

Exchange rate movements and consumer prices: some perspectives

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Economic developments in the rest of the world affect New Zealand consumer prices. This article traces the channels through which the consumers price index (CPI) is affected by the exchange rate. Changes in the exchange rate that result from changes in the prices of commodities New Zealand exports appear to have had materially different inflationary implications than other changes in the exchange rate.

1 Introduction

New Zealand is a small, open economy. Economic developments in the rest of the world affect domestic prices, including consumer prices, via a number of channels including through exchange rate changes.

There is a large literature on how exchange rate movements affect domestic prices. This literature poses two main questions: how are changes in foreign prices transmitted to domestic prices, and how do domestic prices adjust to movements in the exchange rate? It notes that any given percentage movement in the exchange rate typically results in much smaller percentage movements in tradables consumer prices, something described as 'incomplete' pass-through. This article looks at the issue in a New Zealand context, where fluctuations in export commodity prices have been an important influence. It presents some recent Reserve Bank research into the nature and extent of pass-through, and considers some of the lessons from research carried out elsewhere.

2 Differing exchange rate pass-through of products

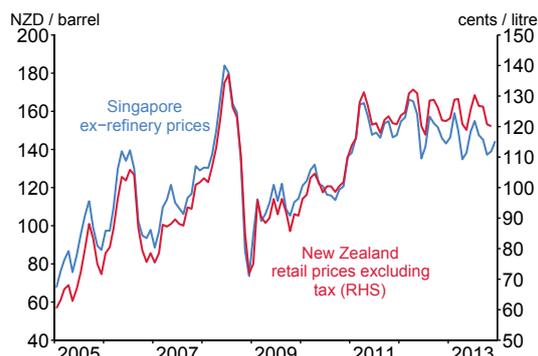
A 10 percent fall in the exchange rate typically does not raise aggregate domestic tradables prices by 10 percent. But that overall observation encompasses a wide range of individual product experiences.

To illustrate, compare the markets for petrol and for new cars. There are no domestic producers of cars, and almost all petrol consumed in New Zealand is imported.

Changes in international prices of petrol are typically passed through almost immediately and in full

to the price (excluding tax) paid by consumers in New Zealand (figure 1).

Figure 1
Singapore ex-refinery and New Zealand retail petrol prices

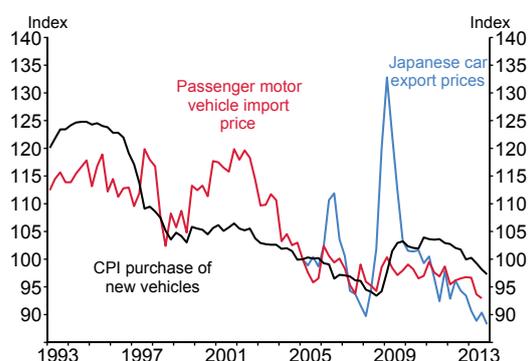


Source: Ministry of Business, Innovation and Employment; Reuters.

The pass-through of car prices is markedly different to that of petrol. The price paid for cars by New Zealand importers fluctuates much less than overall Japanese car export prices (figure 2, overleaf). The price paid by importers varies by less on average than the exchange rate. The final price paid by consumers also fluctuates much less than the import price of cars.

Aggregate measures of exchange rate pass-through – the focus of this article – encompass a wide variety of practices across different goods and sectors.

Figure 2
International and domestic car prices



Source: Bank of Japan, Statistics New Zealand.
Note: Series have been rebased to 2005 Q1 = 100 and are expressed in New Zealand dollar terms.

3 Tracing the economy-wide price response

Aggregate measures of exchange rate pass-through – the focus of this article – encompass a wide variety of practices across different goods and sectors.

Figure 3 shows a stylised representation of the channels through which pricing developments in the rest of the world affect New Zealand’s consumer prices. For analytical purposes, the consumers price index (CPI) is commonly decomposed into ‘tradable’ and ‘non-tradable’ components. The differing channels through which the international prices of New Zealand’s imports and export commodities affect these two components are shown separately in figure 3, opposite.

