Kiwi drivers – the New Zealand dollar experience
AN 2012/02

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NON-TECHNICAL SUMMARY

On 1 August 2011 the Reserve Bank’s trade-weighted exchange rate index (TWI) rose to 75. The only previous time that this level was reached since the exchange rate was floated in 1985 was in July 2007. On both of these occasions, the high level of the TWI was matched by the ANZ commodity price index, which itself reached levels not seen in 30 years. The close timing of these peaks was almost certainly no coincidence. In this paper, we quantify this relationship and consider its importance for explaining the New Zealand dollar over the past 25 years relative to the many other influences, such as housing cycles and interest rate differentials.

The aim of this paper is not to estimate the “equilibrium”, “sustainable”, or in any other sense “appropriate” level for the New Zealand dollar, but rather to understand which variables have explained the movements of the New Zealand dollar. It is well known that foreign exchange markets can overshoot levels warranted by medium-term economic fundamentals. This paper does not attempt to address that issue at all.

This analysis is done in two steps. The first is to estimate the correlations between the New Zealand dollar and a group of indicators. We include a range of indicators that are commonly used in commentaries on the exchange rate. Each can be seen as capturing some aspect of the expected return on (and risk of) holding the New Zealand dollar relative to the return from holding trading partner currencies. Then, as a second step, we impose some plausible assumptions to disentangle the sources of new information that drive the New Zealand dollar. This is done using a statistical model with two blocks of variables, a domestic block and an international block. The domestic block is assumed to have no effect on the international block (New Zealand is too small to affect the world), but can be affected by it. This setup allows us to separate the impact of international factors (including the world price of the commodities New Zealand exports) from the domestic factors.

The models show that at times both international and domestic factors have influenced the New Zealand dollar, though the international effect was usually more substantial. The correlation between New Zealand’s export commodity prices and the New Zealand dollar seems to have been particularly important. For instance, the rise in export commodity prices over the past half-decade or so appears to have been the predominant reason the New Zealand dollar has reached recent high levels.

Often enough, domestic and international indicators have been influencing the exchange rate in broadly the same direction. Of the domestic indicators, house price inflation appears to have been most closely related to the exchange rate. The models show a strong correlation between the swings in the exchange rate during the last few years and the large movements in both commodity prices and relative house price...
inflation (indeed recent swings in the exchange rate have been no harder to explain than those in earlier periods). The results show that Interest rate differentials provided little new information for explaining the exchange rate over the post-float sample. This is probably because interest rates themselves are determined by a wide range of real economic variables and so add little additional information beyond that already captured in the real economic variables, such as house price inflation differentials and commodity prices.

1. INTRODUCTION

In general, and despite a large literature, exchange rates are not that well understood. There is no modeling approach that captures all of the influences on the New Zealand dollar all of the time, thus it is useful to consider many models. This paper outlines a couple of methods used to understand fluctuations in the New Zealand dollar exchange rate for cyclical macroeconomic purposes. This paper does not attempt to understand day to day movements driven by international risk sentiment and other short-term factors, such as those considered by Cassino and Wallis (2010). And, at the other end of the spectrum, we do not attempt to explain any long-run trends or try estimate the equilibrium exchange rate, as done by Brook and Hargreaves (2000). More generally, nothing in this paper attempts to assess whether the exchange rate has been at a “sustainable” or “appropriate” level at any particular point of time. We are simply trying to understand which factors have been important in explaining fluctuations in the exchange rate through the floating exchange rate period.

To understand the approach used in this paper, one can think of the New Zealand dollar as an asset and the exchange rate as its price. Many factors influence the expected return on this asset and the perceived risk of holding it. Market participants evaluate new information, adjust their expectations of future returns and trade accordingly. Unfortunately, representative measures of expected New Zealand dollar returns are not available, but by considering the correlations between the New Zealand dollar and various indicators we implicitly try capture the influence of our indicators on these expected returns. Short-term interest rate differentials are one of the indicators that we consider, though they only proxy future returns. Chen and Rogoff (2003) show that export commodity prices have a strong influence on the New Zealand dollar, suggesting these prices are one of the things that influence expected New Zealand dollar returns.¹

The starting point for our analysis, referred to as the indicator model, determines the key correlations between the real exchange rate (RER) and a pool of indicators. We address the causation question using a structural vector autoregression (SVAR) model. Specifically, we use a SVAR that has two blocks of variables, an international

¹ For a discussion of an asset price view of the exchange rate see Munro (2004) and Mabin (2010).
block and a domestic block. A Cholesky decomposition allows us to identify the origin of the shocks in this model.²

