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Exchange rate and commodity price pass-through in New Zealand

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NON-TECHNICAL SUMMARY

Movements in the exchange rate affect a range of domestic prices, including consumer prices. This note investigates the pass-through of exchange rate movements into a number of domestic prices – the output prices of businesses, wages, and consumer prices. Many things cause exchange rates to change, but we separate movements in the exchange rate into two broad classes: those caused by a change in the international prices of the commodities New Zealand exports, and those caused by other factors. Using data from the last 25 years, the effects of these two different classes of exchange rate changes are estimated to have been quite different.

The net impact of a fall in the international prices of the commodities New Zealand exports on the consumers price index (CPI) has been to lower New Zealand consumer prices, even though the exchange rate has tended to fall when export commodity prices fall. Falls in export commodity prices leave New Zealanders as a whole poorer and so domestic spending, and pressure on domestic labour and capital, tends to ease. For exchange rate depreciations caused by other factors there appears to have been little net effect on aggregate consumer prices, since a rise in tradable CPI inflation has been broadly offset by a fall in non-tradable CPI. For each of these classes of exchange rate changes, the inflation outcomes implicitly include the average response of monetary policy to such exchange rate movements over the period. The monetary policy responses are not explicitly modelled.

To understand the implications of exchange rate changes it is, therefore, important to identify what caused them. Exchange rates are heavily traded, and the changes in exchange rates are easily observable in real-time. But the factors behind those changes can be less easy to observe, and hard data on many of the factors that influence exchange rates often emerge only with a considerable lag. Even if we could be confident that export commodity prices were not responsible for a particular exchange rate change, there is a still range of potential factors that could have been influencing the exchange rate, each of which themselves could have materially different implications for the inflation outlook.

The results also show that the impact of exchange rate movements on output prices has varied across sectors. Output prices in sectors traditionally viewed as non-tradable, such as construction, and rental, hiring and real estate are affected by exchange rate movements, highlighting the complexity of the transmission mechanism.

1 INTRODUCTION

Movements in the New Zealand dollar affect domestic prices through a number of channels (see Parker (2014) for a more detailed description). The extent of this impact – how much a given percentage movement in the exchange rate results in changes in domestic prices – is referred to as exchange rate pass-through, and is the subject of a large international literature.

Little recent research has focused specifically on exchange rate pass-through in New Zealand. Hampton (2001) used a stylised model of the economy to estimate the pass-through of import prices into consumer prices, without identifying the underlying cause of the original import price movements. He found that there was a delay between the initial movement in import prices and the greatest impact on consumer prices. The overall impact on consumer prices was also much smaller in magnitude than the movement in import prices.

This note uses time series econometrics to examine how exchange rate changes affect domestic prices. A variety of underlying factors affect the New Zealand dollar, including amongst others: changes to the international prices of the commodities New Zealand exports, activity in trading partner economies, world and domestic interest rates, international investor attitudes to risk, and domestic demand pressures.

Why do similar movements in the exchange rate result in different movements in other prices? To illustrate this point, we analyse the pass-through of exchange rate movements caused by changes in the international prices of New Zealand's export commodities and exchange rate changes caused by other factors. The pass-through in the two cases differs, highlighting the importance of correctly identifying the underlying cause of exchange rate movements.

2 METHODOLOGY

There are a number of channels through which exchange rate movements can affect consumer prices. The retail prices of imported consumer goods are included in the consumers price index (CPI). The retail prices of these imported goods also embody the costs of distribution within New Zealand and the margins of retailers and wholesalers, which are traditionally considered to be non-tradable. The prices of imported raw materials and capital equipment provide further, less direct, channels for the exchange rate to affect

domestic prices. But the factors that led to the exchange rate change can themselves affect domestic inflation.

The pass-through of the exchange rate to domestic prices is in general neither instantaneous nor complete – for a given percentage change in the exchange rate, the price of tradable items in the consumers price index moves by a smaller percentage. One simple method for estimating pass-through would be to regress changes in consumer prices (inflation) against past values of itself and current and past changes in the exchange rate to derive a short-run and long-run estimate for the degree of pass-through, e.g. equation 1.

Equation 1

$$\Delta CPI_t = \sum_{i=0}^p \beta_i \Delta ER_{t-i} + \sum_{j=1}^q \alpha_j \Delta CPI_{t-i} + \mu_t$$

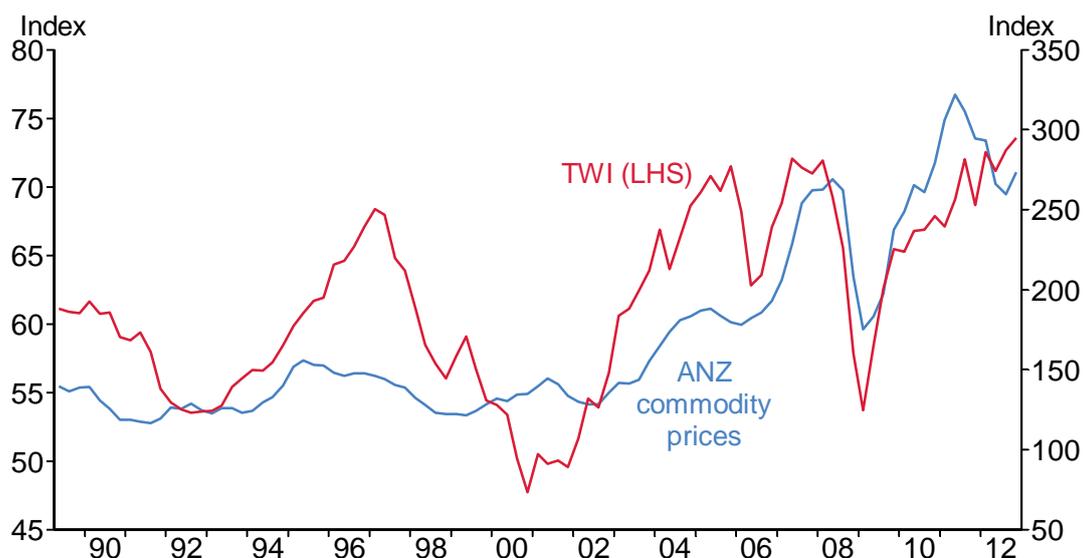
where p and q are predetermined lag orders chosen prior to estimation in order to estimate the dynamics and μ_t is the residual of the regression with the standard distributional assumptions. Estimating equation 1 for New Zealand data suggests that there has been no significant impact on consumer prices from exchange rate movements. In any case, this approach is also unsatisfactory for a number of reasons. First, it ignores the potential for changes in consumer prices to affect the exchange rate. Second, it implicitly assumes that all exchange rate movements, whatever the cause, have the same impact on consumer prices. There are a number of potential causes of movements in the exchange rate (McDonald (2012) modelled which factors had influenced the New Zealand dollar in the post-float period), and each may vary in its impact on consumer prices.

