Comparison of TWI forecast errors: Reserve Bank and other forecasters

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Editor's note

In this paper we compare our projections of the trade-weighted index (TWI) with those of the NZIER and the National Bank of New Zealand. One issue with this kind of analysis is that the Reserve Bank changed the way it generated its exchange rate forecasts in 1997, from an assumption based on relative inflation rates (ie a steady real exchange rate assumption) to an assumption that the exchange rate would gradually return to a long-run equilibrium level.

Note that the Reserve Bank does not consider its exchange rate projections as 'forecasts' (though we may refer to them as such for convenience), but rather as technical assumptions, reflecting that the exchange rate is notoriously difficult to predict.

Executive summary

As part of our examination of the Reserve Bank's forecasting performance, we have examined our quarterly forecasts of the TWI between December 1994 and September 2002. We have also compared our forecasts to Consensus forecasts and to those of the NZIER and the National Bank of New Zealand.

The main findings are as follows:

- Between December 1994 and March 1997 we did not consistently under- or over-predict the level of the TWI at most forecast horizons.
- Since 1997, which coincides with the adoption of endogenous policy forecasts, the Reserve Bank has tended to over-predict the level of the TWI. Forecast errors for near-term horizons are relatively small. Four or more quarters ahead our forecasts have been, on average, at least 5 per cent higher than the actual level of the TWI. We attribute this finding to the change in the behaviour of the TWI (ie its change in direction) rather than to the change in our forecasting methodology.
- Since the adoption of endogenous policy forecasts, the performance of the Reserve Bank's TWI projections has been very similar to that of the average market forecast as measured by Consensus forecasts.
- The Reserve Bank's forecasts have been similar to those from the NZIER; however, their forecasts are slightly more accurate than our own.
- We have tended to outperform the National Bank of New Zealand in term of accuracy and bias when forecasting the TWI. These differences are most pronounced for medium-term forecast horizons (5 to 8 quarters ahead).

Introduction

Our recent examination of the Reserve Bank's forecasting performance indicates that we have tended to under-predict CPI inflation for medium- to long-term horizons. This work also shows that the National Bank of New Zealand and the NZIER have tended to outperform the Reserve Bank (in terms of bias and accuracy) when forecasting annual CPI inflation for

medium- to long term horizons.[1] To explore the possible reasons for this we have examined the Reserve Bank's forecasts of other key variables and compared our performance to these organisations. This note examines the Reserve Bank's assumed forward paths for the trade-weighted index (TWI) and compares them to those from external forecasting agencies.

Our projections of the TWI between December 1994 and September 2002 are examined. Between 1994 and March 1997, the Reserve Bank determined its forward paths for value of the nominal TWI using flat-line assumptions regarding the real exchange rate. Since then we have shifted to the current endogenous policy forecasts framework and have assumed the TWI will tend back to an equilibrium level, which we have occasionally adjusted. The relatively mechanical approaches we have used reflect the inherent difficulty in forecasting exchange rates. Given this change in forecasting methodology, we examine forecast errors for the periods prior to and since the adoption of endogenous policy forecasts separately. We note, however, that this change in methodology coincided with the turning point of the TWI cycle, which will obviously have a very large impact on results.

Our projections since the adoption of endogenous policy forecasts are compared to those from Consensus Forecasts.[2] Consensus TWI projections reflect the average forecasts from several forecasting agencies. Such a comparison provides an indication of the performance of the Reserve Bank's forecasts relative to the 'average' market forecast. The organisations surveyed by Consensus do not restrict themselves to a mechanical approach to forecasting the exchange rate. This indicates that they are suitable benchmark for assessing our performance.

We also compare our projections to those from the NZIER and the National Bank of New Zealand. This comparison aims to explore the reasons for the difference in inflation forecasting performance that has been observed.

Errors are defined as 'projection minus actual.' Hence a positive mean error reflects a tendency to over-predict the level of the TWI, while a negative mean error reflect a tendency to under-predict. Projections are examined on the presence and level of bias[3] (as measured by the mean errors) and the accuracy or size of errors (as measured by the mean absolute error and the root mean square error).[4]

Caution is needed when interpreting our findings. A limited sample period, regime changes and a relatively small number of comparable observations between organisations make a detailed examination of forecasting performance difficult, particularly when conducting statistical tests. Further, our findings are likely to be strongly dependent on the sample period, which includes the Asian crisis, for example. A further issue is that forecasts prepared for the same quarter but at different dates are not necessarily comparable. Those produced at later dates may incorporate additional information, potentially improving their forecasting ability. We have tried to ensure that we only compare forecasts that are prepared at similar dates.

