Articles

Impact of the exchange rate on export volumes

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This article reviews our understanding of how export volumes (as opposed to export values) are influenced by the exchange rate and other factors. Recent analysis finds that the real TWI exchange rate has a sizeable effect on export volumes; the low measured elasticity of export volumes needs to be considered in light of the large cyclical movements in the TWI exchange rate. We also find that export sectors respond differently to the same exchange rate movement, with exports of services volumes (which include tourism) more exchange rate sensitive than export volumes from the agricultural sector.

1   Introduction

As a small and open economy New Zealand is significantly affected by external influences. A modelling approach is often taken in examining the effects of these influences on the New Zealand business cycle.[1] These external influences include world demand, the terms of trade, migration flows, and the exchange rate.

With our exchange rate exhibiting fairly substantial cycles and with it being currently near its previous cyclical peak it is important to understand how the exchange rate will affect the future path of the economy. This article examines how New Zealand export volumes are affected by changes in the exchange rate.

Section 2 begins with a review of the factors that influence New Zealand's exports. Section 3 then discusses empirical analysis that quantifies the effect of the exchange rate on export volumes - at both aggregate and sectoral levels. We discuss limitations of the empirical work in section 4, but also suggest reasons why these results make sense. Section 5 concludes.

2   Influences on export volumes: the exchange rate and other factors

The quantities of exports that are supplied and demanded are influenced by a variety of factors (see figure 1 for a summary of the supply and demand side influences). All else being equal, the more goods and services will be produced for export the higher the real return on exporting, relative to returns from other uses for the resources used in exporting.

The exchange rate influences both the supply of and demand for export volumes. However, as many of our exports are priced in foreign currencies, changes in the New Zealand dollar exchange rate do not automatically affect the demand for our exports. Also, some firms may have the ability to charge 'different' prices to the norm. This is usually associated with the degree to which a product is differentiated from other products. For example, exporters serving niche markets may be able keep their prices in New Zealand dollars relatively constant, despite a rise in the exchange rate, and face little change in demand. In contrast, dairy products and most agricultural commodities are comparatively undifferentiated, and their prices are determined in world markets.

In the short term, physical constraints (such as inputs of capital and labour) and pre-arranged contractual obligations affect the ability of exporters to respond to price changes and changes in demand conditions. For many agricultural exports, climatic conditions are a major determinant of supply in the short run: both droughts and floods can materially

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[1]   Black et al (1997) explain how the economy is modelled in the Reserve Bank's macroeconomic model, the Forecasting and Policy System (FPS). Gardiner et al (2003) contrasts FPS with the New Zealand Treasury model (NZTM).

affect production. Over a longer period of time these constraints are less binding, with producers having greater scope to adjust both the quantities of capital and labour used, and the way in which those quantities are combined (hence affecting productivity). However, even in the long run there are still constraints that affect the capacity to supply, such as finite quantities of land and, in the agricultural sector, biological constraints.

An alternative to exporting is to produce more goods and services for consumption in the domestic market. However, given New Zealand's comparatively small size there is limited scope for local producers to divert production away from exporting.