To overcome the shortcomings of the single equation approach we use a vector autoregression (VAR) framework to study the effects of exchange rate pass-through on several domestic prices. VARs are frequently used in empirical macroeconomics to understand the relationship over time between a number of variables. The framework relates movements in each of the variables to present and past movements in the other variables used in the model.

The baseline model studies the interaction between seven price series. The first series is an index of the prices of the commodities New Zealand exports (in foreign currency terms). The second series is the exchange rate itself. Over the course of the past two decades there have been a number of exchange rate cycles, some of which have coincided with commodity

price cycles, and some which have not (figure 1). In what follows, we separate out those exchange rate movements caused by movements in commodity prices from movements caused by a range of other factors (which might include, for example, the relative strength of New Zealand and foreign economies or changes in relative interest rates) that might be loosely summarised as relating to shifts in the relative return of New Zealand dollar assets.

Figure 1: Exchange rate and commodity price movements



Source: RBNZ, ANZ Bank.

The remaining five price series in the model are import prices, output prices of domestic firms, wages and consumer prices. The consumers price index has been split into goods and services which have a large import component or are subject to international competition – termed tradables – and those which are primarily domestically produced – termed non-tradables. Real wages have been chosen over nominal wages to identify whether or not changes in wages merely reflect changes in aggregate consumer prices. Table 1 has the exact definitions of the series used.

Table 1: Variable definitions

Variable	Definition
World commodity prices	ANZ commodity price index, world terms. Quarterly average.
Exchange rate	New Zealand dollar nominal trade-weighted index (TWI). Quarterly average.
Import prices	Overseas Trade Index import price (New Zealand dollar terms).
Output prices	Producer price index – output prices, all sectors.
Real wages	Earnings and Employment Survey (QES) average weekly wage, all sectors, deflated by the headline consumer price index (CPI).
Tradable prices	Tradable CPI.
Non-tradable prices	Non-tradable CPI.

Note: No adjustment has been made to the CPI series for the change to GST in 1989 Q3 and 2010 Q4. Taking the GST into consideration makes no difference to the results.

The model omits many variables which are likely to influence prices, such as measures of output and interest rates in New Zealand. The results shown below implicitly embody the average response of monetary policy over the period of estimation, but do not separately identify the transmission that takes place through interest rates.

The model is estimated over the period 1989 Q2 to 2012 Q4. The start date was chosen to avoid potential structural changes in exchange rate pass-through arising from the flotation of the New Zealand dollar in 1985.

The model is estimated using the first difference of the natural logarithm of the price series. This estimation method explicitly models the changes to price levels as being permanent rather than transitory. This is consistent with an inflation target rather than a price-level target. While there remains disagreement over how best to model prices in VARs, we believe modelling the price level as a random walk to be the most natural. An advantage of this method is that it also allows these permanent changes in levels to be interpreted as the pass-through.

VARs are modelled as a system of interrelated, endogenous variables, so it is necessary to identify the movements within the system that are caused by exogenous underlying changes, termed shocks. A number of identification strategies exist, each with their own inherent strengths and drawbacks. Given these uncertainties over identification, we choose to emphasise the qualitative findings of the results, rather than focus on specific quantitative findings. As discussed later, we include a number of alternative identification strategies in the appendix.

The identification strategy used in this note is a Cholesky decomposition, which assumes a recursive order. The Cholesky decomposition ranks the variables included in the system in terms of how they affect the other variables within the system. Those variables that affect the others contemporaneously are ordered first, with those that affect fewer variables contemporaneously ordered later. This allows the shocks to be identified each in turn.

Commodity prices are ordered first, which implies that they affect all other variables, but are not contemporaneously affected by the exchange rate or the domestic prices. New Zealand is a small open economy so it is reasonable to assume that domestic price series will not have an immediate impact on world commodity prices which are determined by global demand and supply. The shock chosen here represents a fall in the international prices of the commodities New Zealand exports, such as would occur from a fall in world demand, or an increase in world supply.

It is possible that shocks to demand and supply may have differing rates of pass-through to each other. Indeed, an increase in global demand for all commodities, including those that New Zealand imports, may have a different impact from a specific increased demand for a commodity that New Zealand exports, such as dairy. Any such difference would reinforce the main result of this note that understanding the underlying cause of particular exchange rate movements is necessary to assess the likely implications for inflation.

