIs and surveyed expectations

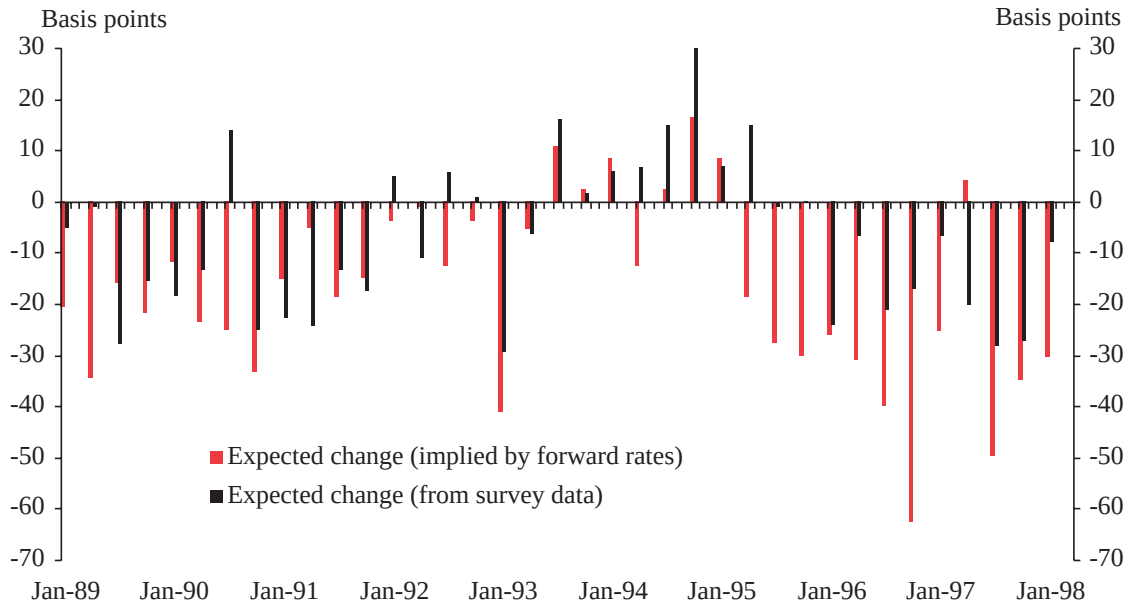
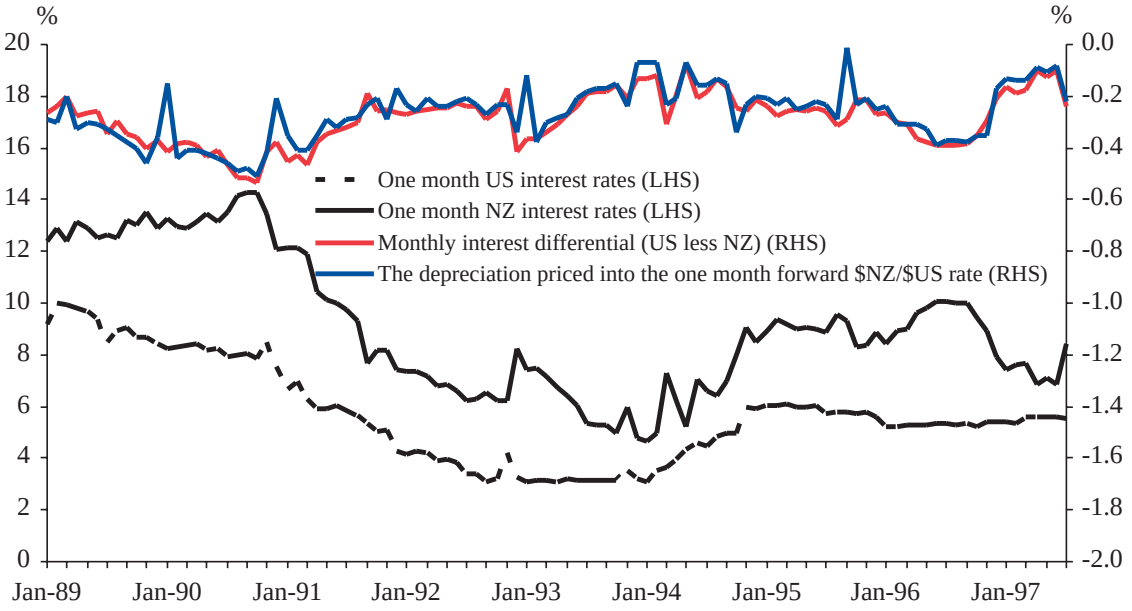