The demand for New Zealand's exports is governed by the market size for our products (influenced by foreign income and population growth) and how well we can compete in world markets. Foreign demand is also a major determinant of the overseas price for most of New Zealand's exports, such as agricultural produce and commodity manufactures. Changes to international supply conditions and consumer preferences also have an influence on the world price of our exports.[2]
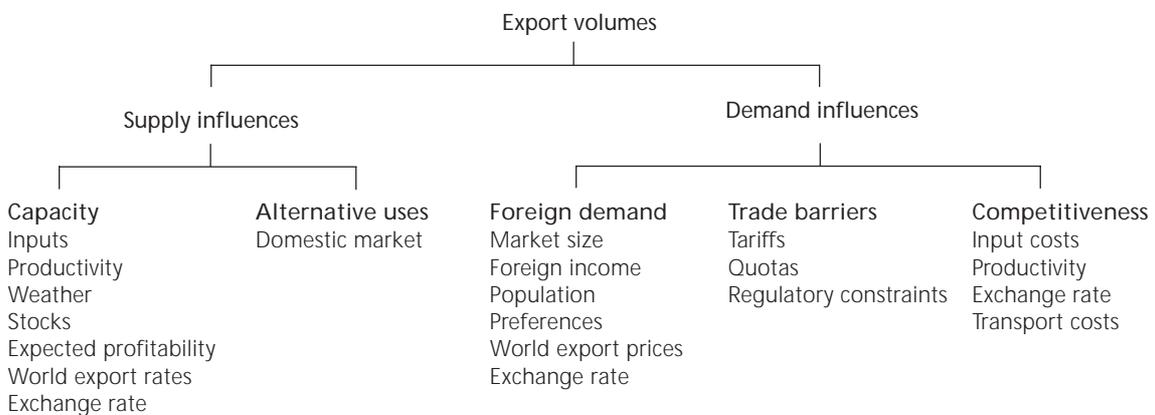
Access to markets is also important, particularly in the agricultural sector. Tariffs, quotas and other trade protection measures can significantly affect the quantity of exports that New Zealand can sell.

Differences in production, promotional, and transportation costs relative to those of other suppliers affect the competitiveness of New Zealand's exporting sector. Since New Zealand is geographically remote from many of its export markets, exporters need to be particularly clever and efficient to offset this disadvantage.

A useful summary measure of our competitiveness is the real exchange rate, which is basically the nominal exchange rate multiplied by the ratio of local and foreign prices. In effect, the real exchange rate is the price of goods and services relative to the price in other countries.[3] Hence a rise in our real exchange rate means our products are more expensive compared to those sold overseas, and are therefore less competitive. An appreciation of the New Zealand dollar, other things remaining the same, will lift our real exchange rate, thereby lowering competitiveness and eventually affecting export volumes. A rise in the exchange rate will also affect exporters' returns, making exporting from New Zealand less profitable, and this too will affect volumes if firms cut back on, or even stop, exporting.

Figure 1
Factors affecting export volumes

Export volumes

Supply influences

Capacity
Inputs
Productivity
Weather
Stocks
Expected profitability
World export rates
Exchange rate

Alternative uses
Domestic market

Demand influences

Foreign demand
Market size
Foreign income
Population
Preferences
World export prices
Exchange rate

Trade barriers
Tariffs
Quotas
Regulatory constraints

Competitiveness
Input costs
Productivity
Exchange rate
Transport costs

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[2] If insufficient global supply is available, higher world prices will eventually result in increased supply.

[3] There are in fact a wide range of real exchange rate measures including those based on relative producer prices, consumer prices, wages, and unit labour costs. The real TWI exchange rate used in FPS is based on relative GDP deflators.

3 Quantifying the exchange rate impact on export volumes

In this section we discuss recent work at the Reserve Bank aimed at quantifying the impact of the real exchange rate on export volumes. We look at the speed and magnitude of export volume responsiveness to the real TWI, and in some sectors, to changes in real bilateral exchange rates. We also use an alternative approach, looking at how export volumes change in response to 'domestic export prices', rather than to changes in the real exchange rate. Domestic export prices are the prices that exporters receive in New Zealand dollars and therefore they incorporate the effects of changes in the nominal exchange rate. Appendix 1 provides technical details on the approach used as well as a summary table of results.

There are several complications involved in identifying the effect of the real exchange rate effect on export volumes. First, we have to distinguish the impact of the real exchange rate from the impact of other determinants of export volumes. Secondly, volatility in export volumes makes it difficult for econometric estimates to fully capture the effect of the exchange rate. In other words, the shocks that hit export volumes make it difficult to detect the systemic variation in export volumes that is due to the exchange rate. Thirdly, there are always some doubts as to how accurate the export volume measures themselves are. Determining export volumes requires either reliable volume indicators, or accurate deflators with which to adjust nominal values. It is possible that the errors relating to volume measures, particularly for services, may be large enough to prevent us from accurately identifying any changes in volumes due to exchange rate movements.