Following Choudhri, Faruqee and Hakura (2005) (CFH), we order the exchange rate second. This implies that it is not affected contemporaneously by shocks to domestic prices, but allows for contemporaneous effects from commodity prices. Like CFH, the justification for this assumption arises from the publication lags of price data. The domestic prices included here are published in the quarter following that to which they refer. This assumption, however, makes little differences for the qualitative point of the exercise, as will be apparent in the robustness exercise we undertake. As with the commodity price shock, the exchange rate shock identified here is the combination of potentially several underlying shocks. Such shocks could include changes to foreign or domestic interest rates, changes to domestic asset prices such as house prices, or changes to expected profitability of domestic businesses. Broadly, this is an amalgam of shocks which can be thought of generally as encompassing shocks to the relative return on New Zealand dollar assets.

We do not attempt to either identify or interpret the remaining five price shocks in the model, as the primary focus of this note is on exchange rate fluctuations.

3 BASELINE RESULTS

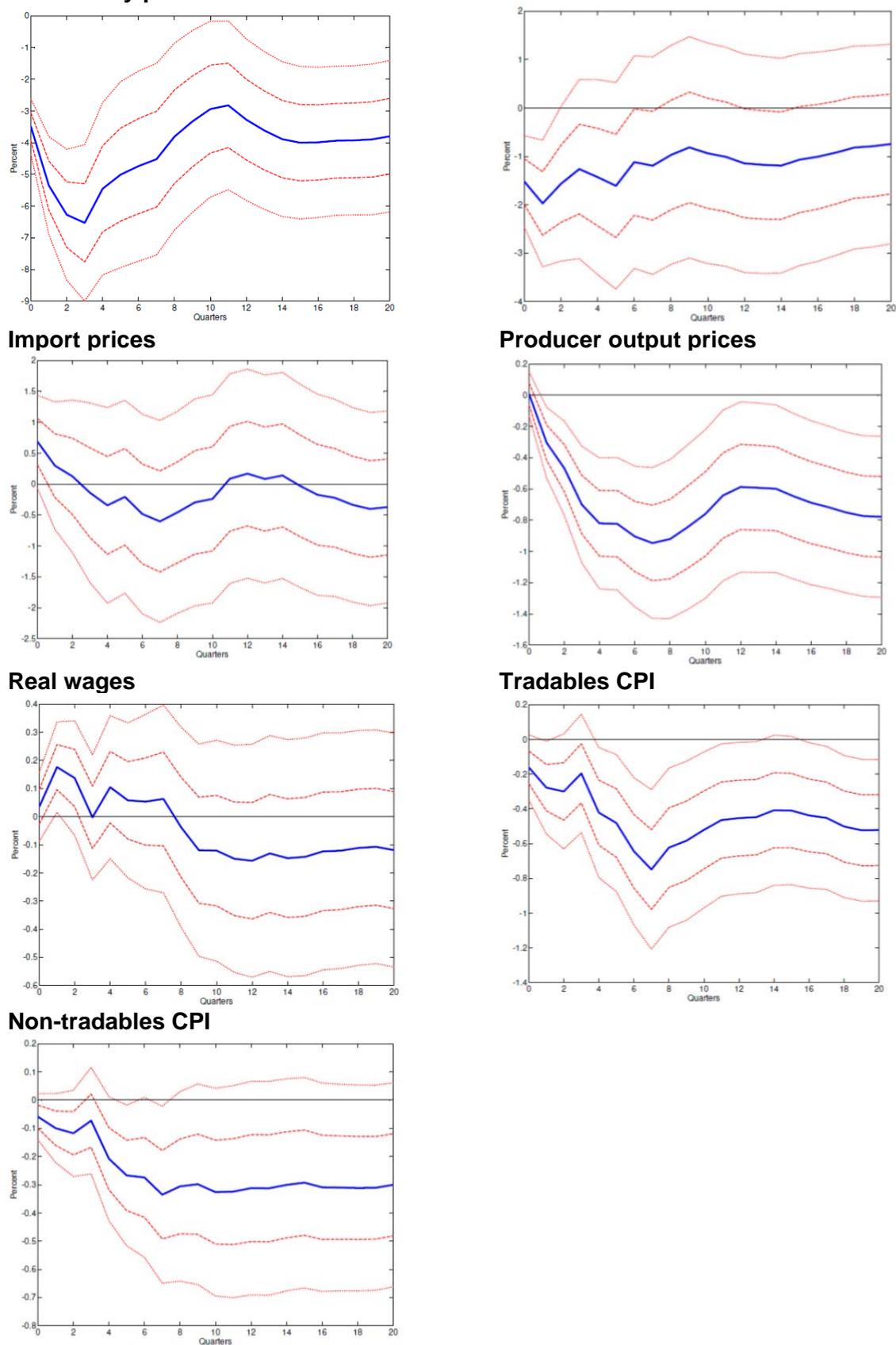
Figure 2 shows the results of a permanent shock to international commodity prices. The shock is calibrated to be the same size as a one standard deviation shock to commodity prices over the sample period – around 4 percent.

Recall that the VAR is estimated in differences; the results presented here are the cumulative responses, and correspond to permanent changes in the level of prices. The blue lines trace out how the variables react over time to the shock, with the confidence bands showing the degree of uncertainty surrounding the estimate at each time horizon. The reaction is considered to be statistically insignificant when a given confidence interval contains the zero line.

Following the downward shock to commodity prices, the exchange rate falls in the same quarter by a little short of 2 percent. There is no net impact on import prices. Domestic producer output prices and tradable inflation fall with the lower commodity prices. Part of this fall may be explained by the nature of the original shock. Falling commodity prices represent lower output prices for commodity-producing sectors (a significant proportion of the overall producers price index) and may also at times have been correlated with falling prices for the commodities New Zealand imports.

Non-tradable consumer prices also fall following a downward shock to commodity prices. The channel here is likely to be indirect – falling world commodity prices reduce New Zealand's terms of trade, lowering national income. This lower income puts downward pressure on the price of all goods and services, including non-tradables.

Figure 2: Impulse response functions to a one-standard-deviation commodity price shock



Note: 68 percent and 95 percent confidence interval error bands drawn using the wild bootstrap method proposed by Gonçalves and Kilian (2004).