Figure 11
The one month interest rate differentials between New Zealand and the US and the depreciation priced into the one month forward $NZ/$US exchange rates



currencies outside those of the US, Japan, and Germany. At the same time, the US is the largest economy in the world and its financial markets are of a size and depth to make them amongst the most liquid. And historically there has been relatively little investment by US investment funds outside of their home country, whether for regulatory or customary reasons. As such, there tend to be more investors keen to invest in central countries – especially the US – than those keen to invest outside it.

By investing cross-border, investors expose themselves to exchange rate risk. To illustrate the nature of this risk, we will use New Zea-

land as an example.[26] Between 1989 and 1997, the one month interest rate in New Zealand was, on average, 3.6 percent higher than in the US. This means that the monthly interest rate gain from investing in New Zealand assets would have been 0.3 percent. However, any interest rate gain could easily have been swamped by the magnitude of short-term exchange rate movements. In fact, on a monthly basis investors would have lost money on well over 40 percent of occasions.[27] These short-term time frames are important, as most private investment funds work to a quarterly or monthly reporting cycle, and they would be very reluctant to report frequent monthly or quarterly losses to their clients.

New Zealand-specific factors, however, are also likely to be relevant in explaining the magnitude of the differentials between New Zealand and foreign interest rates. Part of this may be due to the relatively small size of our financial markets. Probably more important is New Zealanders' appetite for borrowing. The New Zealand economy already draws on a huge amount of overseas capital relative to its size, and has the highest ratio of net foreign debt to GDP of the OECD economies. Most overseas investors in NZ dollar bonds or New Zealand shares have taken unhedged exchange rate positions. Hence, their actual returns when converted back to their home currency, depend on the movement in the NZ dollar. There is a limited appetite for that sort of risk. Thus, in order to attract further offshore capital, New Zealand interest rates have to be higher.[28]

The general reluctance to invest in non-US dollar assets, in conjunction with some country-specific factors, can explain why there has been a wedge between New Zealand and US interest rates, and hence, why forward exchange rates have always been pricing in a NZ dollar depreciation. This implies that UIP, in its strict sense, is not entirely valid – **short-term** exchange rate expectations are not necessarily reflected in **short-term** interest rate differentials.[29]

In this case, can people take advantage of the interest rate differentials? Potentially they could have. Over the past nine years, a US investor who had bought NZ dollar assets may have made above-normal returns. However, as illustrated in the example above, the volatility of these returns would have been high given the volatility in short-term exchange rate movements. But, if investors had been willing to 'tough it out,' the interest rate returns for the entire period would have been higher, while the exchange rate was roughly unchanged by the end of that period.

The UIP framework, however, does provide a useful way of thinking about how the market behaves in response to new information, and about how expectations are formed, but perhaps needs to be adapted to allow for risk and uncertainty. In a similar vein to another popular theory, that of purchasing power parity, one possible alternative is to think of UIP as holding over the long-term, but allowing for departures in the short-term.[30]

UIP, in a **relative** sense, is particularly useful for analysing market behaviour following an inflation surprise, or an unexpected change in monetary policy. The reactions of interest rates and exchange rates are typically consistent with what UIP suggests would happen following these surprises. For example, suppose the Re-

[26] It is worth re-emphasising that a currency risk premium is common across many countries, rather than being unique to New Zealand. It has to do with the general reluctance to take on general exchange rate risk through investing in non-US dollar assets, rather than the specific volatility of the NZ dollar. If anything, the NZ dollar in recent years has exhibited relatively less volatile than many other currencies including, for example, the Australian dollar, or the pound sterling.