Pass-through can be split into two stages, which are described in more detail in the following sections. The first stage covers factors that change the prices paid by New Zealand importers to the foreign producers.

The second stage traces the change in import prices through into domestic costs of production and to prices that are eventually paid by consumers. The retail price of imported final consumer goods appears directly in the CPI. Raw materials, machinery and equipment indirectly affect the CPI via their impact on domestic production costs. Finally, initial movements in tradables prices can induce additional effects, such as changing inflation expectations and wage demands.

A further channel is via changes to the international prices of New Zealand exports, such as dairy and other commodities. Changes in these prices affect the terms of trade and hence domestic income.¹ This change in income will eventually affect inflationary pressures in New Zealand.

Figure 3 does not consider how monetary policy responds to any of these developments. How inflation expectations and wage demands change is likely to be influenced by a central bank’s track record in responding to incipient inflationary pressures.

4 Stage one pass-through: from world prices to the prices paid by New Zealand importers

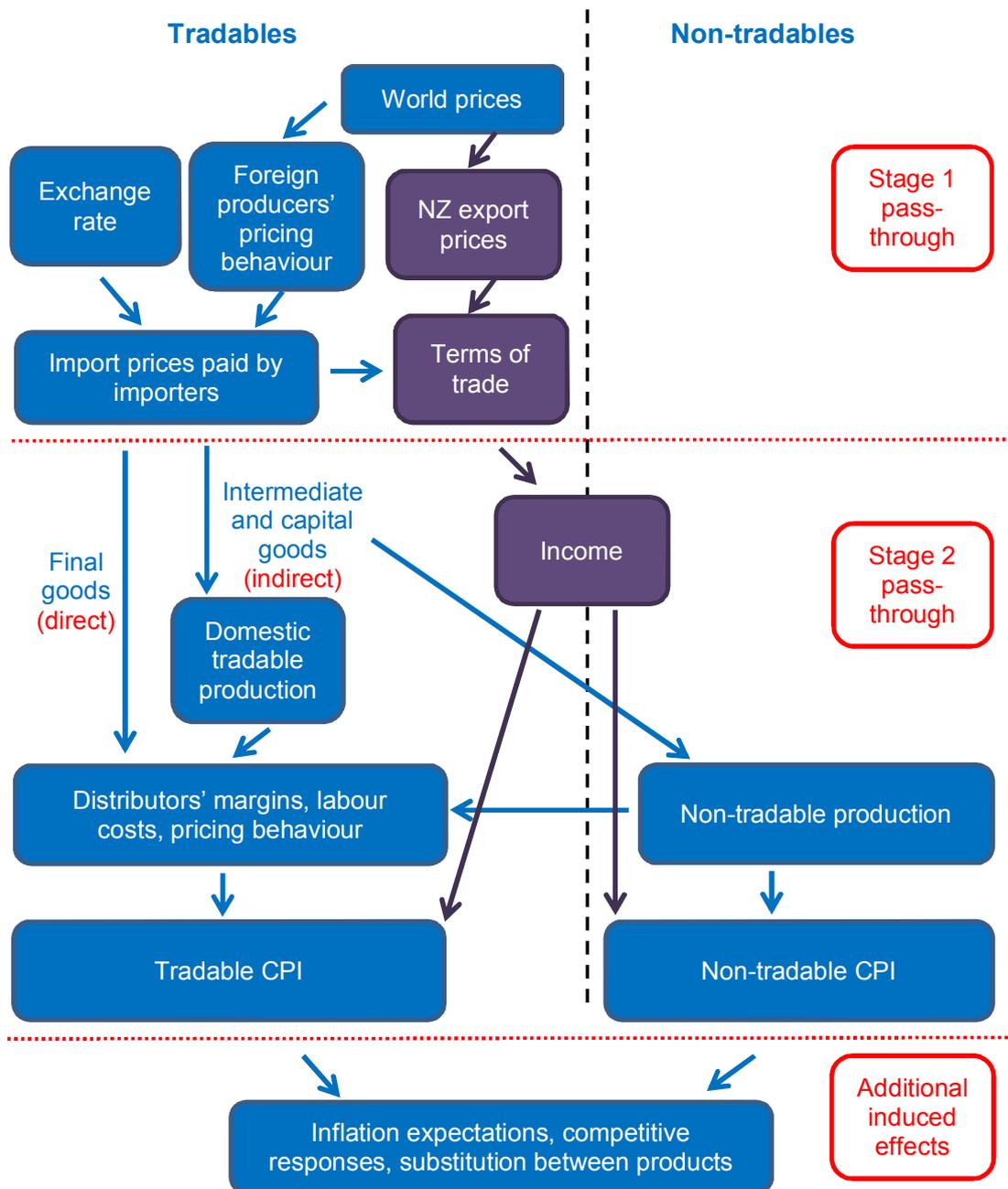
Changes in world economic conditions can translate into changes in the prices paid by New Zealand importers to foreign producers. Two main types are changes in the world prices of goods, including commodity prices, that result in changes in the terms of trade, and movements in the exchange rate that are not directly related to changes in world prices. Changes in trading partner activity are also likely to have some effect on New Zealand CPI, but are not considered in this article.