Export volume trends

In addition to analysing the effects of the real exchange rate on aggregate exports, we have also looked at the effects of the real exchange rate on different export groups. We used two levels of disaggregation based on data from the national accounts, with export volumes for these groupings portrayed in figures 2 and 3.

Figure 2
Export volumes - primary/non-primary split
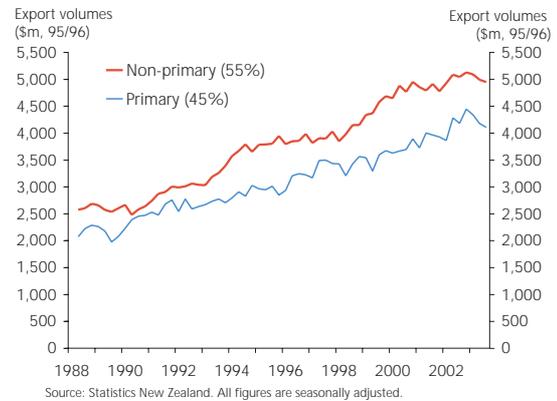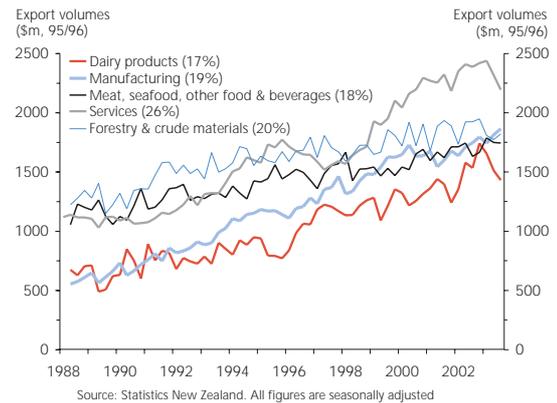*(share of total March 2003 year exports in brackets)*

Source: Statistics New Zealand. All figures are seasonally adjusted.

Figure 3
Export volumes - broad sector split
(share of total March 2003 year exports in brackets)

Source: Statistics New Zealand. All figures are seasonally adjusted

Over the last fifteen years or so growth in non-primary export volumes (particularly manufacturing export volumes) has generally been faster than growth in primary based export volumes. Within the broad primary category, volume growth from forestry (excluding crude materials) and dairy has been considerably higher than growth from meat and seafood (figure 4).

A straightforward way to examine the relationship between the exchange rate and export volumes in different sectors is to look at cross-correlations. These indicate the degree to which the exchange rate and export volumes have moved together over time but only provide a partial analysis as they do not take into account the other possible influences on export volumes.

Figure 4

Average annual export volume growth
(1988 - 2003 March years) (numbers represent share of total exports for March 2003 year)

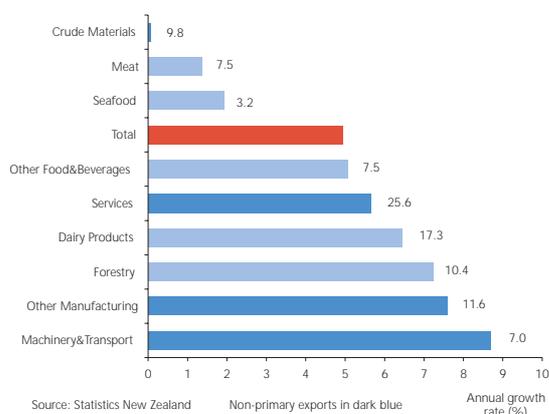Source: Statistics New Zealand   Non-primary exports in dark blue

Figure 5 shows, for a number of sector categories, the correlation between the real TWI exchange rate gap and export volume gap.[4] For each sector, the chart shows the highest correlation between the export volume gap and the exchange gap, and the lag at which that correlation occurs. For example, for manufacturing, the highest correlation occurs when the exchange rate gap is lagged six quarters, with the value of the correlation being -0.1. This suggests that after an exchange rate change, the maximum effect occurs six quarters later.