[27] The standard deviation of monthly percentage changes in the $NZ/$US exchange rate was 1.8 percent.

[28] Neither the New Zealand Government nor New Zealand banks or corporates have taken significant exchange rate risk on their overseas borrowing. Rather, those risks lie with the foreign investors, who require compensation for that risk.

[29] Nearly all studies on UIP have reached a similar conclusion. More recent evidence, however, suggests that UIP may hold over longer horizons.

[30] The Reserve Bank uses an adapted form of UIP in its macroeconomic model of the New Zealand economy.

serve Bank unexpectedly tightened monetary policy, and that this takes the form of a rise in interest rates. What would then typically happen in response? The exchange rate would rise quite quickly. The rise in the exchange rate is consistent with what UIP would lead us to believe, as it serves to offset the now-higher interest rate return on New Zealand assets. If the exchange rate had remained unchanged or even fallen, then offshore investors could have bought a similar or greater amount of NZ dollar assets for a given amount of foreign currency, and benefited from the higher interest rate return.[31] The exchange rate should rise to such a level that the markets then expect it to depreciate over the period ahead to offset the now-wider interest differential. In other words, an unexpected widening in the New Zealand's interest rate differential to the US, should **now** bring about an expectation of a **future** NZ dollar depreciation.

As mentioned above, this is consistent with New Zealand's experience over 1995 to 1996. Over this period, both the Reserve Bank and the markets expected monetary policy to begin easing. But quarter after quarter, inflation turned out to be stronger than expected, leading to a series of unexpected monetary policy tightenings. Each surprise tightening resulted in a sudden rise in both interest rates and exchange rates. Furthermore, exchange rates remained relatively steady after the initial rise, rather than steadily drifting higher. This **'step-change'** pattern in the exchange rate continued throughout the period following each unexpected tightening. This pattern was consistent with the NZ dollar rising to such an extent that it was **then expected** to depreciate over the period ahead. If this were not the case, it would have been reasonable to see the exchange rate **steadily** drift higher over that period. In other words, the interest rate and exchange rate reaction to each surprise was consistent with what UIP would suggest regarding the change in market expectations to these surprises. While the exchange rate never really depreciated during the period, despite the markets' expectation that it would, this was likely due to the series of surprise monetary policy tightenings. In the absence of these persistent surprises, the NZ dollar may well have fallen. To sum up, UIP provides a useful framework in an ex-ante sense, rather than an ex-post sense.

[31] In theory, the rise in today's exchange rate should be instantaneous, so that it should not be possible to gain from the higher interest rates. In reality, however, this process tends to occur over a short period as markets take time to digest this new information.

5 Conclusion

The results in this article suggest that forward rates tell us very little about where things will actually be in a month's time. This is not too surprising, and more than likely reflects the fact that financial market prices can be volatile and difficult to predict, particularly over the short-term. The very fact that the future is difficult to predict explains the value and popularity of forward contracts through their insurance-like qualities.

One puzzling feature of market behaviour is that forward rates appear to have persistently under-estimated actual changes in future market prices over the past nine years. Perhaps part of the explanation is that both central banks and the financial markets have persistently underestimated changes in inflation. Possible reasons for such persistent behaviour include: caution in implementing monetary policy, in the light of an uncertain inflation outlook; uncertainties about the process that drives inflation; and perhaps a reflection of human nature when we ask: "What are the odds that I will be wrong again this time around?"

Forward interest rates and forward MCIs, however, are useful in the sense that they appear to be a reasonable guide of what the market expects to happen in the future. However, forward exchange rates, as quoted in the market, do not look like plausible measures of market expectations as they have nearly always priced in a depreciation of the NZ dollar. Asking why this is the case amounts to asking why New Zealand interest rates have been consistently higher than US interest rates. One explanation is that there may be a currency related risk premium

embedded in New Zealand interest rates. This risk premium largely reflects an element of global preference for US dollar-denominated assets. Because of the structure of the world's financial markets, not all non-US dollar assets are seen as perfect substitutes for US dollar assets. New Zealand-specific factors – such as the overall level of NZ dollar indebtedness to foreigners – may also be relevant.

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