Figure 3 shows the effects of a downward shock to the exchange rate (this exchange rate shock is, by construction, independent of the commodity price shocks described earlier). The shock is calibrated to be a one standard deviation exchange rate shock over the sample period.

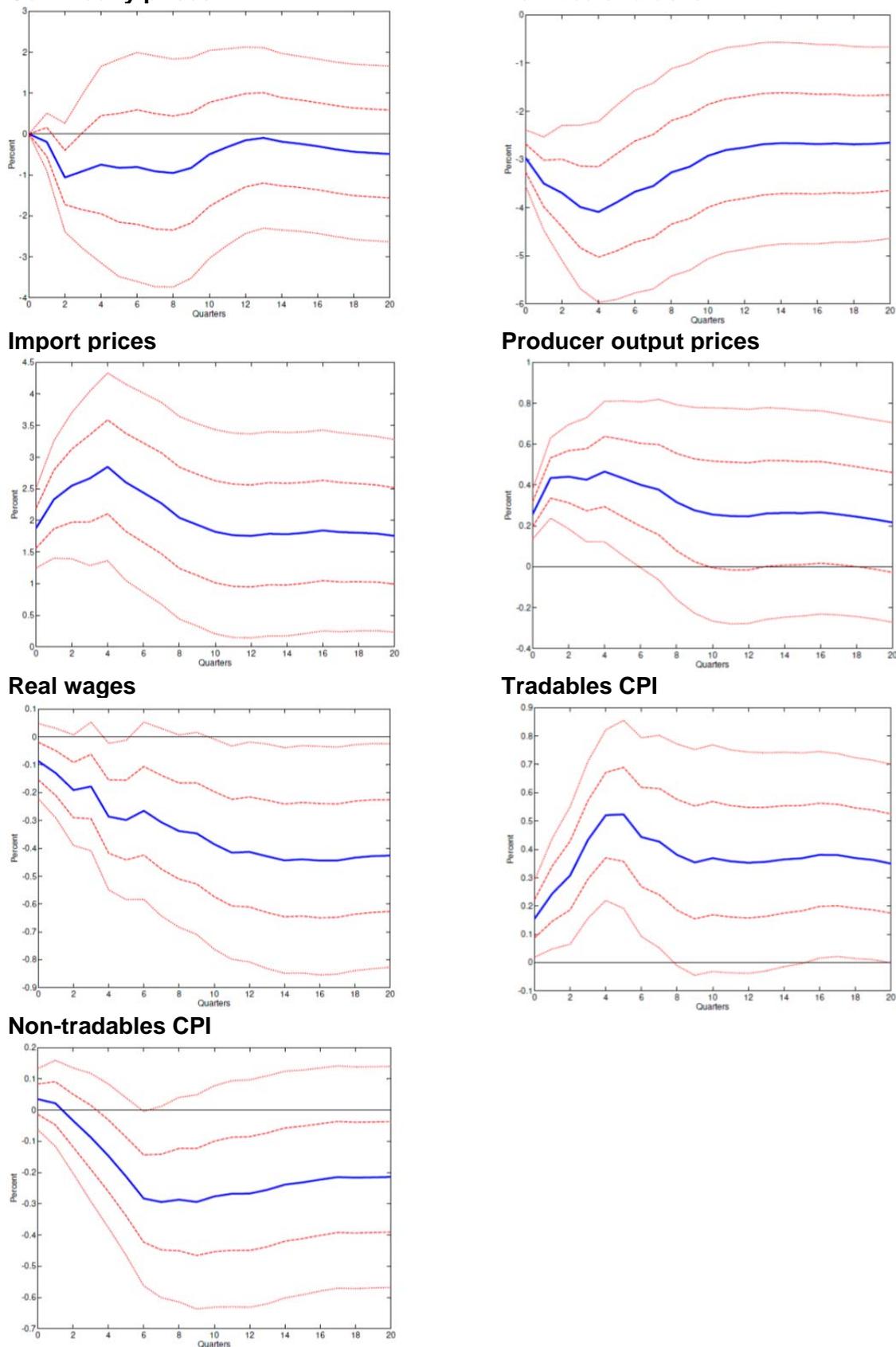
There are striking differences in the pass-through of the exchange rate shock when compared with the world commodity prices shock, despite both resulting in a lower exchange rate. With this other exchange rate shock, import prices are higher, as are producer output prices. The peak response in these prices occurs just after a year following the original exchange rate shock. Real wages are depressed.

Tradables prices increase following this type of downward shock to the exchange rate. This contrasts with the fall in tradables prices following the world commodity price shock, despite the exchange rate depreciating in both cases. Non-tradables prices generally decline in response to both shocks, though the results are statistically significant only at the 68 percent level of significance and not at the 95 percent level.

We try two alternative specifications of the model – using the first day of the quarter rather than the quarterly average for the exchange rate and ordering the exchange rate last, behind the five domestic prices. The results for an exchange rate shock in these specifications are shown in the appendix. The qualitative results for consumer prices are unchanged from the baseline specification – notably the rise in tradables in contrast to the finding for the commodity price shock. That the findings of the baseline model are robust to these alternative specifications lends weight to the conclusion that the underlying cause of movements in the exchange rate has important implications for pass-through.

Figure 4 compares the mean response of the commodity price and exchange rate shocks, calibrating the initial exchange rate movement to 1 percent. We construct an aggregate impact on headline CPI by using the current weights of tradables and non-tradables. Overall the impact on headline CPI of a downward commodity price shock has been deflationary. Exchange rate shocks resulting from other factors have not had a significant impact on headline CPI.