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1 This is examined in "Comparison of Inflation and GDP forecasts"

2 The Asia Pacific Consensus forecast comprises different forecasters: Deutsche Bank NZ, First NZ Capital, HSBC, Bank of New Zealand, BERL, UBS Warburg, Westpac Banking Corp, National Bank of New Zealand, ANZ Bank, Infometrics, NZIER and JP Morgan Chase. The Consensus forecast of the TWI is the average of the forecasts made by the named forecasting groups.

3 When assessing forecasting performance we standardise forecast errors by the level of the TWI in the following manner: *Forecast deviation* $= ((\text{Forecast TWI}_t - \text{Actual TWI}_t) / \text{Actual TWI}_t)*100$
This allows us to measure the deviation of our forecasts form the actual level of the TWI as a percentage.

4 Details of the statistics used when examining forecast errors are provided here.

The remainder of this note is structured as follows: Section 2 examines the Reserve Bank's forecasting performance over both the exogenous policy tracks period and the endogenous policy forecasts period. Section 3 compares our performance to those of external forecasters. Section 4 concludes.

2 The Reserve Bank's TWI forecasting performance

When examining the Reserve Bank's forward track for the TWI, we separate our sample into two periods. During the first sample period (December 1994 to March 1997) our forward tracks for the nominal TWI were determined using flat-line assumptions regarding the real exchange rate. Hence our 'forecast errors' do not have the traditional interpretation, but instead, largely equate to actual TWI movements. This period is referred to as the 'exogenous policy' or 'no policy response' period.

During the second sample period (June 1997 to September 2002) we assumed that the TWI would gradual tend towards an equilibrium level that we have adjusted over time. This period is referred to as the 'endogenous' or 'conditional policy response' period. We examine forecasts for each regime separately. However, we note that due to the forward looking nature of forecasts is it is impossible to get a 'clean' separation of sample periods.

Differences in forecasting performance between the two periods should not solely be attributed to the difference forecasting methodologies. Figure 2.1 plots the level of the TWI and our forecasts at 3 quarter intervals. We observe that the TWI displayed very different trends in each of the two sample periods. Over the period for which we have data the TWI rose consistently until March 1997 and then declined sharply. We have tended to under-predict the level of the TWI when it is rising and over-predict its level when it is falling. As a result, we have tended to under-predict the TWI during the period when exogenous policy tracks were used, and we have tended to over-predict the TWI since our forecasts have included an endogenous policy assumption. Over a full exchange rate cycle such errors would be expected to average out to some extent. Hence, the effects of sample period are an important caveat on our findings. Our examination of the Reserve Bank's forecasts for both regimes is summarised in table 2.1 and figure 2.2.

Figure 2.1
TWI levels and Reserve Bank projections (3 quarter intervals)

