Contents

Editor’s note

Articles
Introducing KITT: The Reserve Bank of New Zealand new DSGE model for forecasting and policy design
Kirdan Lees

The use of statistical forecasting models at the Reserve Bank of New Zealand
Chris Bloor

The Reserve Bank’s process for forecasting business investment
Tim Aldridge

The demographics of household inflation perceptions and expectations
Christina Leung

Exchange rates and export performance: evidence from micro-data
Lynda Sanderson

The evaporation of trust: Prasanna Gai on financial crises
Interview by David Hargreaves

For the record
Discussion papers
News releases
Publications
Articles in recent issues of the Reserve Bank of New Zealand Bulletin

This document is also available at www.rbnz.govt.nz

Copyright © 2009 Reserve Bank of New Zealand

ISSN 1174-7943 (print)
ISSN 1177-8644 (online)
Editor’s note

This edition of the Reserve Bank Bulletin features the theme of forecasting the New Zealand economy. Because adjustments to official interest rates mainly act with a lag of some quarters on inflation, accurately forecasting inflation and other economic developments is critical to central banks across the world.

In our first article on this theme, we are very pleased to introduce the Reserve Bank’s new model of the New Zealand economy, KITT (Kiwi Inflation Targeting Technology). The Reserve Bank has for many years emphasised the benefits that models can bring to organising policy discussions about economic conditions and the outlook. To support the Reserve Bank’s monetary policy deliberations, KITT will soon replace the current model, FPS, which is now more than ten years old. As Kirdan Lees explains, the theoretical foundations and empirical content of KITT significantly advance our modelling towards the current frontier of central bank practice. The article discusses how KITT models the interactions between New Zealand households and firms to build a richer picture of the macroeconomy.

Theoretically-consistent models such as KITT and FPS are a central tool in our economic assessments and policy consideration because they capture economic behaviour at a deep level. However, they are not the only modelling strategy available for forecasting purposes. In our second article, Chris Bloor discusses a range of models we use in our policy process that offer alternative means of interpreting the statistical patterns in the data and extrapolating them forward. The statistical model forecasts help develop our overall forecasts and provide a cross-check on the output of the central model.

Yet another important source of information for our economic assessments is provided by staff analysis of the economic indicators measuring activity at a very detailed level in New Zealand and other countries. These indicators number in the thousands, requiring expert assessment of which are providing the best signal about economic conditions at any given time. In our third article, Tim Aldridge provides an example of this style of analysis, focusing on business investment. Understanding developments in business investment is a key part of interpreting overall economic developments and building up a rich picture of the economy.

Our fourth article, by Christina Leung, looks in depth at how members of the public themselves form views about the future, particularly with regard to inflation. Durably maintaining price stability depends on the public being well-informed about the inflation situation, and acting on the basis that inflation will remain low and stable. The article discusses evidence from the Marketscope survey of household inflation expectations suggesting that households consistently over-predict inflation, and presents results of her research on the possible demographic influences on household inflation perceptions.

This micro-economic approach continues in our fifth article, in which Lynda Sanderson summarises a range of recent empirical work in which Reserve Bank staff have been involved on the impact of exchange rates on export behaviour. This research focuses on the impact of exchange rate movements at the level of the individual firm, including the effect of exchange rate volatility on bilateral exports and firms’ incentives to mitigate volatility in their export receipts through hedging. Like Christina Leung’s research, it is an example of how looking at individual firms’ and households’ behaviour can provide a deeper understanding of the channels through which economic and policy developments will be transmitted through the economy.

Finally in this edition, we present an interview with Prasanna Gai, a Professor at the Australian National University and consultant to the Bank of England. Professor Gai visited the Reserve Bank early in 2009. In the interview, he talks with David Hargreaves about the current financial crisis and its challenges for policy.

I hope you enjoy the range of articles in this edition.

Tim Ng
Editor
The Reserve Bank Museum celebrates and records New Zealand’s economic and banking heritage.

Displays range from timelines and interactive exhibits to comprehensive display panels outlining both the Reserve Bank’s history and role, and how the New Zealand economic system has developed.

Artefacts include the only working example in New Zealand of the MONIAC hydro-mechanical econometric computer developed by New Zealand economist and inventor Bill Phillips in the late 1940s.

In early 2008, the museum received its 10,000th visitor.

The museum is open 9.30a.m.–4.00p.m. weekdays. It is closed weekends, public holidays, and for special events. Please call to confirm opening hours.

Reserve Bank Museum
2 The Terrace
Wellington
New Zealand
ph 04-471-3682
museum@rbnz.govt.nz
http://www.rbnz.govt.nz/about/museum/2766074.html

Photography by Stephen A’Court.
ARTICLES

Introducing KITT: The Reserve Bank of New Zealand new DSGE model for forecasting and policy design

Kirdan Lees

The Reserve Bank of New Zealand has developed a new core macroeconomic model to replace the existing FPS (Forecasting and Policy System) model. KITT (Kiwi Inflation Targeting Technology), the new model, advances our modelling towards the frontier in terms of both theory and empirics. KITT reconfirms the Reserve Bank’s commitment to having a theoretically well-founded model at the heart of the monetary policy process. This article provides context about the reasons for the move to the new model, and an overview of the model itself. KITT builds a rich picture of the macroeconomic economy from specific assumptions about the microeconomic behaviour of households and firms that interact in several goods markets. The article illustrates the structure of the model, how this structure determines the way in which shocks or unexpected events propagate through the economy, and the role of the model in the forecast process.

1  Why the Reserve Bank decided to build KITT

Quantitative analysis using macroeconomic models has long been an important tool for monetary policy analysis. Central banks around the world are both customers and developers of medium to large scale macroeconomic models and have been for some time. In the RBNZ’s case we have been building and using these models since 1971 (see Deane 1971) and there have been many developments since (see for example, Gallacher et al., 1977; Spencer, 1979; Brooks and Gibbs, 1991 and Black et al., 1997). Since 1997, the Reserve Bank has used and continued to develop the FPS (Forecast and Policy System) model as a core macroeconomic model for informing and organising the forecasting process. The development of the KITT model carries on this modelling tradition.

Modern macroeconomic modellers develop their models from a set of microeconomic assumptions regarding the firms, households and policymakers that populate the economy. These models are DSGE (Dynamic Stochastic General Equilibrium) models and specify very particular assumptions. Relative to earlier DSGE models, the new generation of multi-sector macroeconomic models contains sufficient richness to model the interactions between households and firms in the different sectors of the New Zealand economy for forecasting and policy purposes.

“General equilibrium” models work with the assumption that markets clear across a range of sectors. The “stochastic label” refers to the shocks that hit the economy. Unlike static general equilibrium models, “dynamic” general equilibrium models explicitly map the transition across steady-state or long-run equilibria.

There are a number of reasons why the Reserve Bank decided to build a DSGE to replace the existing macroeconomic model.

It had been ten years since the last model development (FPS) and since that time there has been extensive development of monetary theory and the building of a consensus in monetary theory. Woodford (2003) and Gali (2008) provide a more detailed treatment of these theoretical principles.

Woodford (2009) characterises this consensus as founded on five principles:

(i) a coherent set of intertemporal general equilibrium microeconomic foundations;
(ii) that quantitative policy advice requires an econometrically validated structural model;
(iii) that expectations should be modelled as endogenous, and crucially, endogenous with respect to monetary policy;
(iv) that real disturbances and nominal rigidities are an important source of economic fluctuations;
(v) that monetary policy is effective in controlling inflation within the economy. FPS has some but not all of these features; KITT embodies all of them.

Multi-sector models develop the behaviour of prices from the costs faced by firms in tradable, non-tradable, and export sectors of the New Zealand economy. Explicit production functions specify the factors that drive inflation in each sector. Importantly, KITT assumes that it is firms’ marginal costs that drive pricing decisions. Marginal costs increase...
either when the costs of firms’ inputs increase, or when firms expand production to meet rising demand. While FPS told an aggregate story about how increases in demand for a single good translates into increases in inflation, KITT can tell a richer multi-sector story where inflation is determined by both a demand and supply-side story. Finally, agents’ expectations are rational, which ensures that a consistent microeconomic story underpins every forecast story developed with the model. These models can explain the data relatively well and are useful for forecasting purposes.

In addition to advances in macroeconomic theory, significant breakthroughs in Bayesian econometrics and improved computing power allow the new suite of DSGE models to be estimated more easily than before. Further, since the development of FPS, fundamental advances have been made in the techniques for solving these models for rational expectations behaviour.

Several central banks (for example, the Bank of England, the Riksbank, the Bank of Canada, the Central Bank of Chile and the Norges Bank) have successfully developed and implemented DSGE models (see Murchison and Rennison, 2006; Harrison et al., 2005; Medina and Soto, 2006; and Adolfson et al., 2007). When developing our DSGE model, the Reserve Bank used the experience of other central banks. In addition, our visitor programme brought in a number of academics and central bankers who enhanced our learning.

The following section discusses how KITT was built, before turning to an overview of the structure of KITT in section 3. Section 4 discusses the operation of the model within the policy and forecasting environment. Section 5 makes some concluding comments.

2 How the Reserve Bank built KITT

Naturally, there are many aspects of models that do not translate well across economies. Rather than take an existing off-the-shelf model, the decision was made early on to develop the new macroeconomic model in-house. This allowed our in-house modellers to build on the stock of knowledge formed around the existing FPS model, and in turn, to develop human capital, in both macroeconomic theory and estimating models using Bayesian techniques.

Model builders of today have a substantive dataset on which to evaluate and calibrate models from the post 1990 inflation targeting period. Data from this period should informed the model more directly than was the case for the calibrated FPS model.

The performance of the modelling project was evaluated against four overarching objectives:

1. A model estimated on data over the inflation targeting period;
2. The capability to address uncertainty by producing "fancharts", that is, explicit probability distributions about particular future economic events;
3. The capability to tell sufficiently rich economic stories, which capture most of the policy discussions that inform monetary policy; and
4. A model that can incorporate judgement easily and effectively and, in practice, prove useable for regular forecasting and policy formulation.

Together with a strong emphasis on developing a theoretically consistent DSGE model, these objectives provided the context for a single overarching objective: “to build a model worthy of replacing FPS”. We succeeded in building a model that satisfied these objectives.

3 Model structure

3.1 Overview

KITT’s structure is based on four broad productive sectors that summarise the New Zealand economy: non-tradable good producers; tradable good producers, producers of residential investment (used to construct houses that provide a stream of housing services); and exporters. Each sector produces a particular good using a particular combination of inputs. Each good is demanded by domestic households with the exception of export goods that are assumed to be only available for consumption by foreigners. Figure 1 details the production structure of the model with the boxes in red depicting the goods that sum to Gross Domestic Product.
Figure 1 shows that KITT models the export sector as being comprised of two goods: (i) manufactured exports (for example, prams, luxury yachts, ship mooring systems or conveyor belts), that we assume require an intermediate good for production; and (ii) commodity exports (for example logs, meat products and dairy powder) that we assume do not require the intermediate good for production and are thus relatively isolated from the domestic economy, but responsive to movements in the exchange rate and foreign price of New Zealand export goods.

Inflation can be decomposed into inflation in tradable goods that can, in principle, be traded internationally, and inflation in non-tradable goods, that cannot be traded. This decomposition underpins much of the Reserve Bank’s modelling and forecasting programme (see Matheson 2006, for supporting evidence for this strategy). Furthermore, within KITT we assign a specific role for fuel, which is both a consumption good and an input into the production of the intermediate good and tradable good. Within the model, the domestic fuel market is assumed to be a perfectly competitive market where firms simply pass on to consumers changes in the costs of importing fuel – the international price of oil and the New Zealand exchange rate.
3.2 Households
We make a number of specific assumptions regarding the consumption patterns of households to help match the patterns in macroeconomic data and consumption. We assume that households don’t like working. However, they gain utility from consumption, but only relative to the level of consumption in previous periods. This makes it difficult to rapidly switch consumption patterns in response to changes in household income and wealth and the price of consumption goods. This assumption helps us match the behaviour of aggregate consumption, and is relatively standard across several macroeconomic models.

We use a technical assumption (Cobb-Douglas aggregation of the different consumption goods) that in the long run there is a unit elasticity of substitution such that households increase the quantity of each good consumed in the same proportion as increases in income. This ensures that the nominal shares of production of the different types of goods are constant, allowing us to match the persistently higher inflation observed in non-tradable goods relative to tradable goods, over the past decade.

However, in the short-run we allow households to form habits over not just their intertemporal aggregate consumption decision, but over their decisions and preference to consume the different consumption goods, for example, the preference to consume non-tradable goods relative to tradable goods. This reduces the ability of consumers to rapidly switch between types of consumption goods – consistent with not only disaggregated consumption data, but reflected in the behaviour of non-tradables and tradables inflation.

Households derive utility from consuming a mix of four consumption goods: non-tradable goods; tradable goods; housing services; and fuel. Households have a preference that the set of goods that are consumed each quarter consist of at least some of each good.

To fund their expenditure, households receive income from a number of sources. They receive income from their labour, a return from business capital that the households are assumed to own and firms’ profits (that are assumed to be returned to households in their entirety). Further, the household budget constraint is affected by the household debt position and debt servicing costs.

3.3 Firms
A stylised fact of the New Zealand business cycle is an observed negative correlation between inflation in the tradable good sector and inflation in the non-tradable sector. This is at least partly driven by the behaviour of the exchange rate over the cycle. The exchange rate tends to appreciate when demand in the non-tradable sector is strong, making the cost of importing the tradable good fall. To match the behaviour of prices over the business cycle, KITT assumes that both tradable goods and non-traded goods are produced using an intermediate good in their production. The intermediate good (steel for example) is not available for direct consumption by households but is produced by combining labour, capital and fuel in the economy. Changes in the prices of these inputs then affect prices throughout the economy. Finally, the production of tradable goods involves the use of an extra oil input (above the fraction of oil that goes into the production of the intermediate good) to transport the tradable good to suitable retail outlets.

The model contains a housing sector where the existing housing stock is used to produce a housing service for domestic households. The housing stock is developed over time through the addition of residential investment. The addition of the housing sector helps us develop a story

Inflation is decomposed into inflation in tradable goods, that can, in principle, be traded internationally, and inflation in non-tradable goods, that cannot be traded.
about how increases in house prices impact on inflation. The recent cycle in house prices and concomitant increases in household consumption were a key driver of the most recent cycle. Box 1 explains in more technical detail, the operation of the housing sector.

3.4 Inflation

The interaction of firms and households forms the markets in which prices for the goods in the economy are determined. In terms of New Zealand’s Consumers Price Index, (CPI) these markets are non-tradable goods, tradable goods, construction or residential investment goods, and fuel.

However, this system is not sufficient to generate inflation processes that would mimic the dynamics we observe in practice. In particular, prices would be perfectly flexible and market forces would rule out persistent inflation. One key, repeated empirical finding is that prices are not perfectly flexible, implying monetary policy has effects on the real economy in the short run.

To generate some inertia or stickiness in prices, we assume that firms that operate in the non-tradable, tradable, and housing sectors operate in a monopolistic competitive environment. These firms would like to set their price in each period where marginal revenue equates with marginal cost, but face costs of adjusting prices in each period. This implies their markup over marginal cost varies over the cycle. In the absence of monopolistic competition, firms operating within a perfectly competitive environment would be insolvent if faced with adjustment costs that imply pricing below the breakeven point where price equals average variable cost. Figure 2 summarises the factors that determine inflation within KITT.

3 Note that introducing monopolistic competition prevents firms from capturing the entire market share of the sector by pricing at a point where the price is less than marginal cost.
On the right-hand side of the diagram, we can see that consumer price inflation is determined by a weighted summation of tradable good inflation, non-tradable good inflation, construction costs inflation and petrol price inflation. Since the observed petrol price displays relatively little inertia, we do not require the assumptions of marginal competition and sticky prices to generate the observed behaviour of petrol price inflation in the data. However, tradable inflation, non-tradable inflation and construction costs inflation are each determined by the degree of price stickiness in each sector and the marginal costs producers are confronted by in each sector.

The left-most boxes depict the factors that determine firms’ marginal costs in each sector. Turning to the top box that determines cost in the tradable good sector we can see that the intermediate good price and the price of fuel helps determine marginal cost in the tradable good sector since these are key production inputs. Furthermore, tradable good production takes an imported good and effectively readies it for domestic retailing, and is thus subject to increases in the underlying price of the imported good on the world market and fluctuations in the New Zealand dollar. Importantly, we assume that for each individual firm, the production of the tradable good has constant returns to scale such that firms can scale production up and down without changing the marginal cost of production. Individual firms can thus meet additional demand for tradable goods without generating additional inflation.

However, the second box in figure 2 shows that this assumption does not hold for the production of non-tradable goods. Marginal cost in the non-tradable sector is determined by both the price of intermediate goods and the non-tradable output gap.
Marginal cost in the non-tradable sector is determined by both the price of intermediate goods and the non-tradable output gap.

Since we assume that there are diminishing returns to scale in the non-tradable goods sector, firms’ costs and their marginal costs increase to meet additional demand. Additional demand for non-tradables directly generates inflationary pressure in the non-tradables sector.

The third box on the left of figure 2 shows the breakdown of marginal cost in the construction sector. While construction costs inflation comprises 5.5 percent of the consumer price index, it is important for understanding the increases in aggregate consumer price inflation associated with the increase in house prices over the most recent cycle. Within this sector, we assume that firms face diminishing returns to production such that meeting excess demand for residential investment — required to provide the housing stock necessary to provide households with the stream of housing services — requires increasing firms’ marginal cost, generating inflationary pressure.