### 2. INDICATOR MODEL

The indicator model shows the key correlations between the exchange rate and a pool of indicators. We include indicators that have been suggested in commentaries or other research as being important parts of the New Zealand dollar story. Each can be seen as, in some way, influencing markets’ expectations of New Zealand dollar returns relative to the returns on trading partner currencies (or the relative risks around these returns). As such, we include both domestic and international indicators. These indicators, however, are just spot data (that is observed outcomes in a given period) and do not explicitly capture expectations. We start with this indicator approach because it is intuitive; that is, one can easily see the indicators that have been strongly associated with the exchange rate. The results, however, are only correlations.

The model focuses on the real exchange rate (the Reserve Bank's real five-country analytical trade weighted index).³ We use the price-adjusted exchange rate (that is the ‘real’ exchange rate) because it is more likely to have a stable mean than a nominal exchange rate (in the early years of the floating exchange rate period the New Zealand inflation rate was still quite high). This is important because our analysis focuses on explaining deviations in the RER from its mean over the full sample period.

The pool of indicators includes: the ANZ commodity price index in real terms (pxanz); New Zealand’s merchandise terms of trade (tot); relative real house price inflation (rhp); relative house sales per capita (hsale); relative output gaps (rgaps); the current account (cacc); short (rshort) and long (rlong) term real interest rate differentials; permanent and long-term net immigration (immig); relative changes in share price indices (rsx); and the VIX volatility index (vix).⁴ Plots and definitions of these indicators and of the RER itself are available in the appendix (figures A1-12).

The lagged RER is not included in the pool of indicators, though it would be an important explanatory variable. This is because we are attempting to explain the RER’s relationships with other more fundamental variables. The model is estimated

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² Shocks are the observed data that cannot be predicted using past values.
³ This measure of the RER is a weighted sum of five bilateral real exchange rates. These include the New Zealand dollar relative to the USD, AUD, GBP, JPY, and EUR (prior to 1999 the DEM was included instead of the EUR). The cross rates are deflated using relative consumer prices. Weights are calculated using bilateral trade (50 percent) and the relative size of the trading partner’s economy (GDP, 50 percent).
⁴ The trading partner measures for interest rates, house price inflation, house sales and share price indices are weighted averages with weights 80 percent for the US and 20 percent for Australia. The trading partner output gap measure uses the same weights as the RER.
on monthly data and, therefore, we interpolate quarterly series. We use data back to June 1986, the period for which data is available for all of the indicators. For recent months, where data have not been released yet, we use an autoregressive process to forecast those indicators forward.

We estimate this regression using a Bayesian model averaging approach. We do not impose a restriction that all of the indicators should be included in the regression because it is not clear a priori which variables should be included or excluded. Instead, the approach weights together many subsets of the indicators based on their ability to explain the RER. Table 1 illustrates which indicators feature in the best five models (a ‘1’ in a column shows that the indicator was included in the model, a ‘0’ shows that it was not). The models are ranked by their weights. Note that model 1 has 61 percent of the weight, and that almost 90 percent of the total weight is put on these top five models (see the right hand column).

Table 1: Bayesian model averaging results

<table>
<thead>
<tr>
<th>Model</th>
<th>pxanz</th>
<th>tot</th>
<th>rhp</th>
<th>hsale</th>
<th>rgaps</th>
<th>cacc</th>
<th>rshort</th>
<th>rlong</th>
<th>immig</th>
<th>vix</th>
<th>rsx</th>
<th>Weight</th>
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<td>1</td>
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</table>

Figure 1 shows the contribution of the three most important variables over the sample period. We use the 20 most highly weighted models (subsets of indicators) and average each indicator’s contribution across these models using the estimated weights. The figure shows the model estimates up until April 2012.

We find that real commodity prices, relative real house price inflation, and the current account produced the largest contributions from the pool of indicators. Relative house prices and commodity prices have often deviated from their means in the same direction (consistent with commodity prices being a major driver of NZ incomes). The current account has a negative sign suggesting that what is being captured is a tendency for the current account deficit to be large when domestic demand is strong, with relatively strong domestic demand tending to push up the exchange rate.