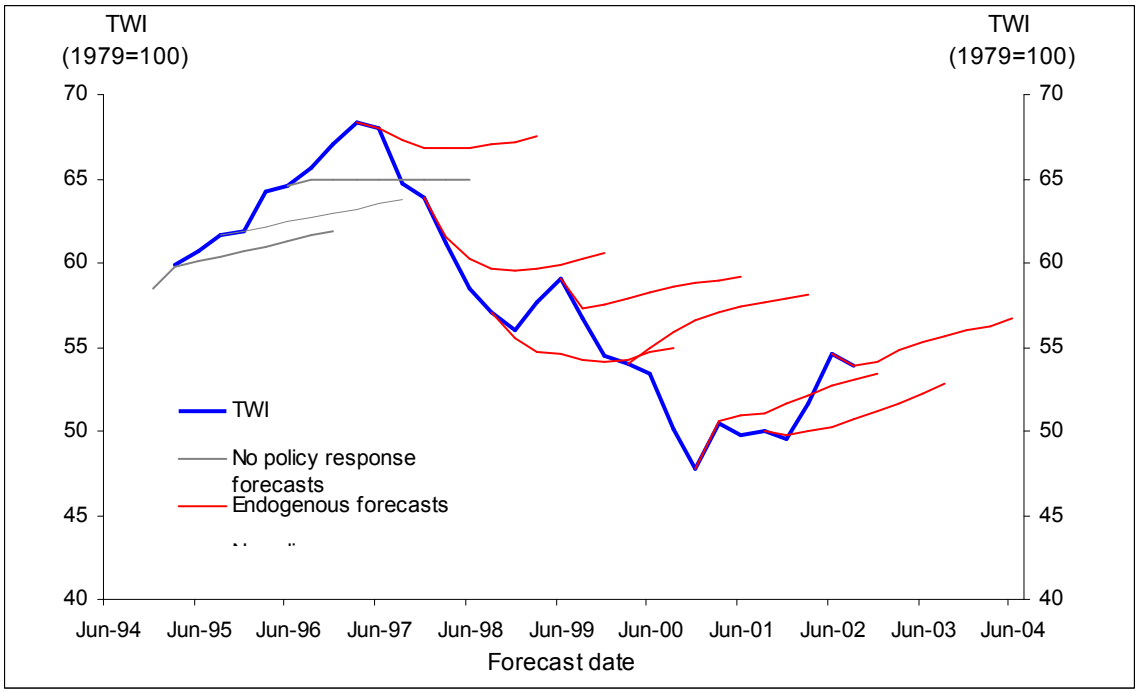


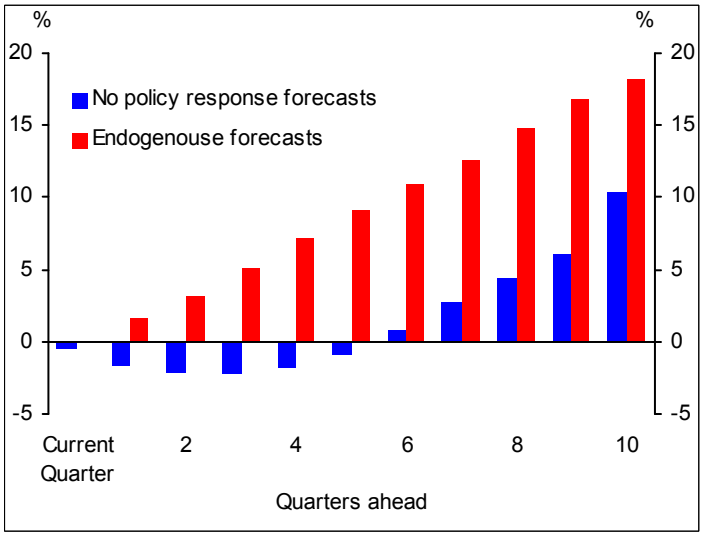
Table 2.1
Forecast error summary statistics for the Reserve Bank

Quarters ahead	Mean Errors		RMSE		Observations	
	Exogenous Policy 1994 Q4 to 1997 Q1	Endogenous Policy 1997 Q2 to 2002 Q3	Exogenous Policy 1994 Q4 to 1997 Q1	Endogenous Policy 1997 Q2 to 2002 Q3	Exogenous Policy 1994 Q4 to 1997 Q1	Endogenous Policy 1997 Q2 to 2002 Q3
Current Quarter	-0.42 **	0.04	0.67	1.31	10	22
1	-1.71 ***	1.58	2.09	4.83	10	21
2	-2.15 *	3.20	3.41	7.05	10	20
3	-2.30	5.11 *	4.31	8.91	10	19
4	-1.84	7.19 **	5.56	10.76	10	18
5	-0.83	9.04 ***	7.51	12.30	10	17
6	0.79	10.88 ***	9.17	13.51	10	16
7	2.68	12.48 ***	10.77	14.15	10	15
8	4.38	14.74 ***	11.52	15.30	10	14
9	6.00	16.78 ***	11.74	17.49	10	13
10	10.35 **	18.26 ***	12.89	19.24	9	11

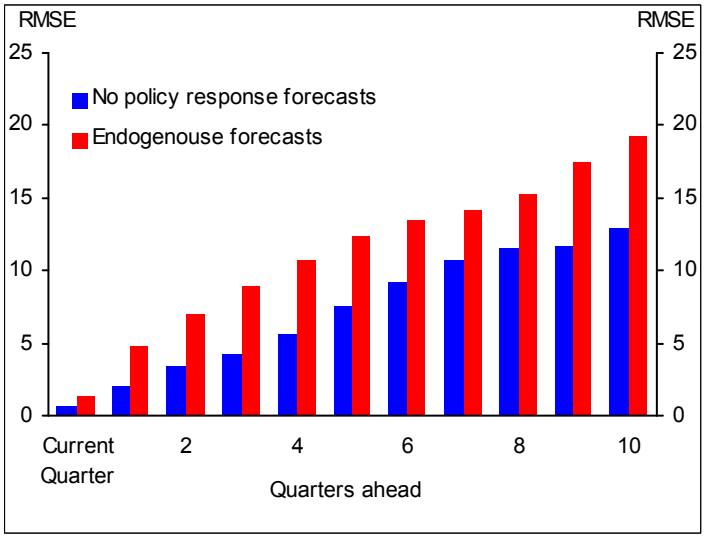
Notes:
Asterisks indicate the significance with which the null hypothesis: Mean Forecast Error = 0 can be rejected
*** = Significant at the 1 per cent level
** = Significant at the 5 per cent level
* = Significant at the 10 per cent level
Forecast errors for the 2 quarters ahead horizon are not normally distributed for the exogenous policy tracks period. For these horizons we test the null hypothesis: Median Forecast Error = 0.