Finally, we choose to model the production of a retail petrol good as simply a combination of the fuel price (adjusted for the tax component) with the exchange rate. Production is constant returns to scale with firms simply passing on changes in fuel and the exchange rate to final retail petrol prices, which we model with a very simple error correction mechanism.

3.5 Policy setting and the transmission mechanism

Within the model, monetary policy responds to future inflationary pressure. This behaviour is captured with a simple rule that also favours smaller interest rate moves over larger movements — everything else equal. Equation (1) below shows that the rule responds only to a small number of arguments: the deviation of inflation from the inflation target \((\ln p_t - \ln p_{t-1})\) and last period’s interest rate \((i_{t-1})\). The appropriate responsiveness to these terms (measured by the parameters and is a constant to capture the average real interest rate) reflects the requirements of the Policy Targets Agreement to avoid “unnecessary instability in output, interest rates and the exchange rate”.

\[
i_t = \rho i_{t-1} + (1-\rho)(\pi_t + \pi_t | t-1 (\ln p_t - \ln p_{t-1})) + \epsilon_t
\]  

These policy rates are transmitted through the economy via four key transmission channels: (i) the exchange rate channel; (ii) an asset price channel; (iii) the demand channel; and (iv) an expectations channel. Similar to FPS, the exchange rate channel of transmission plays a powerful role within KITT. The exchange rate directly helps determine inflation in the petrol and tradable sectors, and New Zealand’s export earnings. Moreover, in addition to the impact on exports, exchange rate appreciations have a powerful expenditure switching effect that promote importing and consumption of domestic goods, dependent on the position of the exchange rate in the cycle.

The total effect of these channels gives a powerful role to monetary policy. Monetary policy is effective in controlling inflation. The role for fiscal policy within the model is particularly simple, operating in the pure model form as an autoregressive process that imparts inflationary pressure in the model. This reflects the motivation for the construction of the DSGE model to provide a tool for setting monetary policy to control medium-term inflationary pressure, rather than setting fiscal policy. In the projection context, the paths for fiscal variables are set exogenously.
Exchange rate channel
To determine the impact of policy on the exchange rate almost all DSGE models, like KITT, use variations on the uncovered interest rate parity principle. The strict form of the uncovered interest rate parity condition assumes that the expected change in the exchange rate moves one-for-one with the difference between domestic and foreign interest rates. On a theoretical level, the assumption is particularly appealing because it implies the existence of a no arbitrage condition, such that investors move funds freely to take advantage of yield to the point where expectations of exchange rate movements affect the future gains from yield differentials.

On an empirical level, the theory has been widely rejected and provides a very unrealistic description of the exchange rate as a variable that jumps rapidly in the presence of new information. Instead, the exchange rate tends to move with some persistence. To reflect this, many central banks (for example the Riksbank and the Bank of Canada) have introduced variations on uncovered interest rate parity to avoid excess “jumpiness” or volatility in the exchange rate. This is also true of KITT where we assume that a fraction of agents are backward-looking and simply use last period’s UIP condition to determine the expected change in the exchange rate. This term could be interpreted as an endogenous deviation within the exchange rate equation, reflecting the need for an adjustment to the general equilibrium framework to account for a particular puzzle that DSGE, and in fact a broad class of models, have failed to account for.

Monetary policy is effective in controlling inflation.

Asset price channel
While box 1 shows how movements in asset prices impact on the risk-adjusted interest rates households face, movements in interest rates also affect asset prices. Both the housing stock and capital stock represent key assets that deliver a rate of return. When current and expected interest rates are high, households discount the future by more. This lowers the demand and hence the price of assets within the model. Since there are costs to installing investment, investment will not equal the desired change in the capital shock instantaneously so that investment becomes responsive to the interest rate and displays some persistence.

The demand channel
Within KITT, households optimise their intertemporal decision based on their expectation of the entire future path of interest rates. That is, not only do households base their decision to consume today or tomorrow (setting the marginal utility from extra consumption equal to the marginal benefit from saving) on the current period’s interest rate, this logic holds for all future periods. Importantly, this implies that households’ beliefs about longer term rates impact on today’s consumption decision. Within the model, longer rates and indeed the entire term structure reflects market participants’ beliefs about future short rates. In comparison FPS used a combination of short rates and long rates to determine both consumption and investment.

The expectations channel
Expectations are critical to understanding all the transmission channels in the model. Households decide whether to consume today with reference to expected future conditions. Firms’ investment decisions hinge crucially on the evolution of comparisons of expectations regarding the future economic conditions. Furthermore, expectations directly impact on the key inflation equations in the model. That monetary policy reacts directly to inflationary pressure reflects the importance of keeping expectations of future inflation closely anchored to the target inflation rate. Throughout the model, agents are assumed to be rational and to form expectations about future variables using current information in a manner consistent with the model. Critically, this includes the manner in which monetary policy is formed (see equation 1) such that households and firms internalise into their own decision-making and expectation formation, how responsive monetary policy is to inflation developments. This principle is consistent with Bernanke and
Woodford (1997) who advise policymakers to be informed by a structural model where agents form expectations based on that same structural model. Within this context, survey measures of inflation expectations provide a useful cross-check on any misspecification in the KITT model.

4 Model estimation and evaluation

4.1 Estimation
One of the key motivating factors behind replacing the existing forecasting model was to utilise the macroeconomic data more formally to estimate or inform the model parameters within KITT. In contrast, FPS is a calibrated macroeconomic model, where the values for the parameters in the model are simply chosen to produce a model that fits the data “well”, in the judgement of the modeller, where “well” is defined loosely if at all.

KITT is estimated on data from the first quarter of 1992 until the last quarter of 2008. This period defines a relatively stable inflation targeting regime. Typically most empirical work at the Reserve Bank eschews using data prior to the formal adoption of inflation targeting in February 1990 and typically favours removing the recession in the early 1990s associated with the transition to a lower inflation rate. Table 1 in the appendix lists the 27 data series we use to estimate the model. It is worth noting that for estimation and forecasting purposes not all model concepts require a directly observable data counterpart. However, matching model concepts (for example, non-tradable consumption) to directly observable counterparts helps us establish (or more technically, identify) the appropriate parameter values.

We estimate the model using Bayesian techniques. These techniques formally combine prior beliefs about the model (that may come from alternative information sources such as microeconomic data, anecdotal evidence, cross-country studies, strong beliefs about particular model properties such as a negative correlation between tradable and non-tradable inflation) with the data, producing distributions of parameter estimates that reflect both the data and the set of prior beliefs. These distributions of parameter estimates provide a natural and particularly useful device for characterising uncertainty, not readily available from a calibrated model.

In addition to the formal estimation of the model, we also employed a number of informal cross checks on the estimated model. Our modelling approach weights explanation of all the series in KITT we use to estimate the model equally. However, implicitly we place a high emphasis on a model that explains the behaviour of key macroeconomic variables, particularly inflation, in addition to output, interest rates, and the exchange rate – the variables that enter clause 4b of the Policy Targets Agreement.

4.2 Model properties
A sense of the properties of the model can be gained from looking at the impulse responses from the model, that is, the manner in which macroeconomic variables respond to the shocks within the model. For this exercise we present two of the 27 possible shocks that can be analysed in the model. Since the model is structural, these shocks will have a structural interpretation. This section presents two shocks:

(i) a shock to the level of non-tradable goods demand by households; and
(ii) a wage-cost push shock.

Figure 3, overleaf, depicts the impact of the non-tradable consumption shock to a selection of key macroeconomic variables. The panel in the top-left of the diagram shows the impact of the shock which increases non-tradables consumption. To meet increases in demand firms increase production but the decreasing returns to scale assumption implies the expansion of output increases marginal cost. The real price (deflated by the CPI) of the intermediate good increases, generating non-tradable inflation. This generates an increase in consumer price inflation and the policy rate increases in response. Tradable inflation follows a relatively
Figure 3
Non-tradable consumption shock

Note: The policy rate is expressed in percentage point terms, with 0.1 percentage points equivalent to 10 basis points. Horizontal axis units are quarters.
Figure 4
Wage cost shock

Note: The policy rate is expressed in percentage point terms, with 0.1 percentage points equivalent to 10 basis points. Horizontal axis units are quarters.
muted profile. Increasing tradable inflation from consumers switching towards tradable goods is approximately offset by an appreciation of the exchange rate in the short run.

Figure 4 shows the impact of a wage-cost shock within the model, where households demand higher compensation for a given level of labour. Such a shock increases wage inflation (depicted in the top-left panel) and hours worked by households falls since the cost of firms’ labour input has increased. Since labour is an input to the production of the intermediate good, the real price (relative to the CPI) of the intermediate good increases. This generates a hump-shaped response to the shock in aggregate inflation, which is returned to its original level after approximately twelve quarters. Policy responds to this inflationary pressure which in turn generates an appreciation of the exchange rate in the short run.

Using impulse response functions to compare the new KITT model to the existing FPS model are difficult since the structure, and hence the nature of the shocks, are different across models. However, one exercise that can be used to compare both models is the following hypothetical experiment. Holding everything else in the model constant, we assume that the interest rate is raised 100 basis points above the neutral nominal rate, held for four quarters and then released such that the endogenous policy rule then sets the interest rate. Figure 5 shows the results of such an experiment for four key macroeconomic variables, with model variables from KITT depicted with a solid blue line and FPS with a dotted red line.

Following the initial increase in the 90 day rate, the policy rate declines in both models, with this decline slightly more prolonged in KITT (where the rule places relatively more weight on last period’s nominal interest rate). This is effectively capturing the fact that the central bank does not want to move the interest rate in large amounts and that small movements in a similar direction are preferred, all else being equal.

Figure 5
KITT-FPS monetary policy experiment

Note: The policy rate is expressed in percentage point terms, with 0.5 percentage points equivalent to 50 basis points. Horizontal axis units are quarters.
In both models the increase in the policy rate produces a higher real interest rate and induces an appreciation in the real exchange rate as investors move funds to take advantage of higher domestic returns. This increase in the real exchange rate is marginally higher in FPS which actually displays a depreciated real exchange over the medium term. Furthermore, output declines in both models but returns to its previous level after approximately three years within KITT.

Finally, there is a somewhat smaller impact on aggregate consumer price inflation within FPS, compared to KITT. Inflation is returned to its previous value after approximately three years in KITT. This process takes longer within FPS. The initial fall in inflation is more pronounced within KITT because of the explicit role for fuel inflation within the model, which decreases sharply via the appreciation of the exchange rate.

5 Model operation in the policy environment

Throughout the development of KITT, emphasis was placed on the development of a model that would be well suited to the forecasting and policy environment of the Reserve Bank. Such a model serves a different purpose to many DSGE models within the monetary policy literature that are designed to address very specific policy questions. While KITT can address a wide range of research questions, KITT must also support the production of the forecasts that are published in the Reserve Bank of New Zealand’s Monetary Policy Statement, quarter after quarter.

One particular feature of the central bank environment is the access to a rich and diverse set of information. It is natural that the forecasts should be informed by these alternative data sources, not readily captured by the 27 variables KITT uses as inputs. These data sources span financial market information, firm-level survey data, near-term indicators, business contact visits, sectoral experts, anecdotal information and alternative statistical models (see

Figure 6
The role of the model in the forecast process

In-sample database → 1st pass forecasts
1st pass forecasts → 2nd pass forecasts
In-sample database → 1st pass forecasts
2nd pass forecasts → 2nd pass forecasts

Check initial conditions → Understand 1st pass
Understand 1st pass → Understand 2nd pass
Understand 2nd pass → Understand alternatives

Raw database → Monitoring quarters
Monitoring quarters → External projections
External projections → Judgement
Judgement → Main risks
Judgement → Main risks
Sens. adj & smoothing → Trends model
Trends model → In-sample database
In-sample database → 1st pass forecasts
1st pass forecasts → 2nd pass forecasts
2nd pass forecasts → Alternative scenarios
Alternative scenarios → Understand alternatives
an accompanying article, Bloor 2009). This environment has an impact on how the model is used. Aside from some treatment of the data, in this respect KITT operates in much the same way as FPS (see Drew and Frith 1998 for a more detailed treatment). Figure 6 shows a schematic of how the model is used within the forecasting process, with the additional information and timing of its incorporation within the process.

The top left of the schematic shows that the raw database is augmented with both monitoring quarter information and external projections. Monitoring quarter information is an assessment of this period’s macroeconomic data that may in practice be released with a one or two quarter lag (for example, Gross Domestic Product takes time to compile and produce, and is released with approximately a two quarter lag). KITT obtains monitoring quarter information from sector experts. In addition, because New Zealand is a small open economy and the effects of the New Zealand economy on the world can be assumed to be negligible, the model focuses on domestic data rather than an explicit set of assumptions for the foreign economy. In the forecasting environment, exogenous forecasts for foreign GDP, foreign interest rates, foreign prices and commodity prices are used to provide forecasts for the world outlook. This updated dataset is filtered using a trend model that takes a large number of series and establishes trends for variables including non-tradables, tradable consumption, business investment and exports. Judgement can be applied to the initial conditions that form the starting point for the “first pass” model forecasts.

After the model produces the initial first-pass model forecasts, the forecasts are tested against alternative information sources, including alternative forecasts, business survey information, financial market information and alternative interpretations of these information sets. Substantial judgement is added to the sets of forecasts by specifying the paths of particular variables and adding structural shocks to the model. These “second pass” forecasts are subject to a second round of judgement.

6 Concluding remarks

Development of KITT will enhance the economic modelling and forecasting underlying the quality of advice provided for monetary policy formulation. The model offers at least four substantive improvements over the existing FPS model: (i) a richer sectoral picture that decomposes inflation into predictions regarding non-tradables, tradables, petrol, construction costs; (ii) a structural framework that emphasises the role of firms’ marginal costs in addition to the output gap; (iii) a housing sector that allows a structural role for house prices to impact on consumption; and (iv) an estimated model that can help policymakers understand the uncertainty that surrounds model-based forecasts. That said, no model captures the richness and complexity of the forces that drive the business cycle. Like all models, KITT remains an abstraction from reality in a number of respects.

As our knowledge of the New Zealand economy evolves, so will our beliefs about the appropriate modelling structure to best represent the economy. Certainly our experience with the FPS model was one of continuous evolution (see Delbrück et al, 2008) and this will surely be the case with KITT. The model moves the Reserve Bank closer to the macromodelling frontier and provides a strong foundation for our forecasting and monetary policy advice.
References


### Appendix

#### Table 1

**Model variables**

<table>
<thead>
<tr>
<th>Series name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic interest rate</td>
<td>Reuters</td>
</tr>
<tr>
<td>Headline inflation</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Exchange rate growth</td>
<td>Reuters, RBNZ</td>
</tr>
<tr>
<td>Relative price of tradable</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Relative price for non-tradable</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Relative price of non-oil import</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real world price</td>
<td>DataStream</td>
</tr>
<tr>
<td>Real world oil price</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real price of non-commodity export</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real construction costs</td>
<td>RBNZ</td>
</tr>
<tr>
<td>Real price of commodity exports</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Relative price of houses</td>
<td>Quotable Value Limited</td>
</tr>
<tr>
<td>Real wages</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real total consumption</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real consumption of housing services</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real consumption of non-tradables</td>
<td>RBNZ estimate</td>
</tr>
<tr>
<td>Real business investment</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real Housing investment</td>
<td>RBNZ estimate</td>
</tr>
<tr>
<td>Real non-commodity exports</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real commodity exports</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real non-oil imports</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real oil imports</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Debt to nominal GDP</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Labour (hours paid)</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td>Foreign interest rate</td>
<td>RBNZ</td>
</tr>
<tr>
<td>Foreign real output</td>
<td>RBNZ</td>
</tr>
</tbody>
</table>
The use of statistical forecasting models at the Reserve Bank of New Zealand

Chris Bloor

Economic forecasts, in particular the forecasts for inflation, are an important part of the monetary policy formulation process at the Reserve Bank. The forecasts from a range of statistical models provide an important cross check for the forecasts produced by the main policy model that supports the policy deliberation process. This article describes the suite of statistical models used at the Reserve Bank and how these models fit into the forecasting process.

1 Introduction

The Policy Targets Agreement (PTA) sets out that the goal of monetary policy in New Zealand is to keep future inflation between 1 to 3 percent on average over the medium term. A key requirement for achieving this aim is forecasting the medium-term path of inflation. At the Reserve Bank of New Zealand, the forecasts underlying policy decisions are formed as part of a rigorous forecasting process. The forecasts from economic models are an important part of this process.

There are many different ways to model the economy, and the choice of model can result in materially different forecasts. Modelling approaches at the Reserve Bank can be split into two broad categories. The first are so-called structural models, where the model is based on theory about how agents in the economy operate. The existing policy model at the Reserve Bank (FPS) and the new policy model described in an accompanying article in this issue (KITT; Lees, 2009b) are both of this form.

Structural models offer many advantages to the model user. As the relationships in the model are based on economic theory, it is possible to tell rich stories about the particular drivers of the forecasts. The forecaster can incorporate important known features of the economy, such as the inflation target, into these models which may improve medium-term forecast accuracy. It is also possible to judgamentally adjust these forecasts in a consistent way, usually to incorporate information not captured by the model, so that judgement to one part of the model will have implications for other parts of the model. These features make structural models ideal as the main policy model at a central bank.

However, these models require the model builder to make very strong assumptions about the nature of the economy. These assumptions are often critical to the behaviour of the model, but are highly uncertain in practice. In many cases it is difficult to check the validity of these assumptions empirically, and choices are often made to achieve desired theoretically-motivated properties in the model rather than on the basis of strong supporting evidence in favour of one choice over another.