Interestingly, interest rate differentials receive very little weight in the indicator model. Market and policy interest rates adjust to all other information, including the other

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5 The indicators are lagged one month to deal with endogeneity.
6 The Bayesian model averaging approach estimates a model’s probability based on its ability to explain the RER. Specifically, the model weights are their log likelihoods relative to the other models.
7 In each model, we estimate the parameters using Bayesian techniques with loose (diffuse) priors. When Gibbs sampling, we draw ten thousand times and burn the first five thousand.
indicators in these models and, therefore, may not have provided much new information. Also, the 90-day bank bill and 10-year government bond interest rates, which were chosen because they were available back to 1986, may not have been the most relevant measures of interest rates. For example, some analysts focus on expected future short-term interest rates rather than simply on the current 90-day rate.

In terms of robustness, the correlations between the exchange rate and export commodity prices and between the exchange rate and house prices were consistently important across different specifications of the model.\(^8\)

Figure 1: Indicator contributions to RER deviations from mean

![Figure 1: Indicator contributions to RER deviations from mean](image)

Note: The contributions are a weighted average of the contributions from each of the 20 models. We include only the three largest contributors in this chart.

Figure 2a shows the model-implied level and actual history of the RER. We show the uncertainty around this estimate arising from parameter, residual, and model uncertainty. Our results show that the movements in the RER can be explained fairly well using this pool of indicators. While commodity prices themselves are quite hard to predict, a substantial change in commodity prices (all else equal) is likely to have been quite quickly reflected in a change in the New Zealand dollar exchange rate.

Figure 2b shows deviations in the RER from the model estimates. These were largest in the mid 1990s and in 2005. These deviations are likely to reflect variables that we omitted from the model and, also, changes in the relative importance of the different

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\(^8\) The results remained broadly unchanged when we estimated the model on data starting in 1992 and, also, when ending in 2004.
indicators. Despite this, developments in the RER since 2007 have been at least as well explained using these indicators as any earlier period since the float.

Figure 2a: Indicator model estimates of the RER

[Graph showing indicator model estimates of the RER]

Note: The grey bands show the 80 and 90 percent confidence intervals.

Figure 2b: Difference between model estimates and actual RER

[Graph showing difference between model estimates and actual RER]

3. STRUCTURAL VECTOR AUTOREGRESSION (SVAR)

The structural vector autoregression (SVAR) model, used to better understand the drivers of correlations in the data, resembles that used by Haug and Smith (2007). With this model, we aim to disentangle the impact of international and domestic factors on deviations of the RER from its sample mean more systemically. To do this, the international and domestic variables are modelled slightly differently. The international variables are functions of only the international variables lagged (i.e. the international variables are block exogenous). By contrast, the domestic variables are functions of both the domestic and the international variables lagged.

We include in the model measures of the output gap, CPI inflation, real house price inflation, and a 90-day interest rate for both New Zealand and a weighted average of
our trading partners. We also include the RER as a domestic variable and real export commodity prices as an international variable. The number of parameters that we estimate is quite large with this many variables. Therefore, we preferred not to include all the other variables used in the indicator model.

**Estimation and identification**

We estimate the SVAR on monthly data starting from June 1986. Based on the Bayesian information criteria (which evaluates the fit of the model relative to the number of parameters in it and the sample size), we use only the first lags of the variables in each equation. We estimate the model's parameters using Bayesian estimation.

The residuals (or the movements in the variables that cannot be predicted using past data) are decomposed into structural shocks, which are new pieces of information to the model. We do this by imposing a Cholesky decomposition. In this decomposition, a shock to variable A only affects variable B contemporaneously if variable B is ordered after variable A. The international variables are ordered first, so they are not affected by the domestic shocks. The international variables are ordered as: house prices, output gap, CPI, the 90-day interest rate, and then commodity prices. In the domestic block, we order the variables as house prices, the output gap, CPI, the 90-day interest rate, and the RER. Therefore, the RER can be immediately affected by every other variable in the model.

The structural shocks that we identify are likely to reflect many fundamental drivers. While we link each shock to a variable, what is actually being captured by the shocks can be quite uncertain. For example, the house price shock is likely to reflect not only housing specific shocks (perhaps due to a spike in migration) but potentially also shocks to financial conditions (such as the widening of the gap between the floating mortgage rates and the policy rate).

As a robustness check, we considered different orderings of the Cholesky decomposition and used sign restrictions to identify the shocks. While we do not show the results from these other methods, the aggregate contributions from the international and domestic shocks were quite similar. However, it is apparent from the alternative identification methods that separating the international contribution into individual shocks can alter the contributions assigned to the various international variables.

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9 The trading partner CPI and output gap measures use the same weights as the RER. The trading partner 90-day interest rate and real house price inflation measures are also weighted averages, but with weights 80 percent for the US and 20 percent for Australia.