Figure 2.2
Summary statistics for the Reserve Bank's TWI forecasts

Mean forecast errors



Root mean squared errors



2.1 TWI forecast errors between December 1994 and March 1997 (Exogenous policy tracks)

We did not consistently under- or over-predict the TWI up to 9 quarters ahead during the exogenous policy period.[5] However, we did over-predict the level of the TWI 10 quarters ahead. TWI projections for this horizon were, on average, 10 per cent higher than the actual TWI. As expected, the accuracy of our assumed forward tracks declined as the projection horizon lengthens. This reflects the inherent uncertainty of foreign exchange markets.

[5] Although the mean forecasts errors for the current quarter and 1 and 2 quarters ahead horizons are negative and significantly different from zero, they are still relatively small. This finding is most likely a reflection of the sample period and the low variability of errors for these horizons.

2.2 TWI forecast errors between June 1997 and September 2002 (Endogenous policy tracks under FPS)

Since June 1997 we have seen a dramatic decline in the TWI. Not surprisingly, the Reserve Bank has tended to over-predict the level of the TWI during this period. Up to three quarters ahead this over-prediction has been relatively small. However, for longer forecasting horizons we have tended to over-predict the level of the TWI by a much larger amount. On average our one year ahead TWI projections tended to be 7 per cent higher than the actual TWI, and two years ahead they have been 15 per cent higher. Again we find that the accuracy of our projections declines as the forecast horizon lengthens.

Caution is needed when generalising from our findings. The TWI was depreciating for most of the sample period. Further, this was an unusual period. Normally we would expect to see the TWI moving in a similar direction to world commodity prices. However, since mid-1999 this has not occurred.

3 Comparison to external forecasters

We compare the Reserve Bank's projections of the TWI during the endogenous policy forecasts period (June 1997 to September 2002) to those from the external forecasting agencies. In contrast to the Reserve Bank's mechanistic approach, market forecasters are more likely to account for expected movements in commodity prices, interest rate differentials, international risk aversion and other factors when forecasting the TWI. Summary statistics for our comparisons are presented in appendix 1.

We first compare our TWI projections to Consensus forecasts. This provides an indication of the performance of our projections relative to the 'average' market forecast.

Our projections are then compared to forecasts from the NZIER and the National Bank of New Zealand. These two organisations were found to have outperformed the Reserve Bank when forecasting CPI inflation for medium to long term horizons. This examination aims to explore whether different TWI projections could have been a contributor to this.

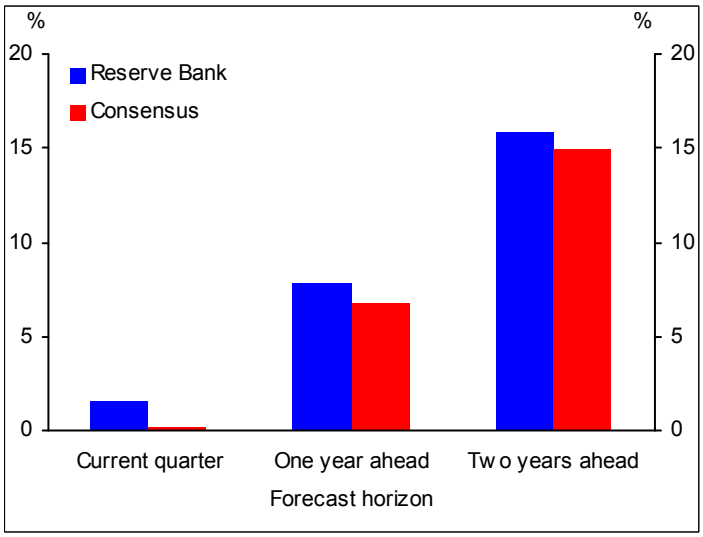
When making comparisons between forecasters, we include observations only for those quarters where both organisations published forecasts. This reduces our sample size but ensures the comparability of our sample.