An alternative approach is to use forecasting methodologies that rely more on the statistical patterns in the data. These techniques generally require the modeller to make fewer assumptions about the structure of the economy. At the Reserve Bank, forecasts from this class of model are used as a cross check for the central forecasts produced with the help of the main policy model, and can provide a basis for incorporating judgement into the final published forecasts.

This article proceeds as follows: Section 2 outlines the motivation for using statistical models. Section 3 discusses the actual models used for medium-term forecasting. Section 4 discusses the historical forecast accuracy of these models. Section 5 discusses other modelling techniques used as near-term indicators, while section 6 discusses areas for future work. Section 7 concludes.

2 Why use statistical models?

Statistical models allow the user to estimate the historic relationships between macroeconomic variables, while remaining relatively agnostic about the true structure of the economy.
However, since the estimated relationships are based on historical correlations, rather than causal relationships based on formal assumptions about the behaviour of households and firms, it can be hard to decipher the drivers of a particular forecast. For example, a particular model may pick up that interest rates and the exchange rate have tended to move in the same direction over time, but cannot distinguish the direction in which the causality runs.

Nevertheless, statistical models generally produce forecasts of similar accuracy to judgementally adjusted forecasts from structural models. The former thus provide a useful cross check to the latter. Statistical models are used in the forecasting process at a number of central banks. (See, for example, Kapetanios et al. (2007) for the Bank of England, and Bjornland et al. (2009) for the Norges Bank.)

Generally statistical models are designed to forecast medium-term movements in the economy – roughly two to eight quarters into the future. This is the major focus of the statistical modelling work at the Reserve Bank. However, there are some techniques for forecasting shorter-term movements in the economy. These are discussed in more detail in section 5.

3 The Reserve Bank's medium-term statistical forecasting models

While statistical models generally remain agnostic about the structure of the economy, the model builder does still have to make a number of choices about what information to incorporate in their model. Models differ in terms of how much data enters into them (both the amount of historical data and the number of data series), what lag structure is allowed in the model, and what the functional relationship between data is.

The Reserve Bank's statistical model suite contains a range of different models that vary across each of these dimensions. For example, the smallest models in the suite use a single indicator to forecast the variable of interest, while the largest model contains around 400 series.

The statistical models used for medium-term forecasting at the Reserve Bank can be usefully split into four different groupings, ordered from the most data-driven to the least data-driven: factor models, bi-variate indicator models, vector autoregressive models, and Bayesian vector autoregressive models.

The forecasts from these models are one input into the forecasting and policy process at the Reserve Bank.

Factor models

Factor models are useful for summarising large quantities of data. The ability to forecast using large quantities of data means that the model builder does not have to make strong assumptions about which particular series are important for forecasting the variable of interest.

Factor models generally use principal components, a statistical technique, to estimate the underlying “common factors” generating fluctuations across a wide range of data. These factors are the linear combinations of all of the data in the model that explain the highest proportion of the variance in the data. These factors can thus be thought of as picking up the underlying movements in the economy that show through in a large number of series. These estimated factors are used as predictors in a linear regression on the forecast variable of interest.

Matheson (2006) developed a factor model of the New Zealand economy that is estimated with a panel of around 400 macroeconomic indicators. This model forms part of the Reserve Bank’s statistical modelling suite.

A common criticism of factor models is that their “black-box” nature makes it hard to interpret their forecasts. One technique to mitigate this is to split out the contributions of various classes of data to the forecasts. An example of the contributions to the factor model forecast for quarterly GDP growth at the end of 2008 is shown in figure 1. The black line shows that GDP growth was projected to be below average over the entire forecast horizon. The coloured bars show the contribution of each class of data to that forecast. They indicate that the low near-term GDP forecast at that time was primarily due to weakness exhibited in surveys of business conditions such as National Bank’s Business Outlook.
and NZIER’s Quarterly Survey of Business Opinion (the red bars on the graph). The own lag term picks up the portion of the GDP forecasts that is explained by the past history of GDP movements.

Figure 1
Contributions to factor model forecasts of GDP in 2008Q4

Bi-variate indicators
Rather than combining a large number of series into a small number of factors, an alternative approach is to use each series individually to forecast the variable of interest. Another type of forecast in our suite uses the factor model data panel to estimate a series of bi-variate regressions. A weighted average of the resulting forecasts is then created, with the weight determined by the in-sample fit of that particular indicator.

Since this methodology is averaging a large number of forecasts, each of which have relatively small predictive power, the resulting forecasts tend to be close to the historical average of that particular series.

Vector autoregressions (VARs)
In contrast to the previous two approaches, which are agnostic about which data provides predictive power, VARs require stronger assumptions to be made about the structure of the economy. While the forecaster need not specify the exact relationship between data, strong assumptions have to be made about which particular variables to include in the model, as these models typically include a dozen or fewer variables.

A VAR model is a system of equations where each variable is modelled as a function of contemporaneous and lagged values of the other variables in the system. Since each variable in the system enters the right hand side of each equation with a number of lags, the number of estimated parameters grows very quickly as the model size increases. As a consequence, these models tend to overfit the data and forecast poorly if too many variables or lags are included.¹

Therefore, VARs tend to be estimated with a relatively small number of variables, requiring the model builder to decide which variables are particularly important.

Nevertheless, this approach has some advantages over pure data driven approaches like factor models. In VAR models, the forecasts for each variable influence the forecasts for other variables in the system. This consistency between model variables makes it easier to interpret the economic story underlying the forecasts than in factor models or bi-variate indicators.

At the Reserve Bank we estimate a large number of VARs, and then average the forecasts across these models. This allows us to incorporate the information from a larger number of series without over-fitting any particular model.

Bayesian vector autoregressions (BVARs)
The use of Bayesian techniques is another way to overcome the problem of overfitting in standard VAR analysis. BVARs do this by imposing prior beliefs on parameter values. Generally these priors are a-theoretical in nature and are of a simple form, such as that all variables will remain at their current levels or grow at their average growth rates. These priors act to shrink the parameter estimates away from what would be obtained from an unrestricted VAR, and hence act to limit the signal that is allowed to be extracted from the data.

Using this approach it is possible to build models that forecast using a very large panel of data without exhibiting signs of overfitting. As is the case with VAR models the

¹ Overfitting occurs when too many parameters are estimated relative to the quantity of data available. An estimated model can achieve an arbitrarily close fit to the data over history as more parameters are included, but the estimated parameters will tend be inaccurate. As a result, an overfitted model will tend to forecast poorly.
forecasts for each variable are internally consistent, allowing the economic story to be disentangled.

Recently this modelling technique has been used to develop a 35 variable BVAR for the New Zealand economy, details of which are available in Bloor and Matheson (2009). This particular model employs conditional forecasting techniques that are usually associated with structural models like FPS or KITT. In other words, one can form forecasts that are conditional on certain events happening. For example, the forecasts from this model are often produced assuming that a certain outlook for the world economy will eventuate. Using these techniques, it is also possible to consider alternative scenarios, where assumptions about the path of exogenous variables are altered.

These techniques make this model more effective in the policy environment, as forecast stories can be effectively communicated, and differences from central forecasts can be more easily disentangled. For example, it is possible to decompose historical observations and the forecasts to the originating shocks that have hit the economy. While it would require very strong assumptions to allocate these shocks to particular variables, it is possible to allocate them to broader blocks of variables using relatively weak identifying assumptions. Figure 2 shows an example of the shock decomposition for GDP from the BVAR at the end of 2008. At that time the BVAR interpreted the 2008 recession as being due to a combination of world and domestic activity shocks. The assumed outlook for the world economy was interpreted as consistent with an improvement in the domestic economy over 2009.

### 4 Forecast accuracy

Since forecasts play an integral part to the policy process at the Reserve Bank, regular work is done to evaluate the forecasting performance of both the published forecasts and the various inputs into those forecasts. An example of this work is Turner (2008), which evaluated the Reserve Bank’s forecasting performance against Consensus Forecasts, an average of forecasts produced by reputable forecasters.

Figures 3 and 4 show the historical forecasting accuracy of the medium-term forecasting models in the statistical model suite compared with internal forecasts based on the Reserve Bank’s core structural model of the New Zealand economy, FPS, over the period 2000 to 2008. These are used as the main projections to inform the Reserve Bank’s policy discussions, and the projections published in each Monetary Policy Statement.\(^2\)

In these graphs, the measure of forecast accuracy used is the root mean squared forecast error (RMSFE) statistic, which is a measure of the average forecast error over time. It shows that many of the models in the statistical model suite have been able to produce more accurate forecasts than the main internal forecasts for GDP over the time period considered. However, only one model in the suite has been able to outperform the internal forecasts for CPI inflation.

**Figure 3**

Forecast accuracy for GDP (RMSFE)\(^3\)

---

\(^2\) See RBNZ (2004) for further details on how these forecasts are produced.

\(^3\) Forecast errors that are marked with an asterisk are statistically different from FPS-based forecasts at the 10 percent level. Big BVAR in these charts refers to the model described in the BVAR section of this paper, while the BVAR model is a smaller model which uses similar techniques.
While statistical models have been shown to produce similar forecast accuracy to the more sophisticated internal FPS-based forecasts over this particular time period, this may not always be the case. Stock and Watson (2007) show that over the period of low macroeconomic volatility labelled the Great Moderation, forecasting became easier, and it became increasingly difficult for more sophisticated models to outperform relatively simple statistical models. If this period of relative stability has come to an end, more complicated structural models of the economy may again show superior forecasting ability.

5 Near-term forecasting models

The Reserve Bank’s forecasts for the very near-term economic outlook are produced largely judgementally, taking into account large quantities of information. Generally statistical models struggle to match the accuracy of these short-horizon forecasts. This is often due to information available to the near-term forecaster that is difficult to incorporate into models, such as announced increases in electricity prices. However, there are an additional three models in the suite that are designed to pick up shorter-run fluctuations in specific areas of the economy. All three models are applications of the factor model methodology.

Factor augmented vector autoregression (FAVAR)

Matheson (2007) applied a variant of a factor model to New Zealand using around 2000 economic indicators. This particular model is designed to forecast using the most timely pieces of data that have been released, which makes the model particularly good at short-term forecasting. Historically it has produced more accurate forecasts for near-term GDP than the judgemental forecasts produced at the Reserve Bank. This model is an important input for the near-term GDP forecasts.

Factor model core inflation indicator

Measures of calculating core inflation are often employed by central banks to gauge the likely persistence of movements of inflation away from target. The first common factor extracted from a dataset of all sub-indexes in the CPI regimen is one measure of the underlying movements in inflation. This factor-model-based indicator of core inflation is described in more detail in Giannone and Matheson (2007) and Holden (2006).

QSBO cyclical indicator

A third short-term model is a factor model that is estimated only on data from NZIER’s Quarterly Survey of Business Opinion. The first factor from this model correlates well with capacity pressures in the economy, and is used as an indicator of the current cyclical position. This indicator has tended to give a one-year lead on movements in non-tradable inflation.

6 Frontiers of statistical modelling

In November the Reserve Bank held a conference on Nowcasting and Model Combination, a summary of which is available in Lees (2009a). This conference highlighted some of the frontiers of statistical modelling, and suggested some areas for future work at the Reserve Bank. Already underway is an evaluation of the benefits of model averaging compared to the forecasts from individual forecasts. Possible areas for future development include greater use of probabilistic forecasting, rather than forecasting the single most likely outcome, as well as modelling techniques that are more robust to structural change in the economy.
7 Conclusion
The forecasts from statistical models form an important part of the forecasting and policy process at the Reserve Bank. These techniques have tended to produce forecasts with similar accuracy to the Reserve Bank’s internal forecasts. While forecasts from statistical models often lack the richness of those produced by more structural models, techniques have been developed to improve the story telling ability of these models.

The continued development of statistical forecasting models represents part of the continued evolution of forecasting practice at the Reserve Bank. We regularly analyse our historical forecast performance, and this has provided impetus for the continued development of forecasting techniques.

References


The Reserve Bank’s process for forecasting business investment
Tim Aldridge

The Reserve Bank pays close attention to trends in business investment, due to its importance in contributing to inflationary pressure and the economy’s long-run productive capacity. This article discusses the components of business investment, and how the Reserve Bank forecasts them.

1 Introduction
Investment in new capital goods is central to the long-run health of the New Zealand economy. Without investment, the capital stock would become run down, and be insufficient to support the production of goods and services which we demand to maintain our standard of living. Changes in business investment can also have significant effects on inflationary pressure. In the short term, high levels of investment may heighten inflationary pressure due to the increased demand for resources necessary to produce investment goods, whereas, in the long run, investment also increases the potential output of the economy.

When a firm purchases a new capital asset or structure which is used to produce output, this is classified as business investment, a component of expenditure on Gross Domestic Product. All businesses, however small, carry out investment. For a small firm, a significant investment may be the purchase of a desktop computer, whereas, for a large company, it may be an entire factory.

Because business investment is a volatile component of expenditure on GDP, it is important for the Reserve Bank to forecast it as accurately as possible. While there are a number of indicators that provide useful information, economic judgement, which is based on both economic theory and more qualitative information sources such as the views of individual firms, is also important in arriving at the final projection for business investment.

This article begins by discussing the components of business investment in section 2, and the Reserve Bank’s approach to forecasting business investment is discussed in section 3.

2 Business investment and its components
The Reserve Bank forecasts business investment, residential investment and non-market (i.e. central government) investment separately. This is because each of these categories of investment is carried out by different sectors of the economy, and consequently, each category is driven by distinct factors.

In the national accounts, investment is described as gross capital formation, and is comprised of residential investment (i.e. new house construction and residential additions and alterations), changes in inventories, and investment in other fixed assets. At the Reserve Bank, we separate investment in other fixed assets into business investment and non-market investment. While the majority of business investment is carried out by the business sector, the category also includes investment carried out by state-owned enterprises and local government authorities. Total nominal business investment in the year ended December 2008 was $21.9 billion, or 12 percent of expenditure on GDP.

At the Reserve Bank, we also consider the components of business investment separately. Figure 1, overleaf, illustrates the relative size of each of the six major components of business investment.

These components are now discussed in turn. Figures 2 to 7, overleaf, plot the components of business investment as a share of GDP.

---

1 This is the definition of business investment that is going to be adopted by the Reserve Bank once the transition to the new macroeconomic model, KITT, is completed (see section 3 for more details). Previously, local government authority investment was included in non-market investment.
Statistics New Zealand publishes an estimate of plant, machinery and equipment (PME) investment, which captures investment in equipment used in the production process in industries including manufacturing, construction, agriculture and mining. Examples of PME investment include farm vehicles and machinery, construction machinery and electric-power generating machinery. Another recent, significant example of PME investment was an oil rig. At the Reserve Bank, we separate out computer investment from this component, because it has shown a different trend over history (see below). PME investment (ex-computers) is the largest component of business investment, accounting for around 28 percent of total business investment. This component fluctuates with the business cycle, around a relatively stable share of GDP, in both nominal and real terms.

- **Computer investment**

Computer investment is comprised of computer hardware used by firms. Because almost all computing equipment used in New Zealand is manufactured offshore, the Reserve Bank uses imports of data processing equipment as a proxy for this component. This series is quality adjusted by Statistics New Zealand, using a computer price index produced by a United States government agency. According to these estimates, the value of computer investment has been a relatively stable share of nominal GDP, while the real share has been increasing. This reflects rapidly improving computing technology, resulting in better value for money. There is little of evidence that computer investment follows the business cycle.

- **Transport equipment investment**

This component is comprised of vehicles used for commercial purposes, and includes commercial vehicles, aircraft, ships and rail vehicles. Commercial vehicles include trucks, but also passenger motor vehicles purchased by businesses, such as fleet vehicles, rental vehicles and taxis. Although commercial vehicles account for the majority of transport equipment investment, investment in large aircraft can result in sizeable fluctuations in this component. The majority of transport equipment is imported, although some heavy vehicle assembly and body manufacture, aircraft manufacture and ship building takes place in New Zealand. Over the past 20 years, transport equipment investment has fluctuated around a relatively stable share of GDP.

- **Non-residential investment**

Non-residential investment is comprised of the construction of office buildings, industrial buildings and other categories such as accommodation buildings. The upturn in new construction activity over the past five years or so was driven by new office and accommodation building activity, while spending on new factories remained virtually unchanged. Office construction currently makes up around 45 percent of non-residential investment, although this is significantly higher than the average proportion of non-residential investment over the past 20 years. Non-residential investment has the most pronounced cycle of all the business investment components.

- **Intangible asset investment**

Intangible asset investment includes both software investment and mineral exploration activity. Software development comprises about 90 percent of total intangible asset investment. Statistics New Zealand divides software investment into three categories. “Off-the-shelf software” is mass-produced software purchased by firms, “customised software” is individualised software developed especially for the client, and “own account software” is in-house produced software. Similar to computer investment, the real software investment share of GDP has been increasing, while it has been flat as a nominal share, due to technological progress bringing down the quality-adjusted price of software.

---

**Figure 1**

Components of business investment (% of total business investment)

- Plant, machinery and equipment investment (excluding computers)
- Computers
- Transport equipment
- Non-residential buildings
- Intangible assets
- Other construction and land improvement

Figure 1 shows the components of business investment as a percentage of total business investment.
Business investment components’ share of real and nominal GDP

‘Core’ (non-trending) components

Figure 2
Plant, machinery and equipment investment
(ex-computers)

Figure 3
Transport equipment investment

Figure 4
Non-residential investment

Figure 5
Other construction and land improvement investment

Trending components

Figure 6
Intangible asset investment

Figure 7
Computer investment

Note: Blue lines show real shares of GDP and red lines show nominal shares of GDP.
Sources: Statistics New Zealand, RBNZ Estimates.
Mineral exploration accounts for the remaining fraction of intangible asset investment and drives the majority of its volatility, because large projects start and finish at irregular intervals.