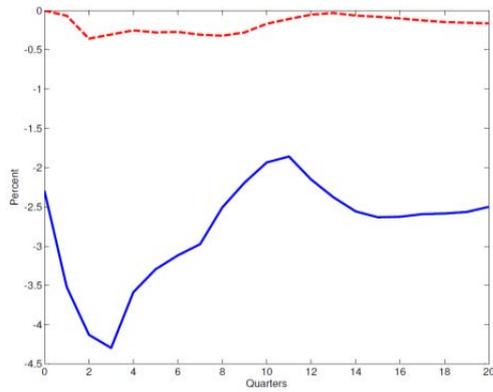
Figure 3: Impulse response functions to a one-standard-deviation exchange rate shock



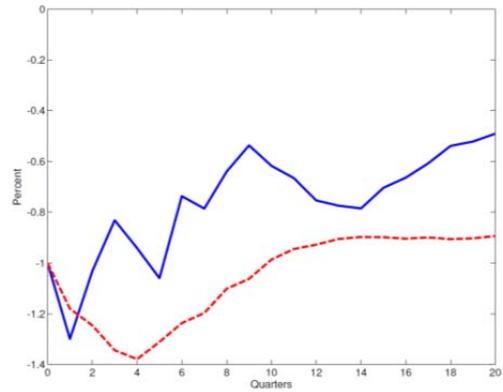
Note: 68 percent and 95 percent confidence interval error bands drawn using the wild bootstrap method proposed by Gonçalves and Kilian (2004).

Figure 4: Effects of a 1 percent exchange rate depreciation, by cause
 Note: Commodity price shock in blue, other exchange rate shock in red.

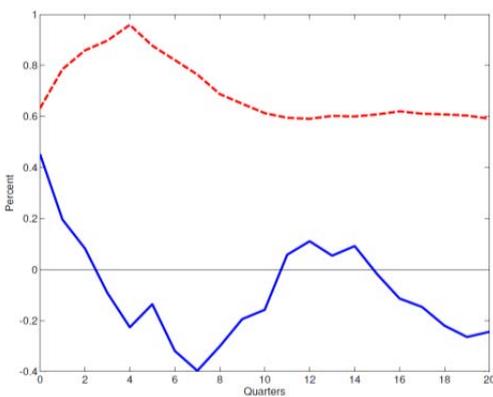
Commodity prices



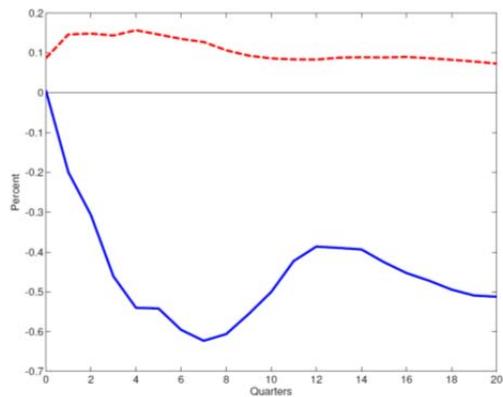
New Zealand dollar TWI



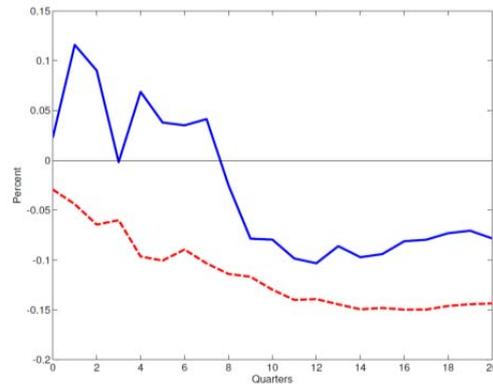
Import prices



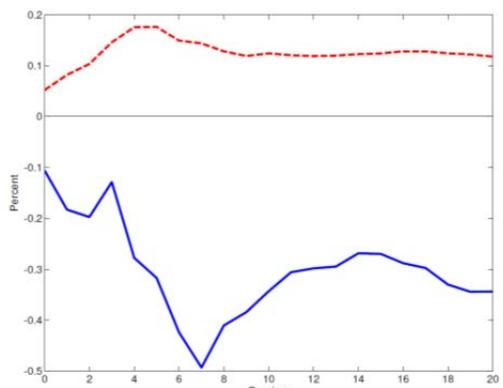
Producer output prices



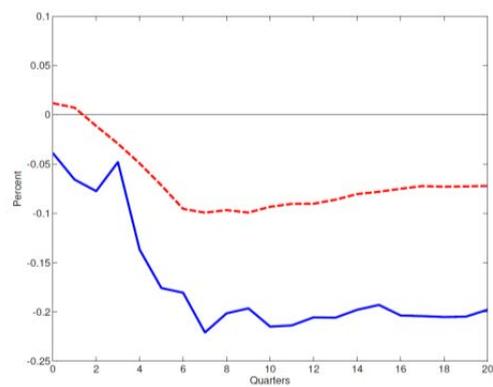
Real wages



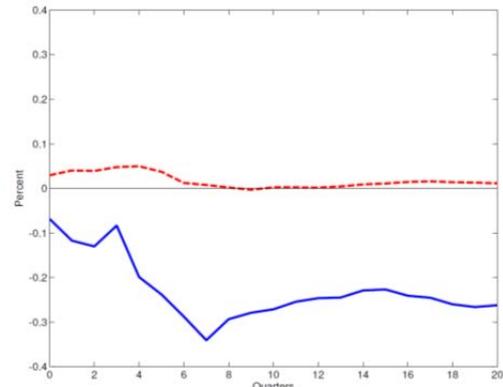
Tradables CPI



Non-tradables CPI



Constructed impact on headline CPI



4 SECTORAL HETEROGENEITY

The baseline model illustrates that exchange rate shocks have had varying effects on different sectors, with aggregate tradables prices having the opposite response to aggregate non-tradables prices. Recent research at the Reserve Bank has also pointed to diverse sectoral impacts on *output* from exchange rate shocks in New Zealand (Karagedikli *et al.* 2013).