3.1 Comparison to *Consensus* forecasts

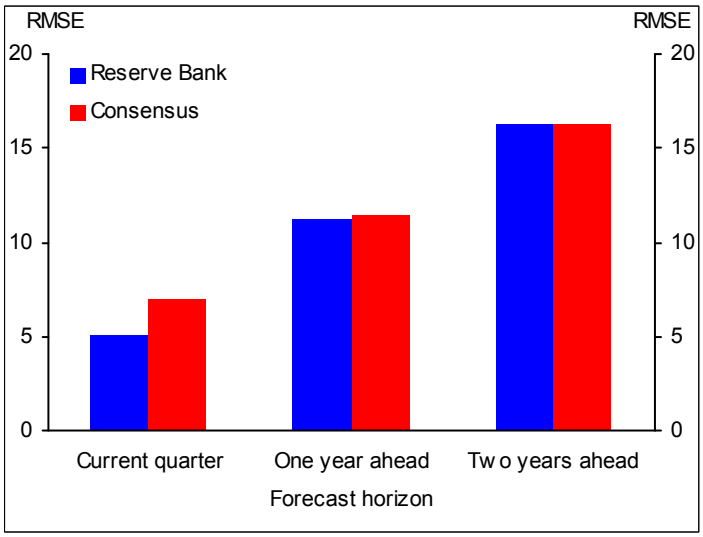
Our sample period when comparing our performance to Consensus forecasts is June 1997 to June 2002. Over this period the performance of the Reserve Bank projections has been very similar to that of the average market forecasts as measured by Consensus. There is no significant difference between the two set of forecasts in terms of bias or size of errors at any of the horizons considered. At all of the horizons considered both the Reserve Bank and Consensus forecasts have tended to over-predict the TWI. As expected, the accuracy of both sets of forecasts declines as the forecasting horizons lengthens.

Figure 3.1
Summary statistics for the Reserve Bank and Consensus TWI forecasts (June 1997 to June 2002)

Mean forecast errors



Root mean squared errors



3.2 Comparison to the NZIER[6]

When examining forecast from the NZIER we have a relatively limited number of comparable observations and consider forecasts only up to 7 quarters ahead. Forecasts for the two organisations have not been statistically significantly different over the sample period, though the NZIER's forecasts have been, on average, slightly lower than our own and hence more accurate.

Both the Reserve Bank and the NZIER have tended to over-predict the level of the TWI since June 1997. However, errors from the two organisations are relatively small for near-term forecasting horizons. For longer horizons (4 to 8 quarters ahead) both organisations have

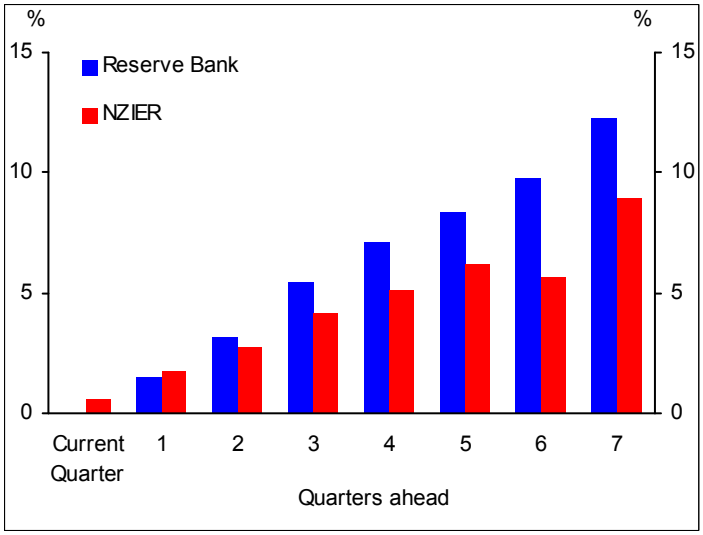
[6] An important caveat to these results is that between May 1998 and September 2000, the NZIER's forecasts were published several weeks after the Reserve Bank's projections were finalised. This includes the Asian crisis period, during which the economic outlook was changing rapidly.

tended to over-predict the TWI by at least 5 per cent. At most horizons, the Reserve Bank has over-predicted the TWI by a greater amount (on average).