- **Other construction and land improvement investment**

Other construction encompasses construction associated with civil engineering, including major earthmoving activities.

Land improvement covers investment spending that is designed change the purpose of the land, so that its productivity can be enhanced. An example of land improvement investment is converting land previously used for a forest plantation into land suitable for use as a dairy farm.

This component is cyclical around a stable share of GDP.

It is important to note that a single investment project can be divided into several components of business investment. For example, a new factory might involve both non-residential investment (the factory building) and PME ex-computers investment (the new machinery installed inside the factory).

Typically we combine non-trending components (PME ex-computers, transport equipment, non-residential, and other construction and land improvement investment) to produce a “core” business investment series. We use this series to compare the current and projected investment cycles to past cycles, because the core business investment series does not have an upward trend over history.

3 **Forecasting business investment**

It is important for the Reserve Bank to accurately forecast business investment because of its impact on the business cycle. Although business investment comprises only around 12 percent of aggregate GDP, it is approximately five times as volatile as GDP. During periods of rising demand, business investment generally increases faster than GDP, and vice versa. Therefore, to accurately forecast economic activity, it is crucial to forecast business investment as accurately as possible.

The business investment cycle is reasonably well correlated with the aggregate economic cycle (figure 8). More specifically, when demand is strong, business investment tends to be above trend. This is because increasing demand generally results in firms utilising their productive capacity to a greater extent. As a result, to take advantage of rising demand, some firms will invest in new productive capacity.

On the other hand, during an economic downturn, falling demand will release spare productive capacity, thus reducing firms’ incentive to invest. The Reserve Bank’s overall activity forecast thus provides significant guidance for the business investment forecast. In addition, business investment is much more volatile than aggregate demand, increasing by more than GDP during an upturn, and declining by a greater amount during a recession (figure 8).

**Figure 8**

GDP growth and the business investment cycle

![GDP growth and the business investment cycle graph](image)

Sources: Statistics New Zealand, RBNZ estimates.

This ‘pro-cyclicality’ of business investment amplifies business cycles, and makes a significant contribution to changes in output through the business cycle. However, given that it is estimated that business investment has a significant imported content, of around 50 percent, changes in business investment have a less than one-for-one impact on output.

The process for forecasting business investment can be divided into the near-term forecast and the medium-term forecast. In the near term, indicators such as imports of capital equipment and vehicle registrations data provide some guidance as to likely business investment. In the medium term, i.e. a year or more ahead of the latest official data, the Reserve Bank’s economic model, and overall judgment, play a greater role in forecasting business investment.
The volatility of business investment means that forecast errors for this component of GDP are larger than for all the other components of expenditure on GDP that the Reserve Bank forecasts. However, the significant import content of business investment tends to reduce, to some degree, the effects on GDP forecasts of uncertainty in forecasting business investment.

Forecasting business investment in the near term
To forecast business investment in the near term, i.e. up to two to three quarters ahead of official GDP data, we use several economic indicators. These include capital goods imports data, capital goods price indices, and the exchange rate. We also visit a number of businesses and related organisations to obtain up-to-date information about economic activity and investment expectations. Each of these sources of information is now discussed in turn.

- **Capital imports**
The nominal amount of New Zealand's capital goods imports are published monthly by Statistics New Zealand. Monthly imports data provide a timely indication for the PME ex-computers, transport equipment, and computer investment components of business investment. However, a limitation of this data is that price changes result in nominal capital imports differing from real capital imports by varying and unpredictable amounts. For instance, an increase in the price of trucks will result in higher nominal capital imports of transport equipment, all else equal, even though the real amount of transport equipment imported is unchanged. However, this difficulty is mitigated to some extent by the quarterly capital goods price index series, which we use to deflate nominal capital imports. We also analyse exchange rate movements to help us get a picture of real capital imports. For example, for a given volume of nominal capital goods imports, a depreciation of the exchange rate will typically result in a higher value of capital goods imports, because most imports of capital equipment are denominated in foreign currency.

- **Building consents and other information relating to non-residential investment**
Non-residential consents indicate the value of newly approved buildings, and are published monthly by Statistics New Zealand. We remove components of non-residential consents that are dominated by government investment, such as education buildings, to arrive at a measure of “market” non-residential consents. Since all new building projects must be approved by the local council, and a consent issued, consents have historically proved to be a reliable indicator for trends in non-residential investment. However, sometimes consented projects may not come to fruition, for a variety of reasons, such as the developer losing access to finance. There is generally a lag of at least one quarter between changes in consents and changes in construction activity. Additionally, the volatile nature of monthly consents data, combined with the “lumpy” nature of large building projects, means that we must often interpret this data with caution. The changing cost of commercial construction will clearly affect the amount of real construction activity implied by a given level of consents. We use the capital goods price index for non-residential investment to adjust market non-residential consents to remove the effect of price changes as far as possible (figure 9), overleaf.

We also look at other information to gauge the medium-term outlook for non-residential investment. Office vacancy rates and capitalisation rates (the yield that the property generates) published by commercial real estate agencies can provide an indication for new construction activity in the medium term. For example, if vacancy rates are low and capitalisation rates are high, developers are likely to be encouraged to develop new buildings. There is usually a lag of several quarters between the start of development planning and construction. Property valuations that are provided by property investment trusts listed on the stock-market also provide us with a timely insight into the sector. For example, if a listed property trust devalues its portfolio of office property, this could reflect overall office building values in a city. In turn, this is likely to reduce the incentive to construct new office buildings, all else equal.
Vehicle registrations

Heavy vehicle and tractor registrations usually provide a reliable indication as to transport equipment investment in the quarter when the vehicle is registered, or the subsequent quarter. Registrations are in volume terms, and are therefore not affected by price changes. Occasionally, registrations are unreliable for indicating actual transport equipment investment because the lags between registration and investment can vary. For instance, in June 2008, truck dealers registered around twice the normal number of trucks normally registered in any given month, possibly because of an imminent change in heavy vehicle regulations. As noted above, capital imports of motor vehicles also provide information as to likely transport investment in the near term.

Business visits

As well as considering traditional economic indicators, Reserve Bank staff also visit businesses across the country throughout the year. The Reserve Bank visits leaders of around 50 different firms and business-related bodies, such as trade unions, employer associations, and industry groups in April, July, and September, and also conducts telephone interviews in early February. The organisations chosen for each round of business visits are designed to broadly reflect the sectors and industries that make up the economy. We typically make repeat visits to some contacts every one to three years, to help ensure consistency. The visits provide very useful “real-time” information about how businesses are seeing sales trends, and how they are reacting to the business environment in terms of their investment plans. If businesses are seeing things markedly differently to what is being suggested by the economic data, or other surveys, we may incorporate this information into the business investment forecast. Business contacts can provide the timeliest information of a turning point in the economic cycle, since economic data, by its nature, lags actual economic activity. On the other hand, the number of organisations we visit is low, and it is not possible to cover more than a few firms in any given industry, at best. Therefore, we are fairly cautious in generalising our contacts’ specific comments to general macroeconomic conditions.

Forecasting business investment beyond the near term

While we find the economic indicators described above helpful for forecasting business investment in the near term, we cannot rely on these indicators to inform us about the likely level of investment more than two or three quarters ahead. In the medium term, other drivers, such as surveyed investment expectations and the demand outlook, become more important. For instance, imports of capital goods did not decrease significantly over the second half of 2008, suggesting that PME ex-computers investment would tend to hold up in that period. However, evidence of tight credit conditions meant that the outlook over the medium term at that point looked less positive.

An important indicator for business investment in the medium term is provided by firms’ investment intentions, which are obtained from surveys of business opinion. The two most important business opinion surveys in New Zealand are the Quarterly Survey of Business Opinion (QSBO) published by the New Zealand Institute of Economic Research (NZIER), and the monthly National Bank Business Outlook (NBBQ) survey. Because firms’ investment decisions are based on their future sales and profitability expectations, investment is highly related to confidence levels. When a firm expects that an investment will yield a positive return, taking into account the firm’s cost of debt and equity capital, it is likely to make the investment if it can access the required funds.
The relationship between surveyed investment intentions and core business investment has been fairly close over the past 20 years (figure 10). Therefore, we pay close attention to surveyed investment intentions, and may revise our projection for business investment when surveyed intentions change significantly. The investment intentions series gives a long lead for changes in actual investment, which is helpful.

Figure 10
Core business investment and QSBO investment intentions

Further out in the forecast horizon, after a year or so, the relationships inherent in the Reserve Bank’s macroeconomic models become much more important for generating the projection for business investment. For example, the Reserve Bank’s current core macroeconomic model, FPS, relates business investment to the strength of the economy, the level of interest rates, and the level of investment required to achieve a ‘desired’ capital to output ratio, where that desired ratio is a long-run function of the cost of capital and assumed productivity growth (Delbrück et al, 2008). These factors on their own would typically produce forecasts for business investment that are more ‘jumpy’ than observed over history. To correct for this, FPS imposes adjustment costs to slow down the response. As discussed in an accompanying article in this edition (Lees, 2009), the Reserve Bank is soon to adopt a new model, KITT, for use in our forecasting process. In KITT, the tradable good sector produces business investment by combining capital, labour and imported goods. Business investment adds to the capital stock which is a key input to the production of an intermediate good, used widely throughout the productive sectors in the model.

The macroeconomic models that we use in generating economic forecasts reflect certain assumptions about the way the New Zealand economy works, and the typical business cycle. However, macroeconomic models cannot include all factors that affect business investment, and additionally, no two business cycles are ever the same in reality. Therefore, we must make judgements about whether the forecast the model generates for business investment over the medium term is reasonable or not, given the unique factors present at the time that the model cannot capture. For example, KITT does not capture the effects of changes in credit availability on business investment, which is an important factor to consider during the current business cycle.2

References

2 For detailed information about the Reserve Bank’s process for finalising economic projections, and determining monetary policy, see: Reserve Bank of New Zealand (2007).
The demographics of household inflation perceptions and expectations

Christina Leung

The Reserve Bank is interested in households’ inflation expectations, as they can provide useful insight into how inflation pressures have evolved in the economy. The Marketscope survey of household inflation expectations suggests that households consistently over-predict inflation. This article uses the Marketscope survey unit record data to find the possible drivers of the average level of over-prediction in household inflation expectations. Gaining a better understanding of how various demographic groups participate (or not, as the case may be) in the survey, and their different perceptions of inflation, enables the Reserve Bank to obtain a more accurate read of households’ true inflation perceptions. It discusses ways in which the Reserve Bank can improve households’ understanding of inflation developments in the economy.

1 Introduction

Inflation expectations measures play an important role in the Reserve Bank’s monetary policy process. Woodford (2001) highlights the increasing importance of managing expectations in effective monetary policy. Hence, it is important for the Reserve Bank to understand the inflation expectations of the different groups. In addition to helping the Reserve Bank to forecast inflation, inflation expectations can also be used to assess how effective the Reserve Bank has been in achieving credibility in keeping inflation under control.

This article looks at households’ inflation expectations at the individual respondent level, to examine whether inflation targeting has had different impacts on the inflation perceptions of various demographic groups.

In the past, the Reserve Bank has tended to give more attention to the inflation expectations of businesses, relative to the expectations of households, when forecasting underlying inflation. This is because businesses have shown themselves to be better than households at estimating inflation. This may be due to the fact that many businesses involved in the inflation expectations surveys are key price makers through the setting of prices, and thus will have better information on price movements in the economy.

Regardless of the reason why businesses’ inflation expectations provide a better estimate of actual inflation outcomes (as measured by the Consumers Price Index (CPI)) from a price stability standpoint the Reserve Bank is still interested in the measure of household inflation expectations if it accurately reflects households’ true perception of inflation. While businesses may be more useful in predicting underlying inflation, large deviations or changes in households’ inflation expectations may point to issues regarding the stability of the economy. Furthermore, household inflation expectations provide some indication of inflation outcomes such as wage bargaining, spending patterns and thus the current phase of the business cycle. Any bias in inflation perceptions is undesirable given that the bias will distort the decisions of households in the economy.

Therefore, it is important for the Bank to understand what drives these biases and look at ways of reducing them.

To gain a better understanding of the drivers behind the headline measure of the Marketscope survey of household inflation expectations, this article uses the unit record data to look at inflation expectations of various demographic groups. An analysis of the responses of individuals from June 1998 to September 2008 finds there are differences in perceptions of price movements across the demographic characteristics. Demographic characteristics of the respondent also had an influence on whether they answered the inflation questions at all.

I would like to thank staff at the Reserve Bank of New Zealand, including Graham Howard, Richard Fabling, Michael Kirker, Tim Hampton and Tim Ng, for their comments and assistance with the preparation of this article.
These findings have important implications for how the Bank uses this household inflation expectations measure. While the survey allocates weights to the respondents based on the distribution of the New Zealand population, and thus attempts to correct for the bias caused by those who choose not to participate in the survey, a proportion of the respondents do not answer the questions related to inflation while answering the other questions. This means there would be differences in the distributions of inflation expectations between respondents in the entire sample and the subset of those who answered all the inflation questions. If the inflation perceptions of these people who did not answer the inflation questions was in fact similar to that of respondents in their demographic group who answered the inflation questions, this selection bias would mean the weights allocated to the individual responses are likely to over- or under-represent certain various demographic characteristics of the New Zealand population.

The remainder of this article is structured as follows: section 2 describes the Marketscope survey of household inflation expectations, and how the headline measure has compared to actual inflation outcomes over the sample period. Section 3 examines the influence of various demographic characteristics on whether respondents will answer the inflation questions, and the influence on respondents’ perceptions of past inflation and expectations of future inflation. Section 4 discusses the policy implications of the findings. Section 5 concludes.

2 Perceived, expected and actual inflation

The Marketscope survey of household inflation expectations is a quarterly survey of 1,000 households, conducted as part of The Neilsen Company’s regular ‘omnibus’ telephone surveys. The sample is chosen such that every telephone location throughout New Zealand has an equal chance of being interviewed. This random sample of males and females aged 15 years and over is then weighted based on age within gender within region (all interlocked), such that the sample would be representative of these characteristics of the New Zealand population. Respondents are asked a range of demographic questions and their estimates of current and 12 month-ahead inflation.

Households have shown a tendency to both over estimate and over predict inflation (figure 1). This may be due to the greater frequency of purchases by households of the items that have tended to increase in price. However, analysis involving a reweighting of the CPI basket to contain only the items frequently purchased by households did not account for the difference in inflation perceptions between households and businesses (Ranchhod, 2003).

Figure 1
Marketscope one year-ahead inflation and actual inflation outcome (annual)

There have also been studies looking at the link between perceptions of current inflation and expectations of future inflation. The Bank of England (BoE) found half the respondents of the household inflation expectations survey reported that their perceptions of past inflation played an important role in forming their inflation expectations (Benford and Driver, 2008). The Federal Reserve Bank of Cleveland also found that the difference in inflation expectations amongst different income groups largely reflect differences in perceptions of price movements, with perceptions of inflation over the past year also overstated and to a greater degree than inflation expectations (Bryan and Venkalu, 2001).

Over the past decade, the Marketscope headline measure of both current inflation and one year-ahead expected inflation has tended to over-estimate inflation. The Marketscope survey also indicates that the errors of estimates of current inflation are closely related to errors on expectations of inflation in 12 months’ time. Figure 2 plots each respondents’ error on one
against the respondent’s error on the other, and shows the strong positive correlation between the two errors. However, the average ratio between the current inflation estimate error and 1 year-ahead inflation expectations error is less than one, indicating that the degree of bias in estimating current inflation is less than that of estimating 1 year-ahead inflation. This probably reflects the fact that households are likely to have more information about current inflation than inflation in a year’s time.

3 Influence of demographic characteristics on inflation perceptions and expectations

Overseas studies have tested whether there are differences in inflation expectations across demographic groups, with mixed results. The Reserve Bank of Australia (RBA) found that respondents with better education and whose jobs involved more access to information tended to have lower and more stable inflation expectations (Brischetto and de Brouwer, 1999). Similarly, a study by the Federal Reserve Bank of Cleveland found that lower income households tended to over-estimate inflation expectations to a greater extent (Bryan and Venkatu, 2001). In contrast, a study on household inflation expectation surveys in South Africa found that the inflation expectations of lower income and younger households are lower, and there was no difference amongst households of different education (Kershoff, 2000).

3.1 Probability of respondents answering the inflation questions by demographic groups

Our analysis of the unit record data in the Marketscope survey of New Zealand households also found that the demographic characteristics of respondents had an influence on their probability of answering the inflation questions (see Box A for further detail on the analysis). This has implications for both our interpretation of the headline measure of inflation estimates and expectations, and any policy aimed at improving the response rate for the inflation questions amongst the sample. We first discuss this finding and then look at the influence of demographic characteristics on the inflation question responses themselves.

The analysis found that the age, employment status, ethnicity, inflation-adjusted income, gender, occupation skill of the respondent, and where the respondent resided influenced whether they would answer all the inflation questions (see Table 1 in Box A). For example, respondents aged under 25 years were much less likely to answer the inflation questions than respondents aged 25 years and over. Respondents who were male or European also had a higher probability of answering the inflation questions than...
females or those of other ethnic groups. An increase in the real household income of the respondent increased the probability of answering the inflation questions, as did the skill level of the occupation of the respondent.