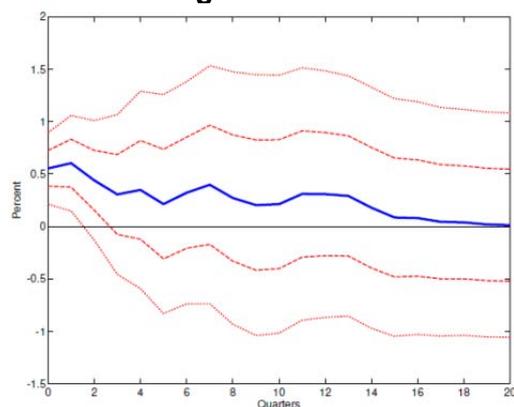
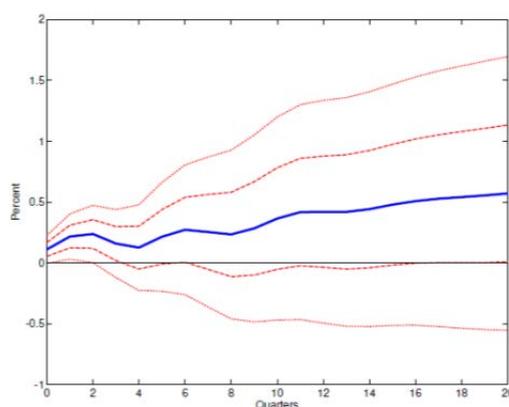
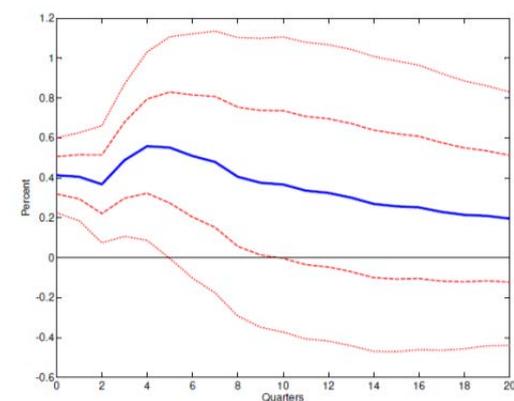
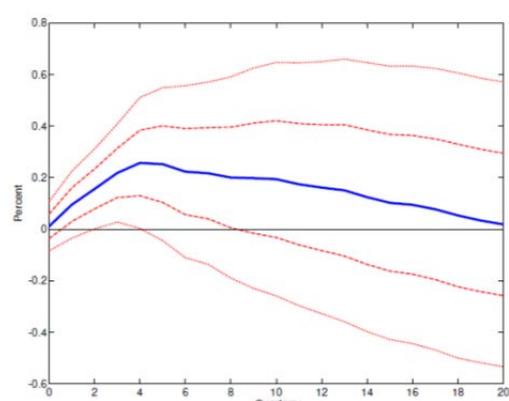
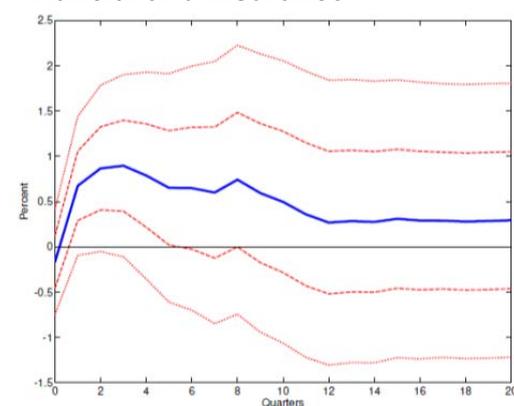
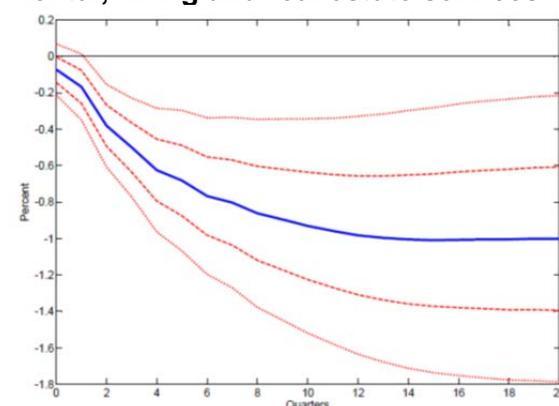
To study the impact on sectoral output prices we augment the baseline model with individual industry output producer prices from the producers price index, running the model separately for each industry in turn. The sample period for this analysis starts in 1994 Q2, the first available data for the disaggregated sectors. The sectors are listed below:

- 1 Manufacturing
- 2 Wholesale trade
- 3 Retail trade and accommodation
- 4 Construction
- 5 Financial and insurance
- 6 Rental, hiring and real estate services

These industries vary in their degree of exposure to the exchange rate. Manufacturing is almost wholly tradable (and a large share of manufacturing in New Zealand involve processing primary products); wholesale and retail trade are non-tradable industries but often sell traded goods; construction uses some materials which are traded internationally, but is generally viewed as being a non-tradable industry; rental and hiring is almost entirely non-tradable.

Figure 5 shows the reaction of producer prices in these industries to the same downward exchange rate shock shown earlier in figure 3 (i.e. a shock caused by factors other than commodity prices). Recall that aggregate producer prices and tradable consumer prices rose following a downward exchange rate shock and non-tradable consumer prices fell. The effects of the exchange rate shock on other variables are qualitatively unchanged from the baseline model and so have been omitted here.