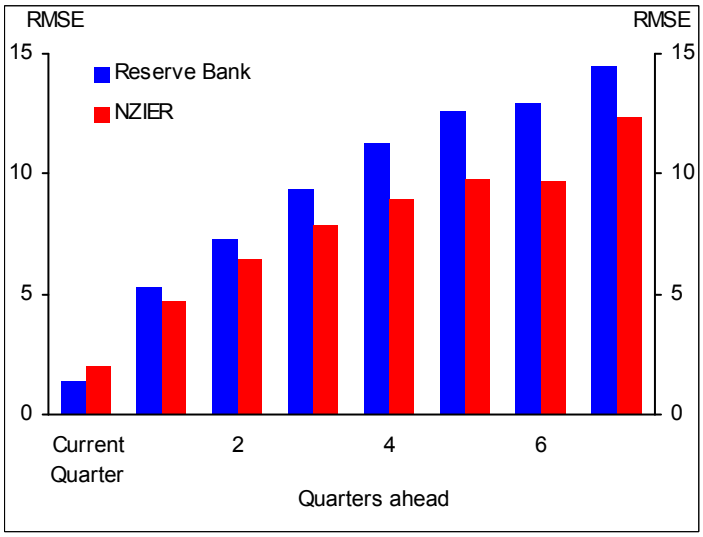
The NZIER's forecasts have has tended to be slightly more accurate (as measured by the mean absolute error and RMSE) than our own at all of the horizons considered, except in the current quarter. However, there is no significant difference in accuracy between the two sets of forecasts.

Figure 3.2
Summary statistics for the Reserve Bank and the NZIER TWI projections (June 1997 to September 2002)

Mean forecast errors



Root mean squared errors



3.3 Comparison to the National Bank of New Zealand

With larger sample sizes, it is easier to determine statistically whether differences in forecasting performance exist. We have a larger sample size when making comparisons to the National Bank of New Zealand than we do when making comparisons to other forecasters. However, the sample size is still fairly small. We therefore stress the potential for events specific to the sample period to influence our findings.

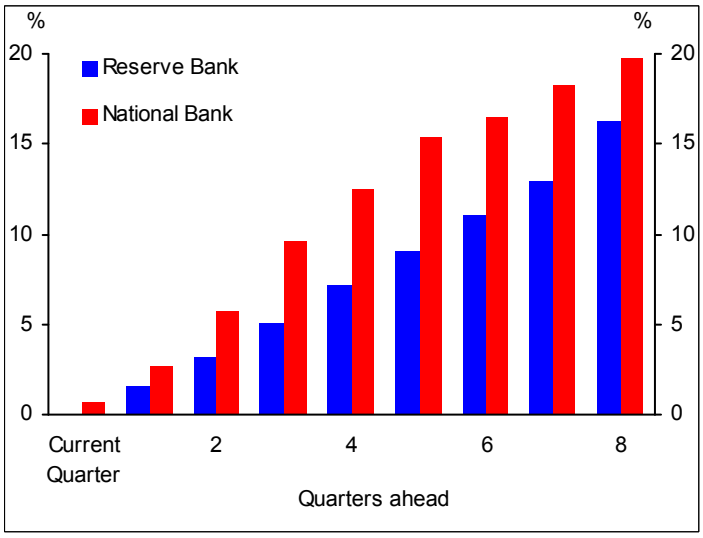
Like the Reserve Bank, the National Bank of New Zealand tended to over-predict the level of the TWI between June 1997 and September 2002. However, the National Bank of New Zealand has tended to over-predict the TWI by a larger amount than the Reserve Bank did over this period. This difference is most pronounced for medium-term horizons (3 to 7 quarters ahead). At these horizons the National Bank's mean forecast errors were, approximately 5 per cent further away from the actual TWI level than our own.

We have also outperformed the National Bank of New Zealand in terms of accuracy, with smaller errors on average. The difference is greatest 5 to 8 quarters ahead.

For much of this sample period, the National Bank of New Zealand forecast that the level of the TWI would rise faster than we did. Given the pronounced and persistent decline that occurred in the TWI, they tended to over-predict the level of the TWI by a larger amount. Hence, our findings for the National Bank of New Zealand, as for ourselves, are strongly influenced by the behaviour of the TWI over the sample period. Over a longer sample period one would expect the observed over-prediction to be less pronounced.