Figure 5

Correlations between the real TWI gap and the export volume gap
(1990-2001Q3. Numbers indicate the quarter lag with highest correlation.)
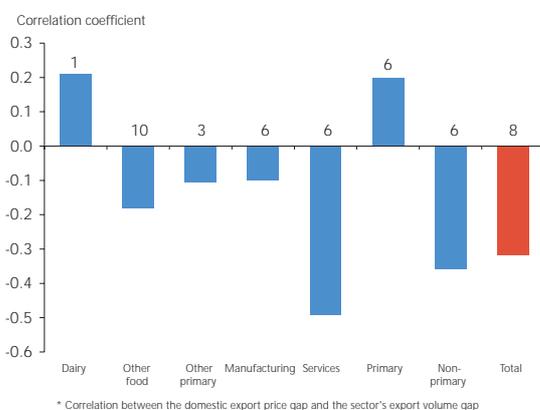
* Correlation between the domestic export price gap and the sector's export volume gap

Most of the correlations graphed are negative, indicating that above-trend real exchange rates tend to correspond with future below-trend export volumes. The largest negative correlation was for the exports of services, with a correlation coefficient of around -0.5.

The correlation shown for the primary sector is different. It shows the correlation between the gap in domestic export prices for total merchandise exports and the gap in primary sector volumes. Given that domestic export prices are inversely related to the exchange rate, the positive correlation shown in the chart suggests that, as for most of the other sectors, a rise in the exchange rate tends to be followed by a fall in export volumes.

Results

In the following sections we discuss the empirical results, beginning with the sensitivity of export volumes to the exchange rate. Then we discuss the importance of other influences, and insights from our business contacts.

Exchange rate sensitivity: aggregate exports

Results for aggregate exports suggest a marginally higher degree of sensitivity of export volumes to the real exchange rate than previously estimated at the Bank. While the export volume elasticity is still comparatively small this implies a fairly sizeable impact on volumes given the large cyclical movements observed in the exchange rate.[5]

Our results indicate that if the level of the real TWI were to rise by 10 per cent relative to its medium-term equilibrium this would result in export volumes being 1.4 per cent lower relative to their trend after 18 months. The lag at which the peak effect takes place - 18 months - is consistent with previous Reserve Bank findings.

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[4] See appendix 1 for further details on how the gap variables are derived; in general, the gap is the difference between a variable's actual value and its trend value.

[5] The New Zealand official nominal TWI has moved in a fairly wide range (46 to 69 during 1990-2003) with trough to peak movements in excess of 40 per cent. Real TWI exchange rate movements are similar to those of the nominal TWI.

Lower domestic export prices (which may result from a higher exchange rate) are also found to lower future aggregate export volumes by approximately the same magnitude and with a lag of 18 months.

The updated estimates also suggest that the real exchange rate accounts for only a relatively small portion (less than 20 per cent) of the total cyclical variation in aggregate export volumes.[6]

Exchange rate sensitivity: export sectors

Although a high exchange rate tends to dampen total export volumes, the impact is unevenly spread across sectors. Non-primary export volumes tend to react more significantly to the real exchange rate than primary exports. This largely reflects the higher degree of exchange rate responsiveness of exports of services volumes, which are approximately three times more sensitive to the real exchange rate than aggregate export volumes.

The lags with which the real exchange rate affects volumes differ by sector. Exports of services volumes respond to the real exchange rate with a lag of 18 months. However, it only takes about a year for the real exchange rate to have an effect on most of our food export volumes. Manufacturing export volumes appear to respond to the real exchange rate with a lag of 12 to 15 months.

For most export sectors, the most relevant measure of the real exchange rate appears to be the real TWI. However, volumes for dairy exports were better explained by the real NZD/USD bilateral exchange rate. For manufacturing exports the real bilateral NZD/AUD and NZD/USD exchange rates were also influential.

Volume sensitivity to changes in domestic export prices, as opposed to changes in the real exchange rate, is more noticeable for primary exports, with volumes responding to New Zealand dollar export prices with a lag of 18 months.

The amount of variation in export volumes attributable to real exchange rate/domestic export price movements differs by sector. Movements in the real exchange rate explain the highest proportion of cyclical fluctuations in services, but even here, more than three quarters of the cyclical variation in export volumes is attributable to other influences.