Higher general domestic inflation in New Zealand’s trading partners can result in higher prices of exports to New Zealand. The main focus here is on relative price changes; in particular changes in world commodity prices, such as oil prices that affect the price New Zealand has to pay when it imports those commodities. As shown in figure 2, the pass-through of commodity prices into import (and consumer) prices can, in some cases, be quick.

The second main factor determining New Zealand import prices is the exchange rate. There are a number of reasons why the exchange rate may move, including: changing world demand for the goods New Zealand

¹ For some products exported from New Zealand (notably meat and dairy) changes in international prices will also fairly directly affect the CPI, as the domestic prices of those items will be influenced by changes in the international New Zealand dollar returns the exporter can achieve. For example, the recent rise in world dairy prices has resulted in higher dairy prices for New Zealand consumers, albeit to a lesser extent than the transmission into domestic petrol prices shown in figure 2.

Figure 3
Impact of world economic developments on New Zealand's CPI



produces; changing relative prices between New Zealand and the rest of the world; changing relative interest rates; and, fluctuations in attitudes towards risk among international investors more generally (to which demand for New Zealand dollar denominated assets appears to be quite sensitive). A lower New Zealand dollar typically results in higher import prices.

Pricing of imports

The extent to which movements in the exchange rate quickly affect domestic prices in New Zealand depends crucially on how foreign sellers set the price of the products New Zealand imports. One option is for businesses to charge the same price for all customers, domestic and foreign (in the economics literature this is termed producer-currency pricing (PCP)). Bulk

Box A

How New Zealand's exports are priced

Recent research has improved our knowledge of how New Zealand businesses price exports in foreign markets. The 2010 Business Operations Survey of over five thousand businesses carried out by Statistics New Zealand asked businesses that self-identified as exporters whether the New Zealand dollar price for their exports was the same across destinations. Around half of exporters by number reported that the New Zealand dollar price varies across foreign markets.

The main reasons cited as being 'very important' for price differentiation between markets include: exchange rate movements (69 percent of exporters), market competition (57 percent) and transport costs (48 percent). When asked whether they increased their export prices in response to a New Zealand dollar appreciation, 45 percent of exporters said they had 'no scope to raise export prices', 30 percent kept the New Zealand dollar price the same and passed on the appreciation in full. The remainder required some amount of appreciation before export prices were changed.

Some caution is required when extrapolating these results to aggregate export prices. A small

number of large businesses account for a very large share of exports. The survey results suggest that larger companies tend to price differently across foreign markets.

However, there may also be under-reporting of firms that price on a PCP basis. Around a third of output from the restaurants and hotels sector is sold to tourists and therefore exported. Yet no business in this sector identified itself as an exporter. This suggests that these businesses mostly treat domestic and foreign customers identically and charge the same prices to both.