This has implications for the interpretation of the headline measures. While the entire sample of the household survey is weighted according to the distribution of age, gender and regional location of the New Zealand population, the subset consisting of the respondents who answered all the inflation questions (in addition to the questions relating to demographic characteristics) may not necessarily be representative of the New Zealand population. Our analysis assumes that those who did not answer the inflation questions were unwilling or unable to enumerate their expectations, rather than not having an expectation at all.

Figure 4 illustrates this difference in distribution for some of the key demographic characteristics found to have had a significant influence on answering the inflation questions, between the entire sample and the subset of those who answered all inflation questions. The weights based on the distribution of age, gender and region in the New Zealand population (as derived from the Census) are applied to the entire sample, including respondents who did not answer all inflation questions. Taking age group as an example, the proportion of respondents in the under-25 age group in the subset of respondents who answered all inflation questions is much smaller than in the entire sample. Combined with the significant influence found for the young age group on their answers to the inflation questions, there are limitations over the ability to generalise the results based on only those who answered all inflation questions.

The difference in response rate to the inflation questions between demographic characteristics may reflect a genuine lack of knowledge about the inflation environment. If that was the case, policies aimed at increasing financial literacy and awareness of inflation issues, for example amongst lower income households in the economy, should improve the response rate for the inflation questions (this issue is addressed further in Section 4).

3.2 The influence of the demographic characteristics of the respondent on their inflation perceptions

We analysed the unit record data to quantify the effects of the demographic characteristics on the degree of over-prediction and over-estimation of inflation. Figure 5 illustrates the contribution of each demographic characteristic to inflation bias. We show this for both estimates of current inflation and expectations of one year-ahead inflation of the respondents, relative to a baseline respondent. The baseline respondent is the respondent with the demographic characteristics most common in the sample, and the median real household income.

The bars show how the demographic characteristic is associated with a higher or lower inflation bias, relative to the baseline respondent. For example, being in the "Young" category (i.e., respondents aged under 25 years) adds on average 1.7 percentage points (as represented in the red bar in the "Young" column of the age group category) to the baseline inflation bias on one year-ahead expectations of 1.6 percentage points (as represented by the red line).

This means that the younger the respondent, the higher the upward inflation bias, with the difference particularly stark between respondents aged under 25 years old and respondents aged 25 years and over. Looking at ethnicity, respondents of non-European ethnicity had a much higher inflation bias relative to Europeans. The gender of the respondent mattered for inflation perceptions, with females having a higher inflation bias than males.
overlap between the different groups, and a very wide range of perceptions within each demographic group (figure 6). Taking gender as an example, while there is a greater inflation bias for females relative to males, a large number of males and females have the same degree of inflation bias, as reflected in the positions of the boxes representing each. In this diagram, the top of the boxes are the 75th percentiles of responses, the bottoms are the 25th percentiles, and the lines in between are the median responses.

Meanwhile, occupation skill and real household income of the respondent also affected the inflation bias of the respondent. An increase in the real income of the respondent generally decreased inflation bias, as did the skill level of the respondent’s occupation.

We had found a higher non-response rate amongst female respondents, those aged under 25 years old and those of non-European ethnic origin. If these non-respondents in fact had similar inflation perceptions to respondents in the same demographic group, and we were to correct for the under-representation of these demographic groups the headline inflation expectations measure would likely be even higher, given these demographic groups tend to have higher inflation perceptions.

These findings are in line with a similar study conducted by the Bank of England looking at the heterogeneity of inflation expectations amongst households (Blanchflower and MacCoille, 2009). Their analysis of micro-data from three different consumer surveys also found relatively high non-response rates amongst females, the young and those on the lowest incomes, thus pointing to the potential for bias of survey results. Comparing across the various surveys, they find non-response rates tend to be higher when quantitative responses are asked for. Turning to inflation perceptions, they find the more highly educated and higher income households generally have lower inflation expectations.

While some key demographic characteristics have a significant influence on inflation bias, a look at the distribution of estimation errors show there is actually a large degree of overlap between the different groups, and a very wide range of perceptions within each demographic group (figure 6). Taking gender as an example, while there is a greater inflation bias for females relative to males, a large number of males and females have the same degree of inflation bias, as reflected in the positions of the boxes representing each. In this diagram, the top of the boxes are the 75th percentiles of responses, the bottoms are the 25th percentiles, and the lines in between are the median responses.

### Figure 5
Contribution of key demographic characteristics to inflation perception bias

- Young
- Old
- Male
- Female
- European
- Non-European
- Full-time
- Part-time
- Low-skilled
- Skilled
- Auckland

- Additional contribution to current inflation bias
- Additional contribution to 1 year-ahead forecast bias
- Current inflation bias of baseline respondent
- 1 year-ahead forecast bias of baseline respondent

### Figure 6
Distribution of estimation error of 1 year-ahead for key demographic characteristics

- Age group
- Ethnicity
- Gender
- Young
- Middle
- Old
- Male
- Female
- European
- Non-European

### 4 Policy implications

It is possible that ethnicity, occupation skill level, nature of employment and real household income are capturing elements of education attainment of the respondent, which is not measured in the survey. Hence, the influence found in these demographic characteristics may be reflecting a difference in the awareness of economic issues. Maag and Lamla (2009) found the tone of media reports on inflation issues affected the dispersion in inflation expectations amongst households in Germany, with inflation reports emphasising the negative effects of high inflation reducing this dispersion. In addition, while the tone of the media coverage affected all educational groups, the reduction in inflation bias increased with increases in the level of education attainment. This indicates the more highly educated were more responsive to media reports about issues in the inflation environment.
Box A
Quantifying the effects of demographic characteristics on inflation perceptions

This Box outlines the econometric analysis used to quantify the effect of demographic characteristics on inflation perceptions. We first need to check for the potential influence of demographic characteristics on the probability of respondents in answering the inflation questions (estimate of inflation over the past year and expectations of one year-ahead inflation).

Firstly, a probit selection equation was estimated to predict the probability of the respondent answering the inflation questions based on their demographic characteristics. We focus on the key demographic characteristics that have been examined with respect to their influence on inflation expectations in previous studies: age, employment status (full-time, part-time or not at all), ethnicity, whether respondent was the main grocery shopper, household income, gender, skill of occupation, region respondent lives in, and quarter and year the survey was taken in.

To take into account of wage inflation over the sample period (with average weekly wages having increased by 44 percent from June 1998 to September 2008), we deflate the household income of respondents back to June 1998 levels before performing the regression.

The rest of the demographic characteristics are included as dummy variables in the equation, with the baseline chosen as the demographic characteristics that were most common over the sample period. Thus, the baseline respondent in this regression is aged 25 to 64 years, in full-time employment, European, main grocery shopper, male, in a semi-skilled occupation, and residing in a city other than Auckland.

Looking at the first part of the analysis, it was found that all of the demographic characteristics had a significant influence on the probability of the respondent answering all the inflation questions (table 1). The significance of the demographic characteristics points to the likely existence of selection bias in the subset of respondents who answered all the inflation questions. While the entire sample is weighted to be representative of the New Zealand population in terms of age, gender and region the respondent resided in, these weights are not corrected for the possible under or over-representation of respondents according to demographics in the subset of respondents who answered all the inflation questions.

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Coefficient</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age_y</td>
<td>-0.930</td>
<td>-32.190</td>
</tr>
<tr>
<td>Age_o</td>
<td>0.107</td>
<td>3.863</td>
</tr>
<tr>
<td>Emp_N</td>
<td>0.123</td>
<td>4.713</td>
</tr>
<tr>
<td>Emp_PT</td>
<td>0.071</td>
<td>3.326</td>
</tr>
<tr>
<td>Ethn_o</td>
<td>-0.510</td>
<td>-20.433</td>
</tr>
<tr>
<td>Groc_n</td>
<td>0.041</td>
<td>1.852</td>
</tr>
<tr>
<td>Groc_j</td>
<td>0.045</td>
<td>1.803</td>
</tr>
<tr>
<td>Real Income</td>
<td>0.338</td>
<td>21.368</td>
</tr>
<tr>
<td>HIncome_y</td>
<td>0.106</td>
<td>3.597</td>
</tr>
<tr>
<td>Gender_f</td>
<td>-0.704</td>
<td>-38.973</td>
</tr>
<tr>
<td>Skill_L</td>
<td>-0.233</td>
<td>-9.643</td>
</tr>
<tr>
<td>Skill_H</td>
<td>0.172</td>
<td>8.998</td>
</tr>
<tr>
<td>Region_A</td>
<td>0.056</td>
<td>3.423</td>
</tr>
<tr>
<td>Season_M</td>
<td>-0.003</td>
<td>-0.139</td>
</tr>
<tr>
<td>Season_J</td>
<td>0.001</td>
<td>0.051</td>
</tr>
<tr>
<td>Season_S</td>
<td>0.048</td>
<td>2.220</td>
</tr>
<tr>
<td>t</td>
<td>-0.033</td>
<td>-12.730</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.933</td>
<td>-17.191</td>
</tr>
</tbody>
</table>

R^2 = 0.184
n = 31031

Inclusion of an explanatory variable that determines selection into the subset of respondents who answered all inflation questions, but at the same time is not related to the inflation estimates the respondent gives, would correct for this selection bias. However, no such variable exists for the survey, hence we can only acknowledge the potential of this selection bias to influence the analysis quantifying the effects of demographic characteristics on the degree of over-estimation and over-prediction of inflation.

OLS regressions of the estimation error on current
inflation and estimation error on one year-ahead inflation against the demographic characteristics were performed to quantify the contribution of each to the degree of over-estimation and over-prediction of inflation. Due to the possible presence of multicollinearity amongst a few variables, strong conclusions cannot be reached about the significance of individual variables. However, given the large amount of data, the contribution of each variable can be drawn from the analysis with some confidence. These contributions are shown as variable coefficients in Table 2.

We find all of the demographic characteristics have a significant influence on the probability of the respondent answering all the inflation questions. The differing distribution of demographic characteristics between the entire sample and the subset of the respondents who answered all the inflation questions raises issues for the representativeness of this subset from which the inflation expectations measure is derived.

Table 2

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Current inflation estimate error Coefficient t-stat</th>
<th>Error on 1 year ahead inflation expectations Coefficient t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age_25</td>
<td>1.297 9.369</td>
<td>1.713 9.811</td>
</tr>
<tr>
<td>Age_65</td>
<td>-0.502 -4.858</td>
<td>-0.705 -5.292</td>
</tr>
<tr>
<td>Emp_N</td>
<td>-0.001 -0.011</td>
<td>0.061 0.463</td>
</tr>
<tr>
<td>Emp_PT</td>
<td>-0.059 -0.702</td>
<td>-0.044 -0.410</td>
</tr>
<tr>
<td>Ethn_O</td>
<td>2.052 17.674</td>
<td>2.642 17.724</td>
</tr>
<tr>
<td>Groc_N</td>
<td>-0.001 -0.020</td>
<td>-0.054 -0.564</td>
</tr>
<tr>
<td>Groc_J</td>
<td>0.033 0.374</td>
<td>0.106 0.944</td>
</tr>
<tr>
<td>Real income</td>
<td>-0.669 -10.773</td>
<td>-0.823 -10.411</td>
</tr>
<tr>
<td>Hincome_T</td>
<td>0.155 1.625</td>
<td>0.192 1.553</td>
</tr>
<tr>
<td>Gender_F</td>
<td>0.589 8.487</td>
<td>0.793 8.946</td>
</tr>
<tr>
<td>Skill_L</td>
<td>0.340 3.373</td>
<td>0.461 3.586</td>
</tr>
<tr>
<td>Skill_H</td>
<td>-0.290 -4.226</td>
<td>-0.403 -4.610</td>
</tr>
<tr>
<td>Region_A</td>
<td>0.066 1.080</td>
<td>-0.023 -0.289</td>
</tr>
<tr>
<td>Season_M</td>
<td>0.013 0.155</td>
<td>0.000 0.002</td>
</tr>
<tr>
<td>Season_J</td>
<td>-0.108 -1.360</td>
<td>-0.014 -0.143</td>
</tr>
<tr>
<td>Season_S</td>
<td>0.045 0.560</td>
<td>-0.078 -0.768</td>
</tr>
<tr>
<td>t</td>
<td>-0.023 -2.435</td>
<td>-0.038 -2.813</td>
</tr>
<tr>
<td>Constant</td>
<td>8.300 12.320</td>
<td>10.493 12.240</td>
</tr>
</tbody>
</table>

Demographic characteristics:

Real income = natural log of the inflation-adjusted household income of respondent

Dummy variables for whether respondent is:

Age_25 = aged under 25 years
Age_65 = aged over 65 years
Emp_N = not employed
Emp_PT = employed part-time
Groc_N = not the main grocery shopper
Groc_J = the joint grocery shopper
Hincome_T = in the top income bucket
Skill_L = in a low-skilled occupation
Skill_H = in a high-skilled occupation
Region_A = residing in Auckland
Gender_F = female
Ethn_O = of ethnic origin other than European

Variables referring to when survey was conducted:

Season_M = March
Season_J = June
Season_S = September
t = year, with 1998=0,...2008=10

R^2 = 0.051
n = 16805

R^2 = 0.059
n = 16044
It appears financial literacy is a key factor in the heterogeneity of inflation expectations amongst households. Hence, educating the public on developments in inflation and the economy more generally would likely result in an improvement in the accuracy of inflation perceptions. The most effective way to improve financial literacy across a broad range of households would be through the formal schooling system, as part of the curriculum in secondary schools.

It is also possible the higher inflation perceptions of respondents with lower real household income may indeed reflect the inflation they are facing. As discussed in the introduction, earlier analysis involving a reweighting of the CPI basket to contain only the items frequently purchased by households did not account for the difference in inflation perceptions between households and businesses (Ranchhod, 2003). However, it is possible the different consumption baskets amongst households with different household incomes may lead to differing rates of household cost increases. Given higher-income households are likely to spend a greater proportion of their income on items that tend to fall in price, such as electronics, the smaller degree of upward bias in these respondents’ expected inflation could be justified.

Related to this, it is possible the true inflation perception of respondents with lower household incomes is indeed higher. This would have implications for the saving rate of lower-income households. Higher perceptions of inflation would mean lower expected real interest rates, making spending more attractive relative to saving.

As discussed earlier, the weightings applied to the entire sample are likely to be over- or under-representing certain demographic characteristics. This limitation of the survey needs to be taken into consideration when interpreting the headline household inflation expectations measure. If we were to correct for the under-representation of females, respondents aged under 25 years old and those of non-European ethnic origin, the headline inflation expectations measure would likely be even higher, given these demographic groups tend to have higher inflation perceptions.

5 Conclusion

The Reserve Bank is interested in whether current measures of household inflation expectations provide an accurate read on households’ true perception of inflation, as well as the demographic groups with the greatest inflation perception bias. An analysis of the Marketscope household omnibus survey at the unit record level provides some detail on the drivers behind the headline measure of household inflation expectations.

Many demographic characteristics have an influence on the probability of survey respondents answering the inflation questions. This may reflect genuine lack of knowledge about inflation developments. Because the Reserve Bank takes its communications role seriously, part of effective communication policy would include educating the public to improve financial literacy. In the longer term, inclusion of financial literacy into the school curriculum would lead to an improvement across a broad range of households. One outcome sought through these efforts would be a higher response rate to the inflation questions, and hence a more accurate measure of true household inflation expectations.

Furthermore, analysis of the responses to the inflation questions shows some demographic characteristics influence inflation perceptions. This suggests the Reserve Bank can potentially bring down the overall inflation bias of households with education efforts targeted towards those groups with the greatest bias in their perceptions. Such a focus should provide benefits for both our forecasting purposes and price stability more generally, through the better anchoring of inflation expectations and stabilisation of the economy.

References


---

See Widdowson and Hailwood (2007).


Exchange rates and export performance:
 evidence from micro-data

Lynda Sanderson

This article presents a summary of early results from an ongoing Reserve Bank research programme on the impact of exchange rates on firm-level export behaviour. Understanding responses to exchange rate movements at the level of individual firms is key to a deeper understanding of the channels through which economic and policy changes are transmitted through the economy. Results suggest that New Zealand firms have limited ability to respond to exchange rate changes through price-setting. Rather, explicit hedging is common and firms’ trade behaviour reflects a desire to avoid the risk associated with exchange rate volatility.

1 Introduction

Understanding the relationship between exchange rate movements and firm behaviour is of importance to the Reserve Bank for two primary reasons. First, subject to its primary objective of maintaining price stability, the Reserve Bank is tasked with “avoid(ing) unnecessary instability in output, interest rates and the exchange rate” (Policy Targets Agreement, clause 4b). Understanding the impact of movements in the exchange rate on firms’ export and growth potential helps guide how best to consider volatility in the exchange rate alongside the other clause 4b objectives. Second, understanding how the exchange rate impacts on firms’ production and trade is useful for deepening our understanding of the transmission mechanism, which is largely derived from macroeconomic theory and evidence.

In this article we summarise recent Reserve Bank research on one aspect of the overall policy environment – the relationship between exchange rates and firm-level trade. This work represents the beginning of a longer term research programme utilising a new prototype database developed by Statistics New Zealand. The Longitudinal Business Database (LBD) draws together a range of existing datasets to create a comprehensive database of financial and other information about New Zealand firms (See Box 1). Such large-scale databases, and the computational power required to make full use of them, have become available to researchers only relatively recently. This data now allows researchers to consider a wide range of possible interactions between firm characteristics, the economic environment and firm performance.