10 We use white noise priors where all the coefficients have a prior mean of zero. We implement the prior using dummy observations, as done by Bloor and Matheson (2009). We iterate the Gibbs sampler ten thousand times and burn the first nine thousand.
Results
We started this analysis wanting to determine the drivers of the exchange rate. We attempt to do this by examining three outputs from the SVAR model. These include:

I. The forecast error variance decomposition of the RER;
II. The historic decomposition of the RER;
III. The RER response to shocks in the model.

Our SVAR results primarily focus on the influence of aggregate international and domestic factors. We focus on these more aggregated results because, in part, they are robust to different identification methods.

I. The forecast error variance decomposition of the RER

The forecast error variance decomposition shows the proportion of the RER forecast errors explained by international, domestic and idiosyncratic shocks. Intuitively, if we had produced forecasts over our sample, the errors can be explained by these shocks. The decomposition separates the relative importance of each group of shocks at different forecast horizons.

Figure 3 shows that for horizons shorter than one year, a large proportion of the forecast errors were due to idiosyncratic shocks to the RER. This idiosyncratic component is the unexplained part of the RER once all the other variables have been accounted for.

Figure 3: Contributions to the RER forecast variance

Note: forecast errors are larger at longer horizons. As such, the decline in the idiosyncratic proportion reflects larger contributions from other shocks rather than a decrease in the size of contributions from idiosyncratic shocks.
For long horizons, the idiosyncratic component explained around 30 percent of the forecast errors. Also, much more of the forecast errors were due to international shocks, which explained nearly 60 percent of the forecast errors. The remaining 10 percent or so was due to domestic shocks, that is the movements in the domestic variables over and above the impact of the international shocks.

II. The historic decomposition of the RER

This section shows the estimates of the international and domestic contributions to the RER movements over the sample period. The following equation shows that the model variables at each point in time \( Y_t \) can be represented as a function of the initial values \( Y_0 \) and all the shocks that have occurred since \( e_1 \) through to \( e_t \), where \( e_t \) is a vector of international and domestic shocks).

\[
Y_t = F^t Y_0 + \sum_{k=1}^{t} F^{t-k} e_k
\]

We decompose the \( e_t \) contributions into international, domestic (excluding the RER shock), and RER specific. Figure 4 shows these contributions, ignoring the RER specific shocks, in terms of how much they caused the RER to deviate from its mean. A positive value implies the factor pushed the RER above its mean and vice versa.

Figure 4: Domestic and international contributions to RER deviations from mean

\[11\] Each element of \( e_t \) is a linear function of so called ‘structural’ shocks (each of which is independent), \( F \) is the estimated parameters of the model when the VAR is represented in companion form, see chapter 1 of Hamilton (1994).
This decomposition suggests that the RER was typically more affected by international factors than it was by domestic factors over our sample. Also, according to this model the high RER over the last half-decade was likely to have been the result of international factors. One of these international factors appears to be real commodity prices for New Zealand exports, which have substantially boosted New Zealand incomes over this recent period (figure A2).

Prior to 2003, the international contribution was considerably less positive. For instance, from 1998 to 2003 international factors caused the RER to be about 10 percent below what it might otherwise have been. Again, this was correlated with export commodity prices, which were relatively low at this time.

The domestic factors, or the movements in the domestic variables over and above the international influence, had a slightly smaller effect on the RER over our sample. Also, even after allowing for the international influence the domestic contribution broadly followed the international influence. The exception is in recent years, when the domestic influence has been negative and the international influence has been positive. The domestic contribution seems similar to the relative house price inflation indicator in figure A4. This contribution may reflect several things. For example, between 2003 and 2005 the positive domestic contribution was broadly consistent with high net PLT immigration (figure A10).

The results from alternative identification methods, such as different Cholesky orderings or sign restrictions, show quite similar contributions from international and domestic factors (i.e. 60 percent international, 40 percent domestic/idiosyncratic split). In saying this, these alternative methods did highlight that the SVAR can struggle to decompose the international contribution into individual shocks. For example, under many identification assumptions we find that commodity price shocks were the largest contributor to the RER movements. However, we also find that in some cases foreign interest rate shocks were even more important. Much of this uncertainty seems to relate to the period since the global financial crisis, when low foreign interest rates coincided with high commodity prices and a high RER.