Fabling and Sanderson (2013) use customs data to study the reaction of export prices to exchange rate movements. They find that the pass-through into export prices is dependent on the currency of pricing. Those firms that invoice in New Zealand dollars passed on just 9 percent of the exchange rate movement in the long run (defined as at least 6 months, with a median value of two years). Those invoicing in the foreign currency absorbed 90 percent of the exchange rate movement in their own margins. In other words, prices expressed in the currency of invoice did not react much to currency movements.

commodities – such as coal and oil – will typically be priced in a PCP fashion with all countries importing at the same international price, even if transactions are typically denominated in, say, United States dollars.

Alternatively, foreign exporters could set prices independently in various different country markets, known as local-currency pricing (LCP) or pricing to market. For example, Japanese car exporters could set a price for cars exported to New Zealand tailored specifically for the New Zealand market conditions, and fix a different price (adjusting for exchange rates) for exports to the United States (and perhaps a different price again for sales in Japan).² This sort of approach to pricing appears to

be more common for products where brand loyalty is a significant factor in long-term profitability and where international businesses control distribution channels in ways that enable them to effectively maintain different prices across countries. Participants in the market presumably judge that they would be less profitable in the long-run, across all the markets they sell in, if pricing in each market adjusted fully and quickly to exchange rate movements. Final purchasers may be indifferent between various brands of petrol, but not between various makes of car.

² A third, possibility, less common in practice is that exporters set a price in one currency but invoice in another. In this case the implications for pass-through depend on the speed with which the invoiced price adjusts to reflect exchange rate movements. At one extreme, for example, Amazon quotes

its price in USD, but allows the New Zealand purchaser to pay in NZD, with the New Zealand dollar cost for a new transaction adjusting in near real-time to exchange rate movements.

Under PCP, the New Zealand price of imports is simply the common foreign price adjusted by the exchange rate. Exchange rate movements pass one-for-one into New Zealand dollar import prices. Under LCP, if the price of the import is directly set in New Zealand dollars, exchange rate movements should not have any immediate effect on import prices. Over time, persistent changes in exchange rates may cause foreign exporters to review their optimal price in New Zealand.

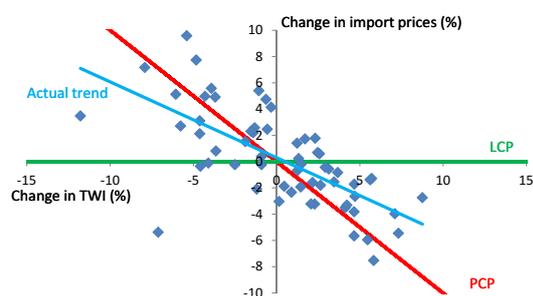
There is little formal or systematic evidence whether New Zealand imports are priced in local or producer currency, but some evidence exists for exports (see box A, overleaf). Survey evidence suggests that about half of New Zealand exporters price to market. Prices, as expressed in the currency of invoice, do not tend to react much to movements in exchange rates, even in the long run. In the case of commodity exporters this is probably not surprising – global dairy prices are largely set internationally, in response to world supply and demand pressures, and Fonterra's exports are probably largely denominated in foreign currency terms.

In the absence of detailed research into how New Zealand imports are priced, a rough approximation can be gleaned from aggregate data. Figure 4 is a scatter plot of contemporaneous quarterly changes in the Reserve Bank's New Zealand dollar TWI exchange rate index against import prices, expressed in New Zealand dollar terms, over the period 1998 Q1 to 2012 Q4.