Increasingly, researchers – including the central bank community – have used micro-economic datasets to address macroeconomic questions (see for example, Bils and Klenow 2004, Gopinath and Rigobon 2008, Klenow and Willis 2006, and Altissimo et al. 2006). While the Reserve Bank has developed a substantial body of macroeconomic research around both the immediate impact of interest rates on the exchange rate (see eg, Coleman and Karagedikli, 2008; Karagedikli and Siklos, 2008; and Smyth 2009) and the impact of open economy aspects of New Zealand’s transmission mechanism (eg, Munro and Sethi 2007, Drew et al. 2008, Lees 2009, Delbrück, et al. 2008), the microeconomic dimensions of this work have remained relatively underdeveloped.

The LBD work programme seeks to complement and deepen the Reserve Bank’s understanding from a microeconomic perspective. For example, while macroeconomic research typically fails to find a strong relationship between exchange rate volatility and trade, micro-economic analysis suggests that this result is due to aggregation. Small exporters select out of volatile markets, leaving only the stronger exporters, pushing up the average export value of remaining firms while having little impact on aggregate export value (Fabling, Sanderson and Taglioni, forthcoming).

Section 2 of this article discusses the theoretical reasons why exchange rates are expected to have an impact on firm-level trade behaviour, and the firm-level factors that might mitigate or exacerbate these effects. Section 3 summarises the results of four recent or forthcoming Reserve Bank discussion papers that consider a range of aspects of
Box 1
The Longitudinal Business Database

1 What is it?
The prototype Longitudinal Business Database was developed by Statistics New Zealand (SNZ) and draws together existing sources of firm-level micro-data into a comprehensive longitudinal database. The core data within the LBD covers almost 1 million private-for-profit firms over 8 years (2000-2007), with between 445,000 and 525,000 active firms in any given year. Among active firms, around one-third are employing in any given year.

The fundamental elements of the LBD consist of SNZ’s Longitudinal Business Frame (LBF), which provides information on industry, location and ownership; administrative data from the Inland Revenue Department (IRD) including goods and services (GST) returns, financial accounts (IR10), and company tax returns (IR4); information on employers, employees and wages aggregated to the firm level from the Linked Employer-Employee Dataset (LEED); and shipment level merchandise trade data provided by the New Zealand Customs Service (Customs). In addition to the core administrative data, a number of additional data sources have been linked to the LBD, including several surveys administered by SNZ and details of firms’ participation in government assistance programmes. More detail on the development and coverage of the LBD is available from Statistics New Zealand (2007) and Fabling et al. (2008).

2 Why Micro-data?
Micro-data not only opens up a range of specifically micro-economic research opportunities, it can also be used to throw new light on macroeconomic questions. Increasing availability of firm-level micro-data over recent years has shown that even within narrowly defined industries, firms differ dramatically on a range of dimensions, including size, productivity and export intensity (see eg, Bartlesman and Doms 2000 for a review of the literature). Firm heterogeneity, and the distribution of firms within the economy are key to understanding the channels through which economic and policy changes are transmitted. Because changes in economic conditions may impact very differently on different types of firm depending for example on their size, R&D intensity or past experience, the distribution of impacts may be widely skewed across the economy. This has implications for welfare, but also for the estimation of aggregate effects and responses to shocks.

3 Why is the LBD so useful?
The advantages that the LBD provides over past sources of micro-data are due to its three dimensional nature:

- Length: with eight years of firm performance data and an additional four years of detailed Customs data, the LBD provides the opportunity for looking at causal relationships, rather than simple cross-sectional associations. This is an essential element for any evaluative or predictive research.

- Breadth: as it contains data on all 44 economically significant firms in the New Zealand economy, the LBD can be used to provide representative statistical analysis of any relevant subsample of firms within the economy, or of the economy as a whole.

- Depth: the LBD provides a depth of detail on firm performance that has never before been available for New Zealand research. By linking quantitative performance data with quantitative and qualitative data on areas as diverse as innovation outcomes, ICT use and receipt of government assistance, the LBD opens the door to research on the causal impacts of a wide range of government policy areas.

Underlying the current work programme is comprehensive shipment-level data on merchandise trade, provided by the New Zealand Customs Service. Alongside details of product composition, volume, value and destination of merchandise exports, Customs forms also provide information about the currency in which the trade was denominated, whether the transaction was hedged and if so, at what rate. Such detailed data allows a greater emphasis on the actual exchange rate risk firms are undertaking when they trade, as well as permitting analysis of differences in behaviour across firms and products.
New Zealand’s merchandise trade performance, including its relationship to exchange rate movements: “Exchange rate uncertainty and firms’ trade” (Fabling, Sanderson and Tagliioni, forthcoming); “Over the Hedge? Exporters optimal and selective hedging choices” (Fabling and Grimes, 2008b); “The Evolution of Export Unit Values: Some stylised facts” (Fabling, Joyce and Sanderson, forthcoming); and “Export Market Choices of New Zealand Firms” (Fabling, Grimes and Sanderson, 2008). Section 4 outlines the Reserve Bank’s ongoing micro-economic research programme in this area.

2 How might exchange rate movements affect firm-level trade?

Exporting is a risky business at the best of times. Entering new export markets can impose substantial costs on firms – understanding foreign demand, negotiating country-specific regulations and setting up distribution networks – yet the majority of new export relationships fail to stretch beyond their first year (Fabling and Sanderson 2008). Figure 1 plots the Kaplan-Meier survival functions for entering exporters and for new trade relationships. These survival functions show the probability of a new trade relationship surviving for a given number of years.

In both cases, failure rates in the first year are very high, with only 36 percent of new relationships lasting more than one year. At the firm-level, roughly 60 percent of firms are still exporting after one year.

Although learning to manage exchange rate risk is just one of a myriad of skills that new exporters need to come to grips with, exchange rate fluctuations can have substantial impacts on the incentives firms face to engage in international trade. Exchange rates affect both the cost of imported intermediate inputs, and the prices that firms receive for their export goods. For a firm that has entered into a contract to supply or purchase goods at an agreed foreign currency price, exchange rate volatility can create risk since the firm may find that the New Zealand dollar value of the transaction has changed by the time payment is made. In the longer-term, real appreciation of the New Zealand dollar raises the relative price of New Zealand goods for foreign consumers, inhibiting export opportunities, while long-term real depreciation raises the real cost of imported inputs, increasing production costs.

Figure 1

Export survival functions

<table>
<thead>
<tr>
<th>Firm-level export survival</th>
<th>Relationship-level export survival</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Probability of survival</strong></td>
<td><strong>Probability of survival</strong></td>
</tr>
<tr>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Trade relationships are defined at the firm-country-product level. For example, a firm exporting toasters to Australia for the first time would count as a new trade relationship, and the relationship-level survival function would be based on the number of consecutive years that firm continued to export that product to that country. In contrast, the firm level survival function refers to the number of consecutive years over which a first-time exporter exports, regardless of the product and destination composition of those exports. We do not consider here the survival of the firm itself, only the longevity of its export status.
Exporting firms differ in both their degree of trade exposure and their ability to cope with the associated risks. Firms that export a large share of their total sales will, ceteris paribus, be more exposed to currency fluctuations as foreign currency denominated sales make up a greater proportion of their overall earnings. However, a wide range of firm-specific factors can act to exacerbate or ameliorate the risks associated with exchange rate volatility. If a firm is already in a fragile economic position, unexpected variation in its export income may be the last straw. On the other hand, firms with a diverse range of international operations may feel little or no effect from exchange rate movements, as decreased profitability in one part of their operations may be offset by higher returns in other areas. Also, firms with substantial market power may have greater ability to pass exchange rate movements through into prices, creating a buffer between exchange rate movements and export receipts. Finally, firms may take direct actions to reduce the extent of exchange rate volatility they face by using forward or options contracts to hedge their foreign exchange exposures.

The extent to which firms can mitigate the effect of exchange rate movements depends also on the magnitude and frequency of currency fluctuation and the length of the contract horizon. In the short run, over which costs of production and market prices can reasonably be assumed to remain stable, firms face transactions risk from the volatility of nominal exchange rates due to the time delay between entering into a contract and settling it. Measures such as hedging or denominating exports in the domestic currency provide a simple, low-cost way to gain certainty about returns in the face of such short-term volatility.

In the longer run, however, firms must make production and investment decisions that take into account changes in relative prices over time, as well as movements in the nominal exchange rate. These risks are much more difficult to manage. While firms could, in principle, use long-term forward contracts to reduce uncertainty about exchange rate movements, locking in a long-term foreign exchange contract can be expensive, as long-term forward exchange markets are very illiquid or non-existent, and can even increase risk. In particular, where there is some uncertainty about future export revenues (as is likely to be the case beyond the current contractual horizon) firms may find that by committing to sell a certain amount of foreign currency in the future they have unintentionally taken on additional risk if the anticipated foreign sales do not eventuate. Similarly, a firm that locks in a nominal exchange rate contract to cover future foreign currency transactions may find that even if the sales do eventuate, the real value of the hedged nominal rate has been eroded by differential inflation rates. For example, if prices rise more rapidly in New Zealand than elsewhere, exporting firms may find that their hedged export revenue is not enough to cover rising production costs. While hedging has reduced the exchange rate risk the firm faces, it may have increased the degree of inflation risk, by preventing the exporter from benefitting from any compensating depreciation in the local currency (see Brookes et al. 2000 for further discussion).

3 What have we learnt so far?

New Zealand merchandise exporters appear to be ‘currency-takers’

Central to the question of whether short-term exchange rate volatility has a detrimental effect on the profitability of exporting is the issue of whether firms are able to choose the currency in which trades are denominated. If firms are ‘currency-setters’, the impacts of short-term exchange rate volatility can be eliminated simply through choosing to denominate all exports in New Zealand dollars (though this does not eliminate longer-term economic exposure).

Evidence from micro-data strongly suggests that New Zealand firms are not able to freely choose the currency of denomination for exports. Prima facie evidence that firms are currency-takers can be gathered from the large proportion of firms that institute direct forward hedging – between 2005 and 2007 around 65 percent of non-NZD export value and 55 percent of non-NZD transactions were hedged (Fabling and Grimes 2008a). If firms could costlessly set export prices in NZD, there would be no reason for the

---

2 Das, Roberts and Tybout (2007) develop a structural model of export supply which takes into account firm heterogeneity and sunk costs of export market entry to model the effect of exchange rate depreciation using firm-level data from Colombia.
use of financial derivatives.

Further, if firms were able to reduce exchange rate risk by choosing the currency of trade, we would expect to see a negative correlation between the relative exchange rate volatility faced by a firm and the share of exports that that firm denominates in foreign currencies, as firms trading with volatile countries would choose to denominate a greater share of trade in NZD. However, there is in fact a mildly positive correlation (of 0.092), consistent with firms predominantly having the currency of trade imposed upon them (Fabling, Sanderson and Taglioni, forthcoming).

Fabling and Grimes (2008a) find that this result carries over with respect to the level of the exchange rate, as well as exchange rate volatility. They find that the proportion of trade with Australia denominated in AUD does not vary systematically with the bilateral exchange rate. This suggests that, even when exporting to Australia, firms are not able to manipulate the currency choice to take advantage of exchange rate movements.

A focus on bilateral exchange rates with the destination country fails to reflect the realities of (short-term) exchange rate risk

Although we have shown that New Zealand exporting firms are not, in general, currency-setters, this does not imply that trade always takes place in the currency of the importing country. Rather, a substantial proportion of trade takes place in ‘vehicle currencies’ – major currencies other than those of the importing or exporting countries. The use of vehicle currencies is most pronounced in trade with China, where over 80 percent of New Zealand exports are denominated not in New Zealand dollars or yuan, but in US dollars. Figure 2 compares merchandise trade shares by destination and currency of trade.3

When the possibility of exchange rate hedging is also taken into account, it becomes clear that any analysis of the trade impacts of exchange rate volatility must recognise not only the impact of longer-term real appreciations and depreciations in the bilateral exchange rate on relative purchasing power, but also shorter-term volatility in the currency of trade and the prevalence of exchange rate hedging. The relevant measure of exchange rates will depend on the time-frame we are interested in – volatility in the currency of trade will affect the realisation of short-run returns for exports where contractual prices

Figure 2
Aggregate 2007 trade shares by destination and currency of trade
(a) Currency shares of aggregate trade

(b) Destination shares of aggregate trade

3 Goldberg and Tille (2008) examine the relationship between invoice currency, the degree of product heterogeneity, and various characteristics of the exporting and destination countries. They find that relative country size is an important determinant of the choice of invoicing currency, with the currency of the larger trading partner being the more common choice of invoice currency for trade in either direction, and that homogeneous goods are more likely to be invoiced in a vehicle currency (generally the USD). Given these results, it is unsurprising that New Zealand has a relatively low share of exports invoiced in the domestic currency and a high share of USD denominated exports.
are denominated in foreign currencies, while bilateral real exchange rates will influence longer run demand and investment decisions.4

Firms react to exchange rate volatility both by reducing their trade exposure and hedging the exposure of their trade

Short-term exchange rate volatility impacts on the extensive and intensive margins of exports...

One of the clearest benefits of using micro-data to look at exchange rate impacts is that it allows researchers to consider not only the aggregate impacts of exchange rate movements, but also differential effects on firms with different characteristics or in different parts of the economy. This is important in order to understand the distributional impacts of exchange rate movements and also to better predict effects on aggregate export value. For example, the largest one percent of firms account for around 60 percent of merchandise exports, while small firms make up 45 percent of exporters but a mere two percent of export value (Fabling, Sanderson and Taglioni, forthcoming). Because exports are so concentrated, if exchange rate impacts are felt most heavily by small firms increased volatility may have a severe effect on a large number of firms without having a noticeable impact on aggregate export receipts. In contrast, if all firms are affected proportionally by exchange rate movements the impact on aggregate trade will be much stronger.

Perhaps because the effects of volatility may differ across firms, macroeconomic theory and evidence has failed to reach a consensus on the relationship between exchange rate volatility and aggregate trade performance. Early literature found everything from substantially negative to mildly positive impacts of volatility on trade (IMF, 1984; Côté 1994). More recent literature suggests that there may be a negative impact, but this is likely to be small or even insignificant (eg, see Schmidt-Hebbel, 2006).

The impact of short-run volatility on aggregate and firm-level exports is examined in Fabling, Sanderson & Taglioni (forthcoming). Using a standard gravity model of trade, we consider the effect that month-on-month volatility has on both the probability that firms will export to a given market, and the value of bilateral exports among remaining exporters. We find that short-run volatility in the trading currency has an adverse effect on both the extensive (number of exporting firms per market) and intensive (value of exports per exporting firm) margins, but find no evidence of a significant impact at the aggregate level.

Further, we show that the aggregate effect on bilateral exports is masked by compositional differences in the pool of firms that export to each market. Small firms self-select out of more volatile markets leaving only the larger, more experienced exporters, pushing up the average level of export receipts per firm.

Turning to a firm-level analysis, however, we find that when using a measure of volatility that accounts for hedging behaviour to more closely replicate the actual level of volatility faced by the firm and controlling for both country- and firm-level characteristics (eg, size, capital intensity), exchange rate volatility does have an effect on bilateral exports at the firm-level. Countries exhibiting a 10 percent higher level of residual exchange rate volatility receive on average six percent less exports by value per exporting firm.5 Future work will delve more deeply into whether this finding is consistent across firms with different characteristics.

...and on the margins of trading firms, through incomplete pass-through.

The extent to which firms may be hurt (or helped) by movements in the exchange rate depends in part on their ability to re-set prices in order to neutralise (or benefit from) exchange rate movements. Fabling, Joyce and Sanderson

---

4 Coleman (1988) considers the issue of whether prices of agricultural commodities are not only denominated but also priced in major third-country currencies, and hence whether exchange rate indices based on destination-weighted exports misrepresent the agricultural sectors foreign exchange exposure.

5 Volatility in this instance is based on the standard deviation of the month-on-month changes in nominal exchange rates between the NZD and the currency of trade over the prior 36 months. The currency-level volatility is set to zero for trade denominated in NZD or trade which has been hedged. This is aggregated to the firm level by weighting each export shipment by its share in firm-level trade.
(forthcoming) provide some initial descriptive analysis of the dispersion and evolution of export unit values across firms and over time. As unit values can be observed for detailed product classification, firm, destination and currency of invoice, it is possible to distinguish with reasonable confidence between real changes in prices and changes due to compositional differences in products and destinations. Such controls are important, since we show that firms often trade the “same” product to multiple countries at very different prices — differences that are only partially explainable by trade costs.

We find that unit values of export goods adjust frequently over time, and that movements in unit values are consistent with New Zealand firms being price-takers in a foreign currency. Unit values do not adjust one-for-one with currency movements i.e., exchange rate pass through is incomplete. As a consequence, there is greater volatility in the New Zealand dollar equivalent export receipts of firms denominated in foreign currencies than for firms that denominate their trade in the New Zealand dollar. This implies that firms are not able to fully compensate for exchange rate movements by altering prices, a result which fits well with earlier research showing that New Zealand firms actively manage foreign exchange risk in ways that suggest short-run currency movements have implications for their bottom line (Fabling and Grimes 2008b, discussed below).

*Longer term fluctuations also appear to depress trade*

While short-run volatility is clearly a factor in explaining bilateral trade behaviour, the impact of longer run appreciations and depreciations are harder to tie down. However, preliminary evidence suggests a moderate effect of exchange rate appreciations on firm-level trade.

Alongside the focus on exchange rate volatility, we also consider the impact of New Zealand dollar appreciations by looking at the relationship between exports and the deviation of the bilateral exchange rate from its average over the prior 36 months (Fabling, Sanderson and Taglioni, forthcoming). We find that the relative level of the bilateral exchange rate has little or no significance for predicting either aggregate trade or the number of firms in a given market, but that after controlling fully for firm characteristics, there is some evidence that a high New Zealand dollar suppresses the volume of trade in firm-level export relationships. Further work is required to ascertain whether this is due to firms shifting exports between markets or whether exchange rate appreciations actually reduce the total value of exports per firm.