III. The RER response to shocks in the model

The final section of our results shows the responses of the RER to the shocks in the model (known as “impulse response functions”). The shocks are chosen to produce an exogenous decline in each variable similar to what was observed during the global financial crisis.\(^\text{12}\) For example, we shock real commodity prices down by 40 percent, the same amount that it fell during the global financial crisis. These responses are based on an extreme view, where the decline in each variable is the result of its own

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\(^\text{12}\) The RER shock produces only two thirds of the decline in the RER that was observed during the global financial crisis. This allows us to show all of the responses on the same scale.
shock. When considering these responses, we do not consider the impact of the shock on the other variables in the model. As such, these responses cannot simply be added together to understand the RER response during the global financial crisis. The movements of the exchange rate during the global financial crisis, decomposed in figure 4, were the result of many contemporaneous and prior shocks.

The RER responses in figures 6a-6i show that some shocks have a significant impact on the RER. The largest RER response, other than to its own shock, is to a commodity price shock (figure 6b). This shows that an exogenous 40 percent fall in commodity prices would have caused the RER to fall by more than 10 percent, mostly during the first 6 months after the shock.

Another relatively important shock in the model is the New Zealand house price shock. Figure 6c shows that an unexplained 15 percent fall in New Zealand real house price inflation would cause the RER to fall by about 7 percent in the model. The domestic contribution to the RER movements (figure 4) was largely due to these real house price shocks. These shocks reflect New Zealand real house price movements that were not explained by the international variables.

The RER response to the other domestic shocks suggests some of them may not be well identified. Notably, an unexplained fall in the 90-day interest rate and an unexplained fall in the output gap both have little impact on the RER. Practically, we expect these shocks to cause quite large movements in the RER. However, once we allow for the correlation of these variables with the international and New Zealand real house price inflation variables, these shocks (despite being not so well identified) have a relatively small impact on the results.

We checked the robustness of these results by considering alternative identification methods. One change that we considered was, in the Cholesky decomposition, ordering house price inflation after the output gap in the domestic block. This means that a shock to the output gap would be able to impact house price inflation immediately but not vice versa. We found that this had little impact on the overall results, and even the RER response to the output gap shock did not change.

We also estimated the model with data starting in 1993, to exclude the high inflation and highly volatile period of the late 80’s. In general the impulse responses became more significant, and the international contribution was a bit larger (around 70 percent of long horizon forecast errors). For example, the RER response to an exogenous fall in trading partner house price inflation and consumer prices both resulted in significantly positive RER responses. Also, the RER response to a fall in the New Zealand output gap became significantly negative.
Figure 6a: RER response to its own shock (-20%)

Figure 6b: RER response to commodity price shock (-40%)

Figure 6c: RER response to NZ real house price inflation (-15%)

Figure 6d: RER response to trading partner real house price inflation (-15%)

Figure 6g: RER response to NZ 90-day rate (-5%)

Figure 6h: RER response to trading partner 90-day rates (-5%)

Note: Dotted lines show the 90 percent confidence band.
Figure 6i: RER response to NZ CPI shock (-2%)

Figure 6j: RER response to trading partner CPI shock (-2%)

Figure 6k: RER response to NZ output gap shock (-5%)

Figure 6l: RER response to trading partner output gap shock (-5%)

Note: Dotted lines show the 90 percent confidence band.
4. **CONCLUSION**

In this paper, we show that the New Zealand dollar exchange rate can be explained quite well by the movements in commodity prices, relative house price inflation and the New Zealand current account since it was floated in 1985 (figure 1). Notably, the high level of the exchange rate over much of the last decade has been highly correlated with the high export commodity prices over this period. After accounting for these indicators, which are themselves important influences on relative interest rates, interest rate differentials provided little new information for explaining the exchange rate.

To better understand the structural factors driving the exchange rate, we estimate a structural VAR model with international and domestic variables. The key results from the SVAR analysis are:

- International factors relevant to New Zealand explain more (60 percent) of the exchange rate variance over our sample than idiosyncratic and domestic factors.
- The most important international factor is likely to be export commodity prices, though our empirical analysis is not conclusive. For instance, high commodity prices can explain why the exchange rate is at current high levels. But, high commodity prices may be partly a result of current low foreign interest rates.
- The best domestic indicator for the exchange rate is house price inflation. While this indicator also reflects international factors, its movements over and above the impact of these appears to capture some key domestic information for the exchange rate.