If all imports were priced in New Zealand dollars then import prices would not move with the exchange rate and the points would lie very close to the x-axis, shown by the solid green line.³ Similarly, if all imports were priced in foreign currency terms then the points would lie very close to the 45° line, shown by the solid red line. There does appear to be a reasonably tight relationship between changes in the exchange rate and changes in import prices. Roughly speaking, around two thirds of New Zealand's imports (many of which are not direct consumer

products) appear to be priced to the importer in foreign currency terms, suggesting a significant amount of PCP. That this share is less than 100 percent provides one reason why pass-through is not complete.⁴

Figure 4
Contemporaneous movements in the trade-weighted exchange rate (TWI) and import prices



Source: RBNZ and Statistics New Zealand.
Note: New Zealand dollar import price for imports invoiced in foreign currency are calculated using the exchange rates specified by New Zealand Customs Service. These exchange rates are delayed 11-25 days relative to market rates.

5 Stage two pass-through: from prices paid by importers to consumer prices

This section discusses the domestic leg of pass-through – from changes in import prices through to consumer prices. The three principal channels in this stage of pass-through were shown in figure 3.

First, imported final consumer goods such as cars and televisions appear *directly* into the CPI. How much the retail price changes when the exchange rate changes depends on various factors including: the share of imported goods relative to domestically produced goods within total household consumption; the share of retailers' and wholesalers' margins in the final price paid by consumers for the imported goods; how sensitive demand is to changes in price, and the extent to which competitors alter

³ This assumes no overall trend in import prices over the period, which is supported by the data. The TWI used here is not import weighted, so will diverge somewhat from the exact exchange rate index required. Indications are that using import weights would not produce materially different results.

⁴ In addition, some businesses will have hedged the foreign exchange risk, resulting in effectively unchanged import prices for these businesses in the near term, despite measured changes. Over the long run, hedging will not protect businesses from persistent changes in the exchange rate.

their prices. In the case of cars, for example, the ability to substitute between new and existing used cars (the latter not directly affected by exchange rate movements) may be important.

Second, changes in the prices of imported raw materials, such as plastics and steel, machinery and equipment, affect the costs of domestic producers in both tradable and non-tradable sectors. These costs will, over time, be reflected in the domestic price of New Zealand-produced goods and services, including those classified as non-tradable, providing an *indirect* channel for import prices to affect consumer prices.

Finally, following a change to retail prices, consumers and businesses may change their inflation expectations or switch spending to other products, whether between foreign and domestic producers or even between tradable and non-tradable items. These actions can induce additional effects on consumer prices beyond those arising from the initial change to import prices. For example, employees could seek to bid up wages in response to a large increase in food and energy prices. If successful, this would affect the production costs of all businesses in the economy, both tradable and non-tradable. The past track record of inflation, and monetary policy responses, may influence the extent to which these later behavioural responses occur. A track record of low and stable inflation typically provides a good anchor to inflation and wage expectations.

Previous international research has highlighted surprisingly low pass through from exchange rate movements into domestic consumer prices. One strand of the literature explaining this low pass-through has focused on the domestic value-added component of traded goods; a Japanese-built television requires transport within New Zealand, and the final price paid by consumers also includes domestic taxes and the costs and margins of the retailer.

Goldberg and Campa (2010) find that distribution margins account for around 15-25 percent of the purchaser's price for traded goods, using input-output table data for a number of OECD economies, including New Zealand. Split by component of final demand, these

margins are noticeably higher for household consumption than for investment spending or exports. Their results are discussed in more detail in box B, opposite.

The importance of local costs for incomplete pass-through has also been found in studies of businesses. Hellerstein (2008) studies the pass-through from exchange rate movements into the retail price of imported beers in a sample of Chicago supermarkets. The pass-through is found to be small, about 11 percent of the exchange rate movement.

Hellerstein then determines the causes of the low pass-through. Following a US dollar depreciation, local costs associated with beer imports do not change, accounting for 45 percent of the price stickiness (note this number is in line with the aggregate local cost component for the US in table 1). Reductions in margins account for the remainder of the price stickiness, with the burden falling mostly on the manufacturer (47 percent), and some adjustment of the retailer's margin (8 percent).