Other influences: world demand, world export prices, weather

Our analysis also looked at other drivers of export volumes. Although aggregate export volumes were sensitive to the global business cycle (i.e. to world growth), this is of a smaller magnitude than previously thought. It was found that an important demand variable for manufacturing export volumes was a weighted measure of real GDP in the US and Australia. In general, non-primary export volumes, such as exports of services, are more responsive to world demand conditions than primary exports.

Another finding was that higher overseas prices for exports have a delayed but positive effect on primary export volumes, with volumes responding with a lag of between two and four and a half years. Dry conditions boost some primary export volumes in the current quarter (as meat is processed and exported early), but this results in lower export volumes after about 18 months, reflecting the delayed effects of lower production.

Business contacts[7]

Discussions with our business contacts generally supported our findings. Feedback from exporters has suggested that when unit profitability is squeezed by a high exchange rate, many exporters will absorb lower current profitability in the expectation that the exporting environment will eventually improve. This reflects the general tendency of exporters to maintain their position in export markets in the short term, even at the cost of a fall in income, rather than exiting from the market and facing the problem of re-establishing a market presence after the exchange rate has gone down again. Moreover, as many export products are tailored for specific export markets, it is difficult to divert them to other export markets quickly.

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[6]   See appendix 1.

[7]   This material draws on regular discussions with members of the business community held throughout the year. Every quarter Reserve Bank staff meet with around fifty businesses.

Our contacts also suggested that primary export volumes are generally slightly less sensitive to cyclical fluctuations in the real exchange rate than exports from sectors such as services and manufacturing. Contacts in the agricultural/horticultural industry agree that climate is an important short-term influence on export volumes and that capacity over the longer term tends to be influenced by expected profitability (of which world export prices are an important component). Manufacturing organisations confirm that the bilateral exchange rate with Australia and the health of the Australian economy are important influences on export activity. Contacts in the tourism industry are of the view that changes in world incomes will eventually flow through into tourist numbers.

4   Why not a higher export volume elasticity from the exchange rate?

The measured elasticity of export volumes to the exchange rate is comparatively small. However, since the early 1990s fairly large cycles have been observed in the real TWI exchange rate. High exchange rate periods (where the real exchange rate is above its long-term average) tend to follow low ones, with the duration of each part of the cycle lasting approximately three to four years (see figure 6). The impact on export volumes from a sustained appreciation of the exchange rate can be substantial, although volumes will be boosted when the exchange rate falls by a similar amount.

It might be argued that by relating the exchange rate gap to the export volume gap, we are not picking up the persistent effects of the exchange rate on the level of export volumes. Therefore, to get an idea of whether persistent effects occur, we looked at the level impact of the real exchange rate (rather than deviations from trend) on the level of export volumes. Results from levels-based estimates suggested only a marginally higher degree of export volume sensitivity to the real exchange rate.[8]

While we have identified some important drivers of export volumes in this analysis, there have been other important influences that we have been unable to account for. Accurate data on international trade restrictions, for example, is hard to find. Missing information on other key drivers of exports could be affecting our estimates of the effect of the exchange rate.

It seems likely that the biggest effect from changes in the exchange rate may not be on export volumes but on export receipts. Movements in the exchange rate will tend to feed through to domestic export prices and incomes rather than directly affecting volumes (figure 6). However, we need to remember that while a rising exchange rate will contribute towards lowering exporters' incomes, it will also lead to cheaper imports and boost the real incomes of other people within the economy.

Lastly, as referred to above, many of our exporters are supply-constrained in the short-term; they cannot significantly alter production plans, even if it is more profitable to do so. Similarly, pre-arranged supply agreements may also restrict the ability of firms to   adjust production processes quickly. And, as noted earlier, there are non-recoverable set-up costs (e.g. promotional expenses) that could be lost if exporters decide to exit particular markets temporarily; these would be re-incurred if in future they decided to re-enter.

Figure 6
Real New Zealand TWI exchange rate and export prices

Source: RBNZ . Statistics New Zealand's merchandise export price index is used.