Overall, this analysis highlights that both international and domestic factors have been important in explaining the New Zealand dollar exchange rate. International factors (and particularly the prices of New Zealand commodity exports) have been most important, but often enough domestic and international factors have been influencing the exchange rate in broadly the same direction.
REFERENCES


APPENDIX

Figure A1: Real exchange rate

Figure A2: Real ANZ commodity prices

Figure A3: Merchandise terms of trade

Figure A4: Relative real house prices (annual % change)

Figure A5: Relative house sales per capita

Figure A6: Relative output gaps (%)
Data definitions

Real exchange rate (RER)  
A weighted sum of five bilateral real exchange rates, the New Zealand dollar relative to the USD, AUD, GBP, JPY, and EUR (before 1999 the DEM was used instead of the EUR). The cross rates are deflated using relative consumer price indices. Weights are calculated using bilateral trade (50 percent) and the relative size of the trading partner's economy (GDP, 50 percent).

Indicator model Data

<table>
<thead>
<tr>
<th>Indicator model Data</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real ANZ commodity price index (pxanz)</td>
<td>Log of the ANZ commodity price index in SDR terms deflated using the CPI-5 weighted measure of inflation where the weights are the same as the RER.</td>
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<tr>
<td>Terms of trade (tot)</td>
<td>Log of the merchandise terms of trade.</td>
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<td>Relative real house price inflation (rhp)</td>
<td>The annual percent change of the QV house price index deflated using the NZ CPI (inc-GST) less the weighted average of real house price inflation in Australia (20 percent) and the US (80 percent).</td>
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<td>Relative house sales per capita (hsale)</td>
<td>Log of REINZ house sales divided by the HLFS working aged population (interpolated) less weighted average of US (80 percent) and Australian (20 percent) house sales per capita.</td>
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<td>Relative output gaps (rgaps)</td>
<td>Log NZ real production GDP detrended using an HP filter (an approximation of the official RBNZ output gap).</td>
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<tr>
<td>Current account (cacc)</td>
<td>Annual average current account as a percent of nominal GDP.</td>
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<tr>
<td>Short-term real interest rate differential (rshort)</td>
<td>Difference between the real NZ 90-day bank bill rate and a weighted average of the real US 90-day certificate of deposit rate (80 percent) and the real Australian 90-day bank bill rate (20 percent). Each rate is deflated using a centred three-year moving average of the APC of the relevant country's CPI, where the NZ CPI series excludes GST.</td>
</tr>
<tr>
<td>Long-term real interest rate differential (rlong)</td>
<td>Difference between the real NZ 10-year government bond rate and a weighted average of US (80 percent) and Australian (20 percent) real 10-year government bond rates. Each rate is deflated using a centred three-year moving average of the APC of the relevant country's CPI, where the NZ CPI series excludes GST.</td>
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<td>Net PLT immigration (immig)</td>
<td>Net permanent and long-term immigration from Statistics New Zealand.</td>
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<td>Relative stock exchange indices (rsx)</td>
<td>Difference in the annual percent changes of the gross NZSX (all indices) stock price index and the weighted average of the ASX200 (20 percent) and the S&amp;P500 (80 percent) stock price indices. Both indices are expressed in US dollars.</td>
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<td>VIX index (vix)</td>
<td>VIX index based on S&amp;P500 stock prices. Backdated prior to 1990 with the VXO index which is based on S&amp;P100 stock prices.</td>
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**SVAR Data**

<table>
<thead>
<tr>
<th>Trading partner real house price inflation</th>
<th>The weighted average of real house price inflation in Australia (20 percent) and the US (80 percent).</th>
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<tr>
<td>Trading partner GDP growth</td>
<td>De-trended GDP-5 (created using RER weights) using HP filter.</td>
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<td>Trading partner CPI inflation</td>
<td>Annual percent change of CPI-5 (using RER weights).</td>
</tr>
<tr>
<td>Trading partner 90-day interest rate</td>
<td>A weighted average of the US 90-day certificate of deposit rate (80 percent) and the Australian 90-day bank bill rate (20 percent)</td>
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<td>Real ANZ commodity price index</td>
<td>Same as above</td>
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<tr>
<td>Real house price inflation</td>
<td>Annual percent change of the QV house price index deflated using NZ CPI (inc-GST).</td>
</tr>
<tr>
<td>NZ output gap</td>
<td>De-trended NZ production GDP using HP filter.</td>
</tr>
<tr>
<td>NZ CPI inflation</td>
<td>Annual percent change of NZ CPI (ex-GST).</td>
</tr>
<tr>
<td>NZ 90-day rate</td>
<td>NZ 90-day bank bill rate.</td>
</tr>
</tbody>
</table>