6 Terms of trade effect

There is also an important indirect channel (illustrated with the purple boxes in figure 3) from commodity prices to domestic inflationary pressures via the terms of trade. Commodities account for a large share of New Zealand's exports. Higher international prices for these commodities boost income for the domestic producers, such as dairy farmers. This higher income results in greater consumption of both tradables and non-tradables items, increasing overall inflationary pressures within New Zealand.

This effect may be particularly important in New Zealand (as compared to, say, other advanced country commodity exporters such as Australia, Norway or Chile) since the commodity producing sector in New Zealand is both substantially domestically-owned, and mostly owned by relatively small-scale private sector operators. In other words, big swings in commodity prices, of the sort seen several times in the past decade, quickly affect household incomes and spending. Roughly speaking, a 3 percent lift in the terms of trade boosts national income and spending power by around 1 percent.

Box B Evidence on distribution margins from input-output tables

Goldberg and Campa (2010) investigate the share of the final price of tradable products that is accounted for by domestic distribution costs for a range of OECD countries. They use input-output tables, which detail for each industry the source of inputs and the destination of outputs. For example, the majority of the output of the sheep and beef cattle industry is used by the meat manufacturing industry. Similarly, petrol is a large input to the road transport industry.

Goldberg and Campa study 29 tradable industries – agriculture, oil and gas, mining and various types of manufacturing. For each industry they calculate the distribution margin by combining the use of transport with the margins of wholesalers and retailers. Their results are summarised in section A of table 1 and have been updated to show the most recent input-output table for New Zealand. The distribution margins vary between

sectors. For New Zealand, the margin ranges between 0 and 38.8 percent, averaging 15.5 percent.

It is also possible to determine how the distribution margins vary depending on the final use of these industries' output. We restrict the analysis here to how the output of these 29 industries is used for household consumption (section B in table 1), business investment (section C) and exports (section D). The distribution margins are much higher for consumption than for the other final uses. In part that reflects the fact that products used for investment are not typically bought from retailers, and exports are likely to have retailers' margins imposed in their country of destination.

The updated data for New Zealand show that the share of the final consumer price for tradable goods accounted for by distribution margins has increased over time, and is relatively high compared with the rest of the OECD. Nearly half (48.6 percent) of the price paid by New Zealand consumers for tradable goods is in fact accounted for by domestic components.

Table 1
Distribution margins by purchasers' prices and by sources of final demand

Country	Year	A			B			C			D		
		Distribution margins across sectors			Household consumption			Investment			Export		
		Avg.	Max	Min	Wholesale-retail	Transport	Total	W/R	Tran.	Tot.	W/R	Tran.	Tot.
France	2000	19.4	62.3	1.0	27.3	6.2	33.5	8.0	1.4	9.4	3.2	5.2	8.4
Germany	2000	15.1	42.4	3.6	33.0	7.3	40.3	5.6	2.2	7.8	5.3	4.2	9.5
Ireland	1998	9.5	27.0	0.0	26.3	8.3	34.6				5.1	1.5	6.6
Italy	2000	18.4	45.2	3.7	34.8	7.2	42.0	8.9	3.5	12.4	4.8	7.1	11.8
Norway	2002	16.6	4.6	3.2	29.3	11.9	41.2	9.6	2.9	12.5	4.6	17	21.6
Sweden	2001	15.4	35.8	1.0	32.3	2.9	25.3	10.7	0.2	10.9	1.3	4.5	5.8
UK	1995	20.7	46.1	0.0	40.9	7.8	48.7	5.8	1.4	7.2	8.5	5.2	13.7
US	1997	23.9	70.4	4.7	40.9	1.8	42.8	13.9	1.6	15.5	9.5	3.1	12.5
New Zealand	1995/6	13.9	32.3	0.0	31.2	9.8	41.0	14.9	0.0	14.9	5.5	11.7	17.2
New Zealand	2006/7	15.5	38.8	0.0	37.2	9.6	46.8	17.8	0.0	17.8	3.6	6.2	9.8

Source: Goldberg & Campa (2010), except for New Zealand 2006/7 which is calculated by the author.