Figure 5: Industry output price responses following an exchange rate shock

Manufacturing**Construction****Wholesale trade****Retail trade and accommodation****Financial and insurance****Rental, hiring and real estate services**

Note: 68 percent and 95 percent confidence interval error bands drawn using the wild bootstrap method proposed by Goncalves and Kilian (2004).

Following the downward exchange rate shock, output prices rose in most industries. Even sectors traditionally viewed as non-tradable, such as construction, witnessed an increase in price more in line with a tradable sector. The sole exception is rental and hiring, which mirrors the response of non-tradable consumer prices. Again, recall that in all these results, the average response of monetary policy to the exchange rate change is implicit. These are the response observed after monetary policy reacted, not the inflation outcomes the Reserve Bank might have observed had it not reacted.

The sectoral results provide a useful reminder that in a small, open economy such as New Zealand many sectors are exposed to international factors, either through direct competition or through the costs of raw materials and capital equipment. In assessing the overall impact of exchange rate changes, it is important to take into consideration the wider inflationary impact of exchange rate movements rather than focus just on a narrowly-defined tradable sector.

5 CONCLUSION

We have used VAR models to separate out two broad classes of movements in the exchange rate and to understand how these shocks then propagate through to various domestic prices. We find that over the last 25 years falls in the international prices of New Zealand's export commodities have tended to lower prices in New Zealand as a whole, even though such falls in commodity prices have also tended to lower the exchange rate. This contrasts with exchange rate depreciations caused by other factors, which resulted in higher import prices, producer prices, and the prices of tradable consumer goods. The net impact on the CPI of these shocks has been muted, since non-tradables prices fall. In each case, the impact on inflation is estimated having taken implicit account of the response of monetary policy.

The VAR models presented here are intentionally kept as simple as possible. Yet even these simple models serve to illustrate the importance of understanding the underlying cause of particular exchange-rate movements. Effects on domestic prices differ markedly between different underlying causes, despite superficially similar exchange rate movements. Identifying the cause can be difficult in real time, since exchange rate data are immediately available, but other economic data are often published with a significant lag.

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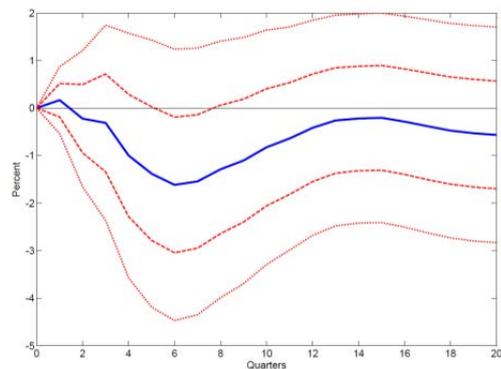
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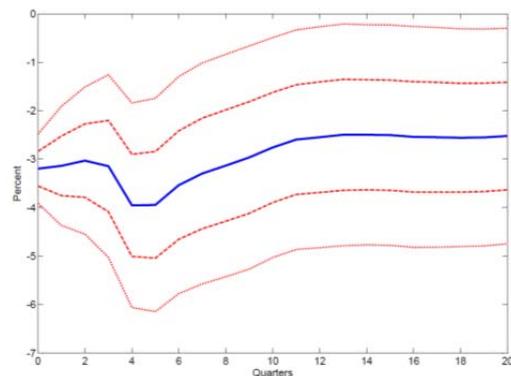
APPENDIX

Figure A1: Impulse response functions to a one-standard-deviation exchange rate shock where the first observation for the quarter is used for the exchange rate