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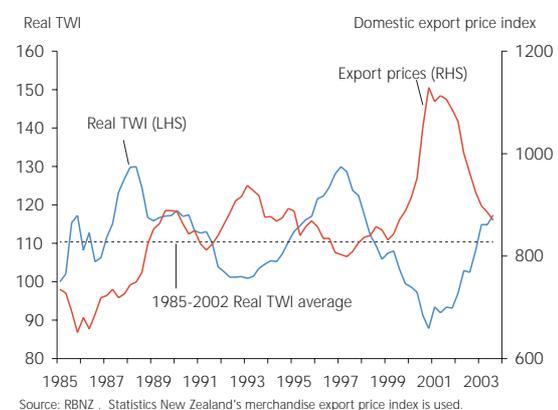
[8]   See appendix 1 for the estimation results.

5   Conclusion

Empirical investigation finds that the measured elasticity of New Zealand's aggregate export volumes to the real New Zealand dollar exchange rate is higher than previously assumed, but is still quite small. However, given the large amplitude of the New Zealand exchange rate cycle this implies quite a substantial impact on volumes. In the September 2003 MPS we incorporated this new evidence into the Bank's macroeconomic model (FPS).[9]

Sector evidence shows some variation, with exports of services volumes more sensitive to the real exchange rate than agriculturally-based export volumes. Other influences affecting New Zealand's export volumes depend on the sector, with agricultural exports responding to world export prices and climatic conditions, and exports of services responding more to world demand.

Our view is that the major effect on exporters from the exchange rate is primarily through its effects on incomes rather than export volumes. Ongoing research will attempt to improve our understanding of the how the exchange rate impacts on the economy.

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[9]   As outlined in box 2 (p 24) in our September 2003 *Monetary Policy Statement.* In FPS a persistent 10 percentage point appreciation in the real exchange rate compared to medium-term equilibrium leads to a 2.4 per cent fall in export volumes relative to trend (1.7 per cent previously), with the peak effect occurring after approximately 18 months.

Appendix 1

Deriving estimates of exchange rate sensitivity

The objective is to derive robust estimates of the sensitivity of export volumes to the real exchange rate. A number of 2SLS regressions are run for aggregate exports and export sectors.

To keep the specification consistent with the FPS framework a gaps-type equation is used:

$$GAP_{x,t} = a*ERGAP_{t-k} + b*Y_{t-k} + c*GAP_{t-k}$$

Sample 1990Q1 - 2001Q3

Instruments:

$ERGAPATWI_{t-k}$, Z_{t-k} , GAP_{t-k}

Where:

$GAP_{x,t}$ = relevant export sector volume gap ((= x actual/x trend - 1)*100)

$ERGAP_{t-k}$ = relevant lagged real exchange rate gap (Alternatively, a variety of domestic export price gaps (PXGAP), calculated from Statistics New Zealand's Overseas Trade Indexes are used)

Y_{t-k} =vector of other demand and supply-side explanatory variables.

GAP_{t-k} = MA/AR term

$ERGAPATWI_{t-k}$ = real Australian trade-weighted exchange rate gap

Z_{t-k} = vector of demand and supply-side instruments

A similar specification is also used to derive a levels-based model for export volumes.

For the correlation analysis and the gaps modelling of export volumes the variables are detrended using an HP-filter - otherwise actual values are used if shown to be stationary by way of an ADF unit root test.[10] This was to prevent spurious correlations and wrong statistical inferences occuring.

Equations for export volumes using domestic currency export prices and the real exchange rate are derived separately; the

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[10] A smoothness parameter (lambda) of 1600 in the HP filter is used to derive most of the gaps, although the medium-term equilibrium real exchange rate used to compute the real TWI exchange rate gap is obtained from the FPS model.

strong negative correlation between the two would bias equation estimates if both were included. To capture world/trading partner demand effects a range of proxies were examined, including OECD industrial production, an export-weighted US and Australian real GDP measure, the Reserve Bank's export-weighted measure of real GDP (GDP12), and a similarly derived world private consumption measure (C11). Other supply and demand influences were tested, with NIWA's soil moisture deficit variable used as to proxy climatic influences. World export prices for various commodity groupings were obtained from the ANZ Commodity and Economist commodity price indices.

