Background research on Reserve Bank forecasting performance: Combined articles

Introduction

This collection of papers makes up the greater part of the background research to the December 2002 (Vol. 65(4)) Reserve Bank Bulletin article, "The Reserve Bank's Forecasting Performance". This research was not originally intended for an external audience, but rather was an exploration of the issues. The papers provide a road-map of our research as we proceeded, finally reaching the conclusions presented in the Bulletin article. They are not stand-alone documents; nor do they represent the views of the Reserve Bank of New Zealand, but rather the views, at the time, of the authors.

The papers have been adapted slightly for external publication. However, they remain technical background papers and as such may not all be entirely accessible to a non-technical reader.

Sharon McCaw
Editor

Contents:

Statistical analysis of the Reserve Bank's forecast errors

The first stage of the project primarily involved basic statistical analysis of our forecast errors for CPI inflation and for other variables.

There are definitions of statistical terms and acronyms used throughout the papers.

Looking for causes of our errors

Once we had a good grasp on the statistical properties of our errors, we began more substantial work on analysing potential causes of them. The following papers examine the following:

How the forecasts evolve as the forecasting rounds progress
Our general stories around the inflation outlook
Our numerical forecasts of the exchange rate, the output gap, world growth and world prices for our imports.
What has caused our biased estimates of the output gap?

Comparison of our forecast errors with other forecasters

Having completed basic statistical analysis of our errors, and some investigations into what we believed was driving our errors, the next step was to compare our forecasts to those of others.

Interpreting results from comparison with other forecasters is not straightforward. For one thing, the forecasters at each institution are constantly changing, so that gathering the forecasts under the banner of a single institution may be misleading. Second, we do not know the macroeconomic models being used by each forecaster. We can therefore draw only very tentative conclusions about what may be driving any difference in the forecasts. A third issue is that forecasts are seldom prepared in exactly the same week. Later forecasts may benefit significantly from additional data revealing the current state of the economy. An additional practical issue is that the sample size was very small for several forecasters, making statistical comparison difficult.

With these provisos in mind, the following articles examine our relative forecast performance for CPI inflation, GDP growth, short-term interest rates, the TWI, and world prices for our imports.

Initially we compared our inflation forecasts with a wide range of forecasters. We found that two, the National Bank of New Zealand (NBNZ) and the New Zealand Institute of Economic Research (NZIER), had inflation forecasts that outperformed our own over comparable sample periods. We therefore examined their forecasts of other variables in greater detail. We also stepped back from numerical analysis and considered how our forecast stories compared with those of the NZIER.

Conclusion

The papers given here make up a large part of the research that lay behind the December 2002 Reserve Bank Bulletin article "The Reserve Bank's forecasting performance". However, they are not the full story. As well as the articles included here there was some work that reached dead ends. For example, running `counter-factual' experiments using the FPS model turned out to be

infeasible, and econometric analysis was plagued by technical issues and a lack of data. There was also much verbal discussion around the issues and historical context that cannot be captured in these written documents but which influenced thinking and conclusions.

Nonetheless, these documents provide much of the background research that led us to the conclusions contained within the aforementioned Bulletin article. It has been an interesting and worthwhile task analysing our forecast errors. Although we have not concluded that the results point to a need to immediately address any issues with our current forecasting approach, the findings reiterate the importance of continually reassessing our understanding of the economy.

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Definition of forecast error statistics

To assess forecasting performance, three basic measures of accuracy are calculated: the mean error (ME), the mean absolute error (MAE) and the root mean square error (RMSE).

The ME allows us to examine for the presence and direction of bias in the forecasts. When examining forecasts of inflation, for example, a positive ME indicates that on average we tend to over-predict the level of inflation, while a negative value would suggest that on average we under-predict it. We examine whether the bias in the forecast errors is significantly different from zero using t-tests.[1] When forecasts from different organisations are compared, F-tests are used to determine whether the mean forecast errors are statistically different from the Reserve Bank's mean forecast errors at each horizon. The mean error is defined as:

$$\frac{1}{T}\sum_{t=1}^{T} (F_t - A_t)$$ where T = number of observations

Ft = forecast of component
At = actual outturn

The MAE allows us to examine the size of our forecast errors. This approach assumes that the seriousness of a forecast error increases in a linear manner (eg a 2 per cent error is twice as serious as a 1 per cent error). The mean absolute error is calculated as follows, with the variables defined as above:

$$\frac{1}{T}\sum_{t=1}^{T}|F_t - A_t|$$

An alternative means of examining the size of our forecast errors is the RMSE. This measure assumes that larger forecast errors are of greater importance than smaller ones; hence they are given a more than proportionate penalty. The root mean square error (RMSE) is defined as:

$$\left[\frac{1}{T}\sum_{t=1}^{T}(F_t - A_t)^2\right]^{1/2}$$

Editor's note

Regrettably the formulae were given in the incorrect order in the December 2002 Bulletin article.

Glossary of acronyms

AAPC	Annual average per cent change (the per cent change in the average level of the past 4 quarters vs. the previous 4 quarters)
APC	Annual per cent change (the per cent change in the level of the series vs. the level 4 quarters previous)
BERL	Business and Economic Research Limited
Bps	Basis points (100 = 1 per cent)
CPI	Consumer Price Index
CPII	Consumer Price Index excluding interest costs
CPIX	Consumer Price Index excluding credit services
ER	Exchange rate
FPS	Forecasting and Policy System
GDP	Gross Domestic Product
GDPE	Gross Domestic Product - expenditure-based measure
GDPP	Gross Domestic Product - production-based measure
GST	Goods and Services Tax
HNZ	Housing New Zealand
HP	Hodrick-Prescott (smoothing filter)
IMF	International Monetary Fund
MAE	Mean absolute error
MCI	Monetary Conditions Index
ME	Mean error
MPC	Monetary Policy Committee
MPS	Monetary Policy Statement
MV	Multivariate (smoothing filter)

NBNZ	National Bank of New Zealand
NZD	New Zealand Dollar
NZIER	New Zealand Institute of Economic Research
OCR	Official Cash Rate
OECD	Organisation of Economic Cooperation and Development
PPI	Producer Price Index
QES	Quarterly Employment Survey
QP	Quarterly Predictions (NZIER publication)
QPC	Quarterly per cent change
QSBO	The NZIER's Quarterly Survey of Business Opinion
RBNZ	Reserve Bank of New Zealand
RMSE	Root mean squared error
SNA	System of National Accounts statistics
TWI	Trade-weighted index (exchange rate)

1 Note: in certain cases forecast errors are not normally distributed. This tends to occur due to the limited sample sizes. In such cases we test if the median forecast error is significantly different from zero.