Figure 3.3
Summary statistics for the Reserve Bank and the National Bank of New Zealand TWI projections (June 1997 to September 2002)

Mean forecast errors



Root mean squared errors

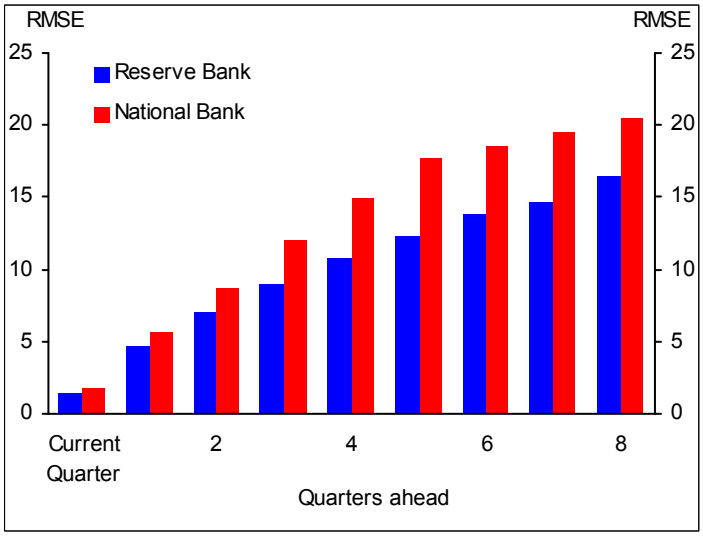
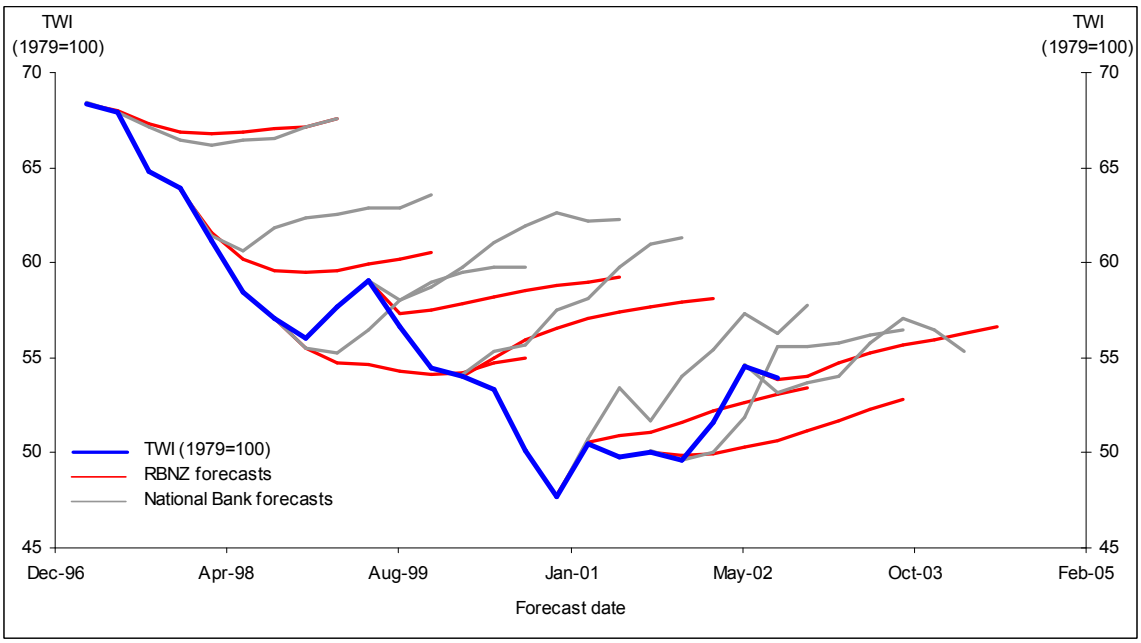


Figure 3.4
TWI levels and forecasts from the Reserve Bank and the National Bank of New Zealand (3 quarter intervals)



4 Conclusion

Foreign exchange movements are inherently difficult to forecast. Since mid-1997, which coincides with the adoption of endogenous policy forecasts, the Reserve Bank has tended to over-predict the level of the TWI. However, this is likely to be a feature of the sample period, during which the TWI declined dramatically. As expected, our performance worsens as the forecast horizon lengthens. Since the adoption of endogenous policy forecasts, the performance of the Reserve Bank's TWI projections has been very similar to that of the average market forecast as measured by Consensus forecasts.

When forecasting the TWI we have outperformed the National Bank of New Zealand in terms of bias and accuracy. These differences are most pronounced for medium-term horizons. However, the National Bank of New Zealand has still outperformed us when forecasting inflation.