Similar results are found in Fabling, Grimes and Sanderson (2008), which focuses on the determinants of entry into new export relationships. While this paper is focused on the relationship between own-firm international experience, learning from the behaviour of other firms and entry into new markets, preliminary results suggest that the relative level of the exchange rate also plays a part in determining firms’ export market entry choices. This effect appears to be asymmetric across appreciations and depreciations, with a low New Zealand dollar having a greater stimulatory effect on new market entry than the negative effect of an appreciation of similar size. As part of our ongoing work programme we intend to test the robustness of these findings further, and to consider the parallel impacts of exchange rate levels on exit from existing trade relationships.

*Firms instigate hedging contracts to directly mitigate short-term risk*

As noted above, the effect of exchange rate movements on firms’ trade behaviour depends not only on the severity of the volatility, but also on the firm’s ability to accept or to mitigate the associated risks. Focusing on trade between New Zealand and Australia, Fabling and Grimes (2008b)

---

6 Unit values are calculated at the monthly level, taking the total value of shipments of a given product during that month and dividing by the number of units (e.g. kilograms, litres).

7 Although ideally we should use real exchange rate measures to consider exchange rate movements over a longer time horizon, reliable price indices are not available for many of New Zealand’s smaller export destinations. The measure of the relative exchange rate used here is therefore constructed using nominal exchange rates. Empirically, this appears to be a reasonably safe approach, as correlation between monthly real and nominal exchange rates for those countries which have both available are well above 0.95 over the period 1999-2007.
consider the relationship between firm characteristics and one specific option that firms have for mitigating exchange rate risk - exchange rate hedging. The early theoretical finance literature (e.g., Modigliani and Miller, 1958) suggested that (under certain assumptions) if shareholders and debtholders are able to access the same financial products as firms, then alternative financing policies should have no effect on firm value. On that basis, exchange rate hedging by the firm should provide no additional benefit to the firm’s owners, and hence if hedging incurs a cost (e.g., administrative or transactions costs) then it must be inefficient. However, the empirical literature makes it clear that many firms do hedge at least some of their exchange rate (and other) risks. The theoretical literature has in turn caught up with the observed empirical realities, identifying circumstances in which firms may find it optimal to hedge.

Fabling and Grimes (2008b) explore the determinants of optimal exchange rate hedging, and find that the state of a firm’s balance sheet, managerial incentives and investment opportunities are among a range of factors that can affect a firm’s willingness to accept exchange rate risks. Firms that are highly leveraged, or which are likely to have need of internal financing for reinvestment are more likely to hedge against exchange rate risks than firms with a less constrained cashflow situation. Similarly, those firms which face a convex tax schedule due to a tax-loss carry-forward also exhibit higher hedging propensities. Meanwhile, hedging propensities are lower among those firms which have certain types of natural hedges in place including those which export in a range of currencies or that import from a range of countries.

Further, Fabling and Grimes (2008b) find that although hedging is more common among large firms than smaller firms, this difference can be fully explained by the greater likelihood of firms having past hedging experience. Thus, the difference in hedging rates between small and large appears to reflect a greater ability of large firms to carry the fixed costs associated with learning to hedge and setting up systems for managing exchange rate risk, rather than anything specific to the size of the firm.

**But not all hedging behaviour is risk mitigation**

While Fabling and Grimes (2008b) find evidence for optimal hedging strategies which reflect the risk set of the firm, they also find evidence for firms attempting to beat the market. Unless firms believe they have greater knowledge of future exchange rate movements than the rest of the market, optimal hedging theories suggest that after controlling for changes in the firm’s characteristics, there should be no reason for firms to hedge more when exchange rates are low than when they are high. Rather, hedging practices should reflect solely the degree of risk aversion of the firm, not beliefs that the exchange rate is too high or too low. However, Fabling and Grimes (2008b) find evidence that firms do attempt to time the market – specifically, hedging propensities are higher (lower) when the NZD is below (above) its historical average, implying that firms are attempting to lock in favourable exchange rates. Selective hedging is prevalent across a wide range of firms and economic conditions, but is somewhat more prevalent among firms which rely less heavily on exporting as a share of sales – perhaps reflecting a less developed understanding of exchange rate markets.

**4 What next?**

A fuller understanding on the impact of exchange rate movements on firm trade behaviour can help the Reserve Bank to better predict the impacts of policy changes on aggregate economic conditions and understand the longer run impacts of monetary policy on economic performance. This work is expected to complement, and in some cases clarify, the results of ongoing macroeconomic research. While the research outlined above provides some useful areas for consideration, we do not yet have the complete picture. For example, the finding that exchange rates have an impact on trade behaviour does not necessarily imply a negative impact on firm financial performance or profitability. Ongoing Reserve Bank research using the LBD looks at the question of whether exporting, and entry into new markets in particular, has a positive impact on firm performance.

---

*(Importing from a range of countries is used as an imperfect proxy for importing in a range of currencies, as currency data on imports is only available for a very limited time period.*
through increasing size or improved productivity. Future work in this area will also include an examination of the determinants of exit from export markets, including the question of whether firms that begin exporting when exchange rates are favourable tend to drop out if the New Zealand dollar appreciates.

The development of the LBD presents research opportunities well beyond issues of exchange rates and export behaviour. Other issues we might consider include the effect of inward direct investment on firm performance and worker outcomes, the extent of nominal wage rigidity in the New Zealand firms, and the effect of macroeconomic shocks on firm outcomes. In some areas, the LBD provides opportunities to extend the international literature in new directions, due to the depth of information available. At the same time, it allows us to test whether findings in the international literature are applicable to the New Zealand economy. The Reserve Bank anticipates that micro-economic analysis using this data will continue to enhance our understanding of the economy, complementing ongoing macro-economic research.

References


Munro, A and R Sethi (2007), Understanding the New Zealand current account: a structural approach, Reserve Bank of New Zealand Discussion Paper 2007/10


You’ve been at the Bank of England for quite a bit of your career, but doing your PhD before that. Now you’re back in academic life at ANU. What do you think of the two different environments?

I think the two environments are actually quite closely connected. The US model, where an academic moves into policy institutions and out again, is a nice one. Central bankers, in general, would benefit from it, and with the entry of academics like Mervyn King, Alan Blinder and Ben Bernanke into senior central bank positions, we are seeing a lot more exchange. That’s healthy for both sides because both parties can really engage with the other. The difference is not as big as people might expect.

How has that interplay affected the topics you have worked on?

I left the Southern Hemisphere to go to the UK to do my PhD in 1990. My motivation for leaving Australia at the time was to work on a policy related topic. My interests at the time were in (what I thought then) were developing country issues. I did my PhD on sovereign debt defaults in the 1980s, and the debt crisis. At the time I thought that was something that would probably lead me into a career in development economics, but I was lucky enough to get a job at the Bank of England. And financial crises have obviously been a developed country phenomenon since! I was offered a position at the Bank of England at the time of the ERM crisis and I left the Bank of England when Northern Rock was going on. And in between we’ve had Barings, Asia, LTCM and the dotcom bubble. So my research and policy interests were always nicely matched.

Do you think crises are going to keep coming at the same rate?

I hope not. I hope they’ll slow down so I can write a few papers! But I think it’s largely in the nature of the financial system that you will see imbalances building up and being corrected very sharply from time to time. I don’t think we’ll ever be in a world without crises. It’s a case of whether or not we have the policy framework to manage them effectively, and to temper their frequency.

One of your areas of expertise is systemic risk - the idea that institutions can appear safe at the individual level, but there could still be something in the makeup of the whole financial system that introduces risk. Could you talk about that a bit?
Systemic risk is something that academic economists have thought very little about. The literature on it is relatively thin. In a way, central bankers are taking the lead in developing thinking on this.

The idea behind my work on the topic is that there are important spillovers or externalities in the actions that individual financial institutions take. So you need a policy framework that will make institutions take into account the effects of those externalities on others. These externalities can take a number of different shapes, which is what makes the current crisis so complex.

For example, there are agency externalities between the principals (e.g., depositors) and agents (e.g., bank managers) relating to their different objectives. There are informational frictions that come from lack of common knowledge about valuations. The lack of understanding about what collateralised debt obligations, for example, really are is a good example of how the end user of a product can have very little information about the risk they’ve taken on.

And then there are the sorts of collective action problems that arise from balance sheet interdependency, where each creditor has an incentive to free ride on the others in terms of monitoring. The carry trade is a good example, where everyone wants to pile into a particular position or trade because others are doing so – there’s a herd type of behaviour.

And people get surprised when the herd suddenly changes course?

That’s right. It’s not just financial institutions that are subject to some of these externalities. Markets change course, so a liquid market can suddenly become illiquid when there are only sellers and no buyers, or vice versa. In a way, that’s been the big lesson of this crisis – that you can get a run on markets. It’s not just bank runs. Banks and capital markets are now very closely intertwined, and the two types of runs are now very closely linked.

You talked about how people would buy something like a collateralised debt obligation without really knowing what was in there. That presents some difficulties for the standard economic assumption that investors are well informed and rational. Why were people piling their money into these things if it wasn’t clear what it was that they were buying?

Well, I think they were confident, and confidence is at the heart of a lot of financial transactions. Investors were quite willing to take on certain transactions thinking that their counterparty was AAA-rated. They were pretty sure you could trade with Lehman Brothers and be confident about counter-party risk. What we’ve seen now is the evaporation of trust. People are no longer willing to trust the counterparties and the institutions that they’re used to dealing with.

Why were institutions set up in a way that allowed them to suddenly collapse?

I think the labour market for financial experts and how they are compensated is key in a lot of these things. Going forward, policy makers are likely to set more rules about executive compensation, and that’s probably not a bad thing. For example, they might focus on bonus structures being linked to long term profitability rather than year to year performance. You need to gauge performance over a long term window without the peaks and troughs. The nature of bonus schemes will have to be revisited.

In 1982, the debt default occurred in the public sector. By contrast, this crisis pretty much started out in the private sector. That’s probably partly because international capital flows have become largely private sector based over that intervening period. Is that going to have to change now?

I think capital flows will remain mostly private sector. What recent crises really highlight is the importance of creditor...
coordination issues. There is a family resemblance in creditor runs seen in the LTCM episode, the country run in Thailand and the problems in Iceland, but I don’t think you’ll see a change away from private sector flows to public sector flows. In part this is because the scale of capital flows is huge and public sector capital inflows will not really be able to meet the demands of developing countries for capital. But we’re going to need to rethink the way in which we control and shape those private capital movements. In a way, the lessons haven’t changed from the last big crisis.

“How do you plug the hole left by a sudden departure of private capital?”

What are some of the issues that policy makers should look at in this area?

The policy concerns are about the pros and cons of the fickleness of private capital, and some of the externalities that I was talking about a minute ago. The ability of private investors to be able to reverse their investment decisions very quickly is necessary for ensuring good behaviour amongst borrowers, but at the same time, the consequences can be extremely costly.

So, at the heart of better crisis management will be trying to design a framework that both deals with the positives of short term capital, while offsetting some of its potentially sharp consequences. In other words, how do you plug the hole left by a sudden departure of private capital? Having contingency plans in place for that is really the way in which we need to think about crisis resolution mechanisms, both at the international level and the regional level.

What about reform of national banking systems?

I think there needs to be a serious revisiting of banks’ approaches to liquidity management. Also, the idea of dynamic provisioning, or building capital cushions in the boom times to ward off possible future crises, is an important policy area that needs to be looked at seriously. Finally, I would like to see a more targeted approach that identifies the financial institutions that are most central to the system, and that puts the onus for adjustment on those institutions. In a way, requiring them to hold additional capital or liquidity cushions can serve as a tax on some of their activities.

The challenge for central banks, really, is to take a system-wide perspective, and to be able to identify the central financial institutions. That’s easy in the case of very large players, but in the case of marginal players like Lehmans in the US for example, it’s quite difficult to judge whether or not a particular player should be allowed to go under.

In all of this, we don’t have a counterfactual – how bad it could’ve been.

That’s very true.

Explaining these repeated crises seems a challenge for macroeconomics. Some academics, particularly outside of current macroeconomics, have been critical of how macroeconomics has developed in the last 10 or 15 years – the lack of attention to the possibility of default, for example. Do you think it’s true that current macroeconomics struggles to explain the events of the last couple of years?

Macroeconomics has certainly been the victim of its own success over the last few years. Certainly the joke at the Bank of England was that for a long time a lot of macroeconomists were moving to the Financial Stability Department because the economics was more interesting! But of course this was partly because of the great successes seen with inflation targeting in the UK during the late 90s. Macroeconomics in the academic profession hasn’t developed quite as fast. The work on financial crises is very much the terrain of microeconomists and financial economists at the moment.

Is it good to have the monetary policy and financial stability functions inside the same public institution in a crisis of that sort?

I think it’s very important, and the two functions should be talking closely to each other. They can seem like quite separate functions in normal times but are inseparable in crises. I think the sort of ideas mooted by people like Claudio
Borio, who are trying to knit together a macro-prudential approach, will be key going forward. Central banks need to make sure they have a structure that allows them to respond to that new reality.

“Central banks need to make sure they have a structure that allows them to respond to the new reality [of macro-prudential thinking].”

How do you think macroeconomics should change?
The crisis highlights the importance of taking a more eclectic approach to macroeconomic modelling. Focusing on a particular class of models – New Keynesian models for example – is not enough to address the sorts of policy problems that we’re actually confronted with. We need to look at a broader array of literatures ranging from microeconomics to micro structure, to banking and finance, risk management and risk modelling, and so forth.

You can’t really afford to take a dogmatic approach to the way you think about financial stability. What you’ll probably find is different models, but which share a similar heritage. You’re not necessarily going to see a particular model becoming the central tool – but you will see models of financial stability that marry elements of macro in different ways. And different central banks will have slightly different perspectives on the topic which will be healthy.

Some of these issues will be discussed in your forthcoming book.
Hopefully! I’m waiting for the crisis to settle down before I put actually pen to paper. At the moment it’s a little bit premature to try to articulate it all.

I remember Krugman saying that the Exchange Rate Mechanism crisis in Europe was quite a nice thing in some ways for macroeconomists, because they could see it coming. It validated their theories about the dangers in that system. Is there anything similar to that in the current situation – views that have been validated by the current crisis?

Certainly, if you look at both the theoretical academic work on the “new style” of financial crises, and if you look at the central banks’ financial stability reports from the last five years or so, there are clear indications that experts in the fields could see a crisis of this kind coming. An important example was the paper Rajan presented at Jackson Hole way back in 20051. This was a very prescient exposition of the idea that financial development has made the world riskier.

Overall, central banks have done quite a good job in anticipating some of the problems. But they’ve not been so good at thinking through how to manage the possible fallouts. For example, the “lender of last resort” and “market-maker of last resort” functions that have been required in many countries were put together very quickly. The tools and ideas (such as broadening eligible collateral for central bank operations) were not things that were openly discussed even within the central banks before the crisis hit.

Perhaps we’re quite lucky to have a Chairman of the Federal Reserve that has studied the Great Depression and the Japanese situation in the 1990s. Chairman Bernanke had thought and written about some of these possible policy responses.

There is some truth to that. There is definitely an advantage to having thought through what the causes of the crisis are and what the right sort of remedies might be. But there can also be a big difference between thinking about it from an academic perspective, and actually applying it. And once they have a course of action planned, central bank governors have also had to convince a lot of different players that they have the right remedies – politicians, markets, the public.

Great. Thanks for chatting, and for your visit.
Thank you. It’s been a pleasure visiting. I’ll have to enjoy this beautiful Wellington weather again sometime.

FOR THE RECORD

DISCUSSION PAPERS

DP2009/04
Forecasting national activity using lots of international predictors: an application to New Zealand
Sandra Eickmeier and Tim Ng
We apply “data-rich” factor and shrinkage methods to understand how large international datasets can be used to improve forecasts of New Zealand GDP. We find that exploiting a large number of international predictors can improve forecasts compared to more traditional models based on small datasets. This is in spite of New Zealand survey data capturing a substantial proportion of the predictive information in the international data. The largest forecasting accuracy gains from including international predictors are at longer forecast horizons. The forecasting performance achievable with the data-rich methods differs widely, with shrinkage methods and partial least squares performing best. We also assess the type of international data that contains the most predictive information for New Zealand growth over our sample.

DP2009/05
Using wavelets to measure core inflation: the case in New Zealand
David Baqaee
This paper uses wavelets to develop a core inflation measure for inflation targeting central banks. The analysis is applied to the case of New Zealand – the country with the longest history of explicit inflation targeting. We compare the performance of our proposed measure against some popular alternatives. Our measure does well at identifying a reliable medium-term trend in inflation. It also has comparable forecasting performance to standard benchmarks.

DP2009/06
Analysing wage and price dynamics in New Zealand
Ashley Dunstan, Troy Matheson and Hamish Pepper
This paper examines the relationship between wages and consumer prices in New Zealand over the last 15 years. Reflecting the open nature of the New Zealand economy, the headline CPI is disaggregated into non-tradable and tradable prices. We find that there is a joint causality between wages and disaggregate inflation. An increase in wage inflation forecasts an increase in non-tradable inflation. However, it is tradable inflation that drives wage inflation. While exogenous shocks to wages do not help to forecast inflation, the leading relationship from wages to non-tradable inflation implies that monitoring wages may prove useful for projecting the impact of other shocks on future inflation.
Ensuring the future health of the finance sector

31 March 2009

Everyone including depositors, the Reserve Bank, trustees and non-bank deposit takers has a role in ensuring the future health of the finance sector, Reserve Bank Head of Prudential Supervision, Toby Fiennes, said today.