The sample period for most estimates was determined in part by data availability, with sector estimates of export volumes being produced only since the late 1980s. The end part of the sample for the gaps estimation was trimmed to 2001q3 to address potential end-point problems from using an HP filter. Structural change (here and abroad) was another motivating factor behind choosing a relatively short sample. Due to the short sample period and the high volatility of exports, many of the equation residuals do not display white noise properties, with MA and AR terms added to minimise potential biases. To make allowance for endogeneity a 2SLS system was used, with the real Australian TWI being the principal exchange rate instrument.

Results

Estimates of the magnitude of response of export volumes to the real exchange rate (e.g. real TWI) and domestic export prices (PX) are summarised in table A1, along with 95 per cent confidence intervals around the coefficient estimates. The partial adjusted R^2 (PartR^2) measures the portion of the total variance of export volumes explained by the real exchange rate/export price terms.

For the gaps model an aggregate coefficient of -0.14 on the sixth lag of the real TWI implies that a 10 percent rise of the real TWI relative to its medium-term equilibrium will reduce the level of export volumes by 1.4 percent relative to its trend after 6 quarters. For the levels model the aggregate coefficient of -0.21 implies that a 10 percent increase in the real TWI will lower the level of export volumes by 2.1 per cent, 18 months down the line. Estimates of the coefficients on the real exchange rate are significant at the 5 per cent level, apart from dairy exports and two NZD bilateral manufacturing export equations, where the real exchange rate is statistically significant at the 10 per cent level.

Table A1
Summary of results

Aggregate exports	Exchange rate/domestic export price	Coefficient	Lag	PartR[2] (qtr)	95% confidence interval		Other influences (quarter lag)
					Low	High	
Gaps model							
Total exports	TWIgap	-0.14	6	0.17	-0.08	-0.20	GDP12gap(-1)
Total exports	PXgap	0.14	6	0.05	0.05	0.23	C11gap(-1)
Levels model							
Total exports	TWI	-0.21	6	0.09	-0.12	-0.30	GDP12 (-1)
Total exports	PX	0.20	6	0.09	0.11	0.29	GDP12(-1)
Sector splits Split 1							
Gaps model							
Primary[1]	PXgap	0.19	6	0.10	0.01	0.36	C11gap(-1), climate (0,-6)
Non-primary[2]	TWIgap	-0.24	6	0.17	-0.13	-0.36	GDP12gap(0)
Levels model							
Primary	PX	0.33	6	0.12	0.28	0.38	GDP12(-1)
Non-primary	TWI	-0.24	6	0.01	-0.13	-0.36	GDP12(-1)
Split 2							
Gaps model							
Other food[3]	TWIgap	-0.15	4	0.08	-0.05	-0.24	World meat price gap(-12), GDP12gap (-1), climate (0)
Other primary[4]	TWIgap	-0.21	3	0.20	-0.05	-0.37	World export price gap(-7), relative cyclical positions (-11)
Services	TWIgap	-0.37	6	0.24	-0.15	-0.59	C11gap(0)
Levels model							
Dairy	NZD/USD	-0.26	4	0.04	-0.04	-0.56	World dairy prices(-18), GDP12(-1)
Manufacturing	TWIulc[5]	-0.41	4	0.06	-0.05	-0.77	US/Australian GDP(-2)
Manufacturing	NZD/USD	-0.08	5	0.05	0.00	-0.16	US/Australian GDP(-2)
Manufacturing	NZD/AUD	-0.15	4	0.04	0.02	-0.32	US/Australian GDP(-2)
Services	TWI	-0.67	6	0.05	-0.29	-1.05	GDP12(-1)

1 Forestry, dairy, meat, seafood, other food & beverages export categories from the national accounts

2 Manufacturing, services, crude materials export categories

3 Meat, seafood, food and beverages

4 Forestry, crude materials

5 Relative manufacturing unit labour cost trade weighted real exchange rate (RBNZ estimates)