The NZIER's TWI forecasting performance has been similar to our own. However, the NZIER's inflation forecasts have tended to out-perform our own. While the difference in TWI forecasts may be small, we have also observed that they have slightly lower (and hence more accurate) interest rate projection. It is likely that it is a combination of factors that has led to forecasts of inflation that are higher (and hence more accurate) than our own.

Future analysis will examine the NZIER and the National Bank of New Zealand's GDP forecasts in more detail and also look at their import price forecasts versus our own.

Reference

Ranchhod, S (2002), "Comparison of inflation and GDP forecast errors," *Reserve Bank of New Zealand Memorandum.*

Appendix 1: Comparison of the Reserve Bank's TWI forecasts to external forecasters: summary statistics

The tables below present summary statistics for the forecasting performance of the Reserve Bank relative to individual forecasting agencies. These figures are calculated using a matched observation approach. This means that when constructing each data set we only include observations for those quarters when both the Reserve Bank and forecaster of interest produced forecasts. These tables only compare individual forecasters to the Reserve Bank and should not be used to make comparisons between forecasting agencies.

Caution is needed when interpreting the findings. In many cases there are relatively few comparable observations. In such cases, the findings may be highly susceptible to distortions due to events specific to particular sample periods. As a result, summary statistics based on a limited number of observations may not accurately represent forecasters' general performances.

Note that the dates refer to indicate to the final month of the relevant quarter, not the dates at which forecasts were prepared.

Table A1.1
Summary statistics for the Reserve Bank's and the Consensus forecasts TWI forecasting performance (June 1997 to June 2002)

Quarters ahead	MEAN ERRORS		RMSE		Significant Difference in ME	Sample size
	RBNZ	Consensus	RBNZ	Consensus		
Current quarter	1.62	0.25	5.12	6.96	No	18
4	7.83**	6.81*	11.23	11.47	No	15
8	15.90***	14.97***	16.27	16.29	No	11

Notes:
Asterisks indicate the significant with which the null hypothesis Mean Forecast Error = 0 can be rejected:
*** = Significant at the 1 per cent level
** = Significant at the 5 per cent level
* = Significant at the 10 per cent level

Table A1.2
Summary statistics for the Reserve Bank's and the NZIER's TWI forecasting performance (June 1997 to September 2002)

Quarters ahead	MEAN ERRORS		RMSE		Significant Difference in ME	Sample size
	RBNZ	NZIER	RBNZ	NZIER		
Current Quarter	0.01	0.62	1.41	1.99	No	18
1	1.48	1.78	5.28	4.75	No	16
2	3.11	2.75	7.29	6.45	No	14
3	5.44	4.16	9.37	7.89	No	13
4	7.16	5.13	11.23	8.93	No	11
5	8.39*	6.19	12.61	9.79	No	10
6	9.77**	5.60	12.96	9.72	No	9
7	12.30***	8.94*	14.47	12.35	No	9

Notes:
Asterisks indicate the significant with which the null hypothesis: Mean Forecast Error = 0 can be rejected:
*** = Significant at the 1 per cent level
** = Significant at the 5 per cent level
* = Significant at the 10 per cent level
NZIER's forecast errors for the current quarter are not normally distributed. We instead test the null hypothesis: Median Forecast Error = 0.

Table A1.3
Summary statistics for the Reserve Bank's and the National Bank of New Zealand's TWI forecasting performance (June 1997 to September 2002)

Quarters ahead	MEAN ERRORS		RMSE		Significant Difference in ME	Sample size
	RBNZ	NBNZ	RBNZ	NBNZ		
Current Quarter	0.04	0.62	1.43	1.76	No	22
1	1.58	2.67*	4.72	5.65	No	21
2	3.20	5.78**	7.05	8.67	No	20
3	5.11*	9.59***	8.91	12.06	Yes	19
4	7.19***	12.44***	10.76	14.92	Yes	18
5	9.04***	15.36***	12.30	17.62	Yes	17
6	11.03***	16.43***	13.78	18.50	Yes	15
7	12.89***	18.18***	14.61	19.44	Yes	12
8	16.24***	19.81***	16.43	20.47	Yes	9

Notes:
Asterisks indicate the significant with which the null hypothesis: Mean Forecast Error = 0 can be rejected:
*** = Significant at the 1 per cent level
** = Significant at the 5 per cent level
* = Significant at the 10 per cent level