Speaking to a business audience, Mr Fiennes said that it is important that everyone plays their part in making the new regulations work.

Mr Fiennes said non-bank deposit takers (NBDTs) - e.g. finance companies, building societies and credit unions - will be required to comply with a new set of prudential requirements. “The Reserve Bank is currently developing the relevant regulations which will be introduced in late 2009 and 2010. We are focused on ensuring these rules and regulations work for the NBDT sector.”

The new prudential regime aims to provide a consistent and rigorous approach to the supervision of deposit takers, and provides a stronger basis for confidence in the deposit-taking sector. “In addition, improved disclosure and credit ratings will assist depositors to make better-informed investment decisions,” he said.

It will be mandatory for all deposit takers to obtain a credit rating by March 2010. Mr Fiennes stressed that this is less than a year away, and deposit takers should be actively seeking to obtain these ratings now to avoid the risk of being unable to obtain a credit rating by March 2010 and therefore being in breach of the law.

“Credit ratings from approved rating agencies will play an important role in the new regulatory regime. Credit ratings assist depositors to better appreciate the risk they are taking and the rewards they are getting when they invest their money.”

Mr Fiennes said trustees are the frontline supervisors who are responsible for monitoring trust deed compliance, reporting to the Reserve Bank and enforcing compliance. “This will require trustees to be proactive, focused and assertive with their supervisory role. The Reserve Bank Act requires the Bank to review the NBDT regime, including the role of trustees within four years.

“The Reserve Bank looks forward to an effective working relationship with trustees and other regulatory agencies. We will ensure that we continue to encourage a collaborative approach so as to achieve a more resilient and enduring NBDT sector in the future,” Mr Fiennes concluded.

Long-term interest rates out of line with RBNZ expectations

1 April 2009

Reserve Bank Governor Alan Bollard today expressed concern over the recent strength of long-term wholesale interest rates.

“As we said in our 12 March Monetary Policy Statement, the economic recovery is expected to be very gradual. Furthermore, the risks around the outlook continue to be weighted to the downside,” Dr Bollard said in a statement.

“In these circumstances we believe the rise in longer-term interest rates is unwarranted and inconsistent with the monetary policy outlook.

“As indicated in our March Statement, we are projecting interest rates to remain at relatively low levels for an extended period.”

Dr Bollard said that if this apparent distortion persists, it could put unnecessary pressure on the cost of borrowing by firms and households.

Draft Insurance Bill released for consultation

20 April 2009

The Reserve Bank today announced the release of a draft Insurance (Prudential Supervision) Bill for stakeholder consultation.

The draft Bill reflects policy approvals provided by Cabinet in December 2007 and August 2008, and is being released for consultation with an expectation that respondents will focus on legal, drafting and operational issues.

Responses on matters of policy, other than those detailed in the explanatory note on the Bank’s website, are not sought in this consultation.
The draft Bill can be accessed on the Reserve Bank’s website (www.rbnz.govt.nz).

Stakeholder comments in response to this draft Bill and the additional explanatory note are sought from stakeholders by no later than 22 June 2009.

Following receipt of submissions to this consultation, the Reserve Bank will finalise the Insurance (Prudential Supervision) Bill for introduction to Parliament later in 2009.

Government appoints Reserve Bank directors
24 April 2009

Finance Minister Bill English announced two new appointments to the Reserve Bank’s board of directors today.

They are Christchurch consultant and professional director Sue Sheldon, who will begin on May 1 and Wellington consultant and professional director Keith Taylor, who will begin on July 1.

“In consideration of the skill set needed for a top performing Reserve Bank board, the government has looked for new directors with particular accounting and financial knowledge,” Mr English said.

“Sue Sheldon is a chartered accountant and brings a wealth of experience as a director across a diverse range of organisations including state-owned enterprises and private sector companies such as Freightways, Contact Energy, Smith City Group, and the Wool Industry Network.

“Keith Taylor has an insurance industry background having been the chief executive and chief financial officer of the publicly-listed company Tower. He also has experience as a director of the Earthquake Commission, Government Superannuation Fund Authority, and is a Member of the Takeovers Panel.”

The main role of the Reserve Bank’s board is to review the performance of the governor and the bank, including whether monetary policy is meeting the government’s policy targets.

“I’m confident these new directors have the skills necessary to help the bank fulfil its duty of meeting its targets and promoting and maintaining a sound and efficient financial system,” Mr English said.

The board normally consists of seven non-executive directors plus the governor. The new directors replace Marilyn Waring who completed a five-year term in February and Paul Baines, who leaves in June after two terms.

OCR reduced to 2.5 percent
30 April 2009

The Reserve Bank today reduced the Official Cash Rate (OCR) by 50 basis points to 2.5 percent.

Reserve Bank Governor Alan Bollard said: “Overall, developments since March point to lower medium-term inflation than previously projected. The main factors behind this are weaker global growth, and an unwarranted tightening in financial conditions via both higher long-term interest rates and a stronger exchange rate than expected.

“Global financial markets have showed some tentative signs of stabilisation since the March Monetary Policy Statement and governments in the major economies are continuing to make progress in resolving their banking system difficulties. However, a large amount still needs to be done and sentiment remains fragile. Negative feedback from the global recession could also still adversely affect financial institutions.

“The world economy deteriorated further than expected in the first quarter of 2009. While monetary and fiscal policy responses in many countries have been substantial and there are some signs of stabilisation in some countries, we still expect the adverse economic forces generated by the crisis to remain dominant throughout 2009. The timing and extent of global recovery remain highly uncertain.

“While the New Zealand economy has not experienced the same extreme falls in economic activity as seen in a number of our trading partners, it remains weak. Business sentiment is low, investment has been curtailed and employment reduced.

“We expect the large decline in the OCR over the past year to pass through to more borrowers over coming quarters as existing fixed-rate mortgages come up for re-pricing.
This, together with the stimulus from fiscal policy, will act to support the New Zealand economy and eventually see activity trough and pick up thereafter. However, the scale of the global financial crisis and domestic adjustments underway are such that it is likely to be some time before economic activity returns to robust and healthy levels.

“We consider it appropriate to provide further policy stimulus to the economy. We expect to keep the OCR at or below the current level through until the latter part of 2010. The OCR could still move modestly lower over the coming quarters.”

Global financial crisis still affecting NZ, says RBNZ

13 May 2009

“Despite the recent pick-up in world equity markets, New Zealand continues to be impacted by the global financial crisis,” Deputy Governor, Grant Spencer, said today when releasing the Reserve Bank’s May 2009 Financial Stability Report.

“Major government interventions have eased stresses in the international credit markets, but the adverse second-round effects of the financial crisis on global economic activity and commodity prices will take some time to play out,” he said.

“These global pressures are encouraging a recovery in household savings which should contribute to an improvement in New Zealand’s external balance over the next few years. Recent monetary and fiscal policy measures will help to ensure that the adjustment to more sustainable debt levels is an orderly one.

“The banking system has continued to lend to households and businesses over the past year, but credit growth has slowed in recent months, lending criteria have tightened and some businesses are reporting difficulties in obtaining credit.

While current conditions warrant caution, it is important that the banks continue to lend to creditworthy borrowers.”

Mr Spencer said New Zealand has been fortunate that its banking system has not experienced the distress seen in some countries. However, while the overall asset quality of the banks remains strong, impaired assets have increased sharply since late last year.

“Provisioning is expected to rise further over the year ahead as business profits weaken and unemployment rises. Banks must ensure that they make adequate provisions and maintain capital levels sufficient to absorb further unexpected losses.”

As discussed in earlier Financial Stability Reports, New Zealand banks remain vulnerable to external financial shocks as a result of their dependence on offshore borrowing. Conditions in the funding markets had improved since late 2008 and one bank had issued offshore term debt using the Government’s wholesale guarantee. Mr Spencer said banks need to lengthen the maturity structure of their funding to reduce their vulnerability to offshore market disruptions. The Reserve Bank’s new prudential liquidity policy, to be released around the end of May, will help to reinforce this objective.

Lending by the non-bank sector is continuing to contract, despite the easing of liquidity pressures as a result of the Government’s Deposit Guarantee Scheme. Asset quality has continued to deteriorate as a result of the economic downturn and the weak property market in particular. In the medium term, higher standards across the non-bank sector are likely to be reinforced by the new prudential regime, which the Reserve Bank is currently implementing.

Assessing and countering potential threats to financial stability in New Zealand will remain a high priority for the Reserve Bank while the effects of the global crisis persist, Mr Spencer said.

RBNZ offers to purchase NZ Govt July 2009 Bonds

19 May 2009

As is usual ahead of a government bond maturity, the Reserve Bank offers to purchase NZ government bonds maturing 15 July 2009 for liquidity management purposes. These purchases will help manage the large cash inflow to the banking system on 15 July as a result of the bond maturity (as at 30 April there were $4,197m of the 15 July 2009 bonds on issue in the market). Purchases will be made for the Bank’s own account and we expect to hold the bonds to maturity or they may be on sold to NZDMO.
This offer opens at 11am on 19 May 2009 and remains open until further notice.

Interested parties should telephone their offers to the Domestic Market section between 11am to 12pm and 2pm to 4pm daily.

Preferred settlement dates will be determined by projected liquidity flows to ensure that these purchases have a limited impact on the current level of settlement cash in the banking system. All transactions will be conducted on a yield to maturity (Treasury bill) basis. Details of purchases will be announced daily.

This operation has been undertaken to manage near term liquidity flows and has no implications for the Bank’s monetary policy stance.

**OCR unchanged at 2.5 percent**

*11 June 2009*

The Official Cash Rate (OCR) will remain unchanged at 2.50 percent.

Reserve Bank Governor Alan Bollard said: “The economic outlook remains weak both in New Zealand and in other countries. However, there are signs that international economic activity is stabilising, and international financial conditions are improving. We expect the New Zealand economy to begin growing again toward the end of this year but the recovery is likely to be slow and fragile. Many key economic indicators such as unemployment are projected to keep deteriorating well into 2010.

“There remain some material downside risks to activity and inflation, but for the first time in some months we can also identify some clear upside opportunities for activity. One such area is a potential rebound in household spending and residential investment as a result of the rise in net immigration and the pick-up in the housing market. Ultimately, however, we do not think such a rebound in spending would prove sustainable given the soft outlook for employment, wages and farm incomes and high levels of household debt.

“On balance, the risks to activity remain weighted to the downside.

“The recent rise in the New Zealand dollar creates an unhelpful tension with our projections. A stronger dollar at a time of weak global growth risks delaying or even reversing the projected increase in exports, putting the sustainability of recovery at risk.

“Overall, recent developments point to lower inflationary pressure than previously projected. Annual CPI inflation is likely to fall temporarily below the bottom of the target band later this year, but we expect it to return to inside the band by early 2010 and remain comfortably there over the remainder of the projection.

“We have cut the OCR by a large amount over the year. We expect the effects to pass through to more borrowers over coming quarters as existing fixed-rate mortgages come up for re-pricing. Although rising longer-term interest rates overseas are placing upward pressure on longer-term lending rates here, there is room for further reductions in shorter-term lending rates.

“The low OCR and stimulatory fiscal policy are the main sources of support to the New Zealand economy at present. It is likely to be some time before the recovery becomes self-sustaining and monetary policy support can be withdrawn.

“We therefore consider it appropriate to continue to provide substantial monetary policy stimulus to the economy. The OCR could still move modestly lower over the coming quarters. As we said at the time of the April OCR decision, we expect to keep the OCR at or below the current level through until the latter part of 2010.”
PUBLICATIONS

Regular publications
Annual Report Published in October each year.
Monetary Policy Statement Published quarterly. A statement from the Reserve Bank on the conduct of monetary policy.

Reserve Bank of New Zealand Statement of Intent, 2007-2010

Recent Reserve Bank Discussion Papers
2008

DP2008/01   Some benefits of monetary policy transparency in New Zealand
            Aaron Drew and Özer Karagedikli, January 2008

DP2008/02   Explaining movements in the NZ dollar – central bank communication and the
            surprise element in monetary policy?
            Özer Karagedikli and Pierre L Siklos, January 2008

DP2008/03   Changes in the transmission mechanism of monetary policy in New Zealand
            Aaron Drew, Özer Karagedikli, Rishab Sethi and Christie Smith, February 2008

DP2008/04   ‘Automatic’ cycle-stabilising capital requirements: what can be achieved?
            Tim Ng, February 2008

DP2008/05   How do housing wealth, financial wealth and consumption interact? Evidence
            from New Zealand
            Emmanuel De Veirman and Ashley Dunstan, February 2008

DP2008/06   The tax system and housing demand in New Zealand
            David Hargreaves, February 2008

DP2008/07   Heterogeneous expectations, adaptive learning, and forward-looking monetary policy
            Martin Fukac, May 2008

DP2008/08   A macro stress-testing model with feedback effects
            Mizuho Kida, May 2008

DP2008/09   Analysing shock transmission in a data-rich environment: A large
            BVAR for New Zealand
            Chris Bloor and Troy Matheson, May 2008

DP2008/10   Incorporating judgement with DSGE models
            Jaromír Beneš, Andrew Binning and Kirdan Lees, September 2008

DP2008/11   Limited information estimation and evaluation of DSGE models
            Martin Fukac and Adrian Pagan, September 2008

DP2008/12   The relative size of New Zealand exchange rate and interest rate responses to
            news
            Andrew Coleman and Özer Karagedikli, September 2008

DP2008/13   Real-time prediction with UK monetary aggregates in the presence of model
            uncertainty
            Anthony Garratt, Gary Koop, Shaun P Vahey and Emi Mise, September 2008

DP2008/14   Over the hedge? Exporters’ optimal and selective hedging choices
            Richard Fabling and Arthur Grimes, October 2008

DP2008/15   Practical monetary policies
            Alfred V Guender and David Gillmore, October 2008

DP2008/16   Inheritances and their impact on housing equity withdrawal
            Phil Briggs, December 2008
DP2008/17    Does natural rate variation matter? Evidence from New Zealand
             Michael Kirker, December 2008

DP2008/18    Combining forecast densities from VARs with uncertain instabilities
             Anne Sofie Jore, James Mitchell and Shaun Vahey, December 2008

DP2008/19    The evolution of the Forecasting and Policy System (FPS) at the
             Reserve Bank of New Zealand
             Felix Delbrück, Ashley Dunstan, David Hargreaves, Ashley Lienert,
             Hamish Pepper and Cath Sleeman, December 2008

2009

DP2009/01    Revealing monetary policy preferences
             Christie Smith

DP2009/02    Real-time conditional forecasts with Bayesian VARs: An application
             to New Zealand
             Chris Bloor and Troy Matheson

DP2009/03    Evaluating household expenditures and their relationship with house
             prices at the microeconomic level
             Mark Smith

DP2009/04    Forecasting national activity using lots of international predictors:
             an application to New Zealand
             Sandra Eickmeier and Tim Ng

DP2009/05    Using wavelets to measure core inflation: the case in New Zealand
             David Baqae

DP2009/06    Analysing wage and price dynamics in New Zealand
             Ashley Dunstan, Troy Matheson and Hamish Pepper

A full list of Discussion Papers is available from Administration, Economics Department.

Selected other publications
Testing stabilisation policy limits in a small open economy: proceedings from a macroeconomic policy forum
Finance and Expenditure Select Committee inquiry into the future monetary policy framework: submission by the
Reserve Bank of New Zealand

Pamphlets
Explaining Currency
Explaining Monetary Policy
The Reserve Bank and New Zealand’s Economic History
This is the Reserve Bank
Your Bank’s Disclosure Statement – what’s in it for you?
Snakes and Ladders – a guide to risk for savers and investors, by Mary Holm

For further information, go to www.rbnz.govt.nz, or contact:
Knowledge Centre
Knowledge Services Group
Reserve Bank of New Zealand
2 The Terrace, P O Box 2498
WELLINGTON
Phone (04) 4722–029
Articles in recent issues of the Reserve Bank of New Zealand Bulletin

Vol. 71, No. 2, June 2008
The New Zealand business cycle and monetary policy
Some perspectives on past recessions
The changing transmission mechanism of New Zealand monetary policy
The relationship between financial stability and monetary policy
The themes and thinking behind New Zealand's 1967 decimal coin designs
Establishing technical specifications for New Zealand's new 10 cent, 20 cent and 50 cent coins

Vol. 71, No. 3, September 2008
Inflation
Flexibility and the limits to inflation targeting
Inflation in New Zealand's trading partner economies
The costs of inflation – what have we learned?
Events precede ideas: Bob Gordon on macroeconomics and monetary policy
Financial turmoil and global imbalances: the end of Bretton Woods II?
A user's guide to credit ratings

Vol. 71, No. 4, December 2008
Liquidity and the New Zealand financial system
Evolution of the Reserve Bank's liquidity facilities
The global financial crisis and its transmission to New Zealand – an external balance sheet analysis
The Reserve Bank's payment system oversight role applied to settlement risk in the retail payment system
New legislation for regulation of non-bank deposit takers
Results from the recent survey of Bulletin readers

Vol. 72, No. 1, March 2009
Financial vulnerability of mortgage-indebted households in New Zealand - evidence from the Household Economic Survey
Thinking about more than one thing at a time: Eric Leeper on monetary and fiscal policy interactions
Recent trends and developments in currency
Overview of a recent Reserve Bank workshop: nowcasting with model combination
Coping with global financial and economic stresses