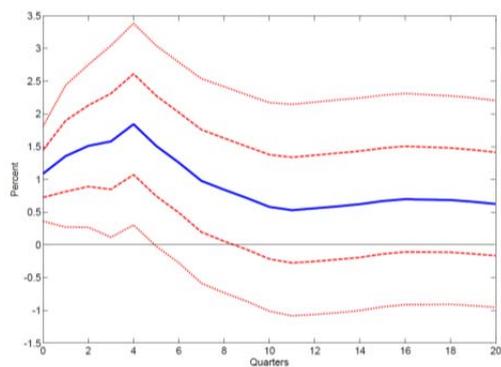
Commodity prices



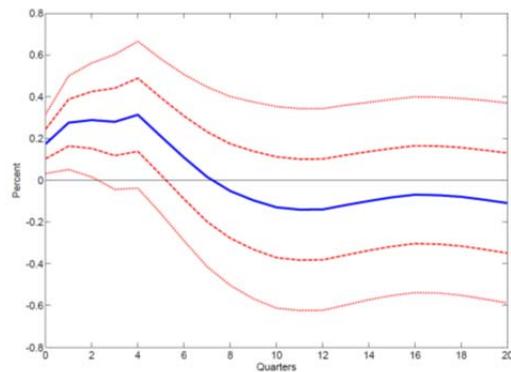
New Zealand dollar TWI



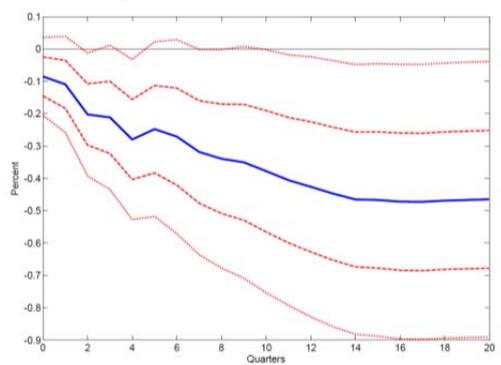
Import prices



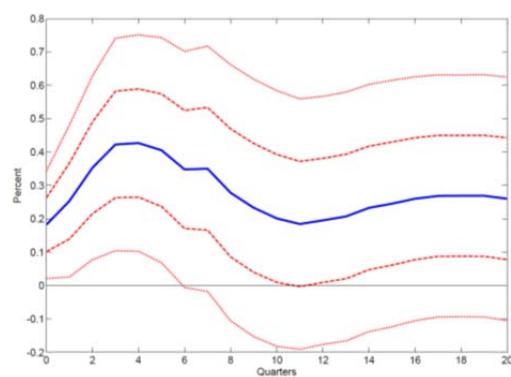
Producer output prices



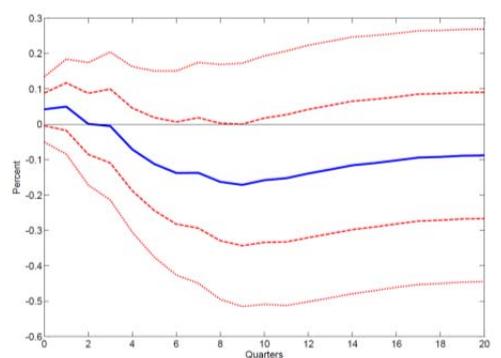
Real wages



Tradables CPI



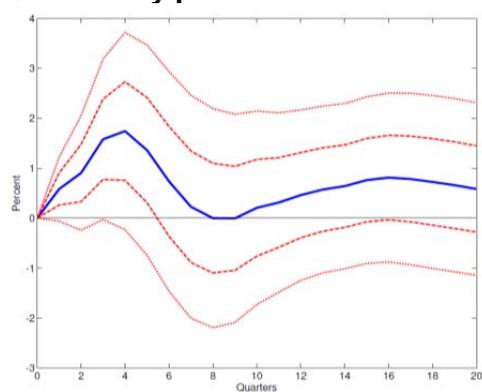
Non-tradables CPI



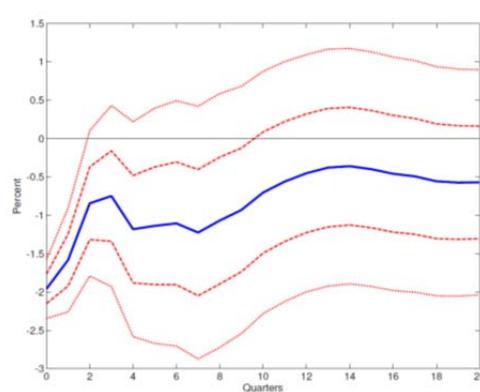
Note: 68 percent and 95 percent confidence interval error bands drawn using the wild bootstrap method proposed by Gonçalves and Kilian (2004).

Figure A2: Impulse response functions to a one-standard-deviation exchange rate shock where the exchange rate is ordered last

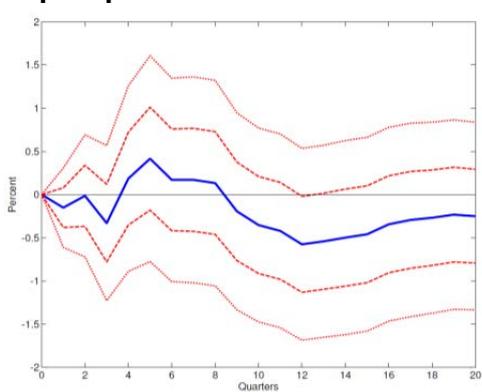
Commodity prices



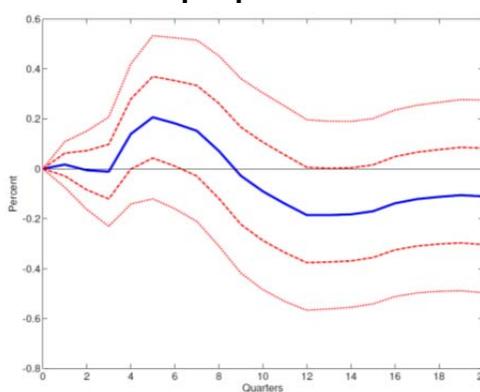
New Zealand dollar TWI



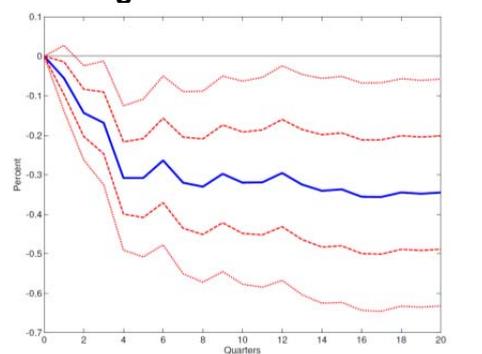
Import prices



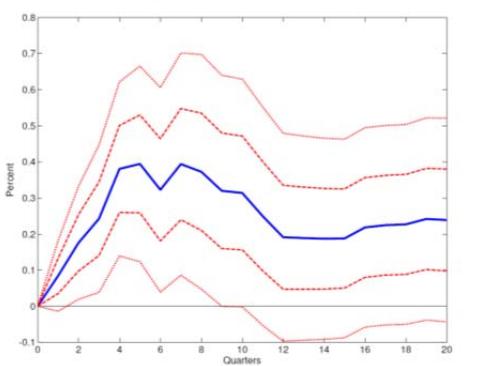
Producer output prices



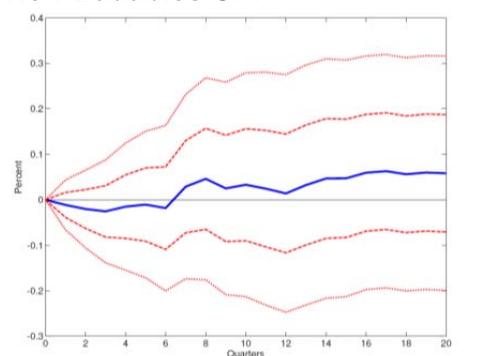
Real wages



Tradables CPI



Non-tradables CPI



Note: 68 percent and 95 percent confidence interval error bands drawn using the wild bootstrap method proposed by Gonçalves and Kilian (2004).