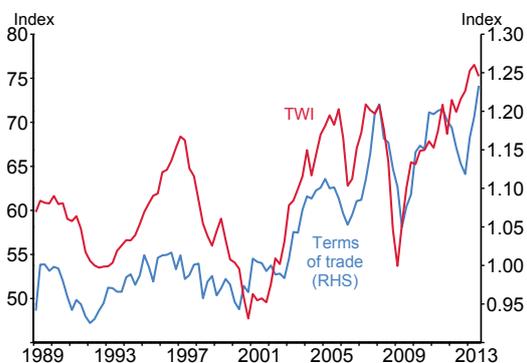
If the exchange rate rises in response to a lift in commodity prices, that lift in national income and purchasing power may accrue not to the commodity producers but to the household and business sector more generally (through a lower cost of imports). The overall boost to income is unchanged.

7 Empirical evidence for pass-through in New Zealand

There are few recent estimates for the extent of pass-through in New Zealand. In work that is now more than a decade old, Hampton (2001) studies the stage two pass-through of import prices to consumer prices for the period 1989-2001, using a stylised model of the economy with a tradable and non-tradable sector. Hampton finds that a 10 percent increase in import prices results in a 0.5 percent increase in consumer prices in the first quarter, rising to 1.5 percent over the long run.

More recently, Parker and Wong (2014) consider the impact on domestic prices of the international prices of the commodities New Zealand exports and exchange rate movements. There have been a number of exchange rate and terms of trade cycles over the past few decades. At times these cycles have coincided, at other times they have not (figure 5).

Figure 5
New Zealand dollar TWI and terms of trade



Source: RBNZ and Statistics New Zealand.

Parker and Wong use a Vector Autoregressive (VAR) model, which models prices as a function of past movements in the other prices. This allows for the complex,

dynamic interaction between the different prices over time. For example, import prices can affect both tradables and non-tradables consumer prices, and consumer prices are able to eventually affect the exchange rate. The domestic prices considered are: import prices in New Zealand dollar terms; producer output prices, real wages, tradables consumer prices and non-tradables consumer prices.

Parker and Wong use econometric techniques to separate movements in the exchange rate caused by changes in commodity prices from other underlying causes. Such causes could include a change in domestic or trading partner economic activity, changing foreign interest rates, or a change in the risk appetite of international investors.

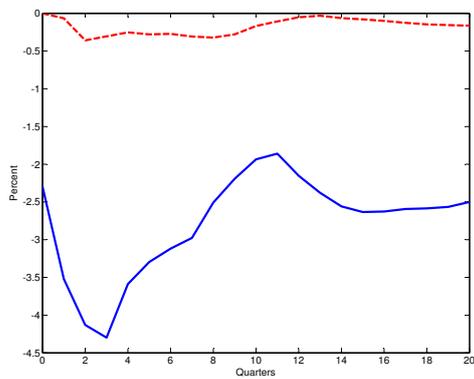
Figure 6 charts show the results for a 1 percent fall in the exchange rate that is caused by (a) lower international prices of the commodities New Zealand exports (shown in the blue line) and (b) by other causes (shown in the red line). These figures trace out how the various domestic prices evolved over time in response to the exchange rate depreciation. The responses shown are the average over the period 1989 Q2 to 2012 Q4. It is important to note that the results implicitly incorporate the average response over that period of other factors that are not explicitly modelled, including the monetary policy response.

In this model, an initial fall of around 2.5 percent in international prices for the commodities New Zealand exports (which itself might be caused by a variety of different factors) causes an initial 1 percent fall in the exchange rate. Perhaps somewhat surprisingly, there is no significant impact on import prices. Domestic producer output prices fall with the lower commodity prices. Part of this fall may be because falling commodity prices represent lower output prices for domestic commodity-producing sectors such as agriculture and primary food manufacturing (a large component of the Producers Price Index). Tradable consumer price inflation also falls, perhaps partly because some export commodities directly enter the CPI, but also because at times falls in New Zealand export commodity prices will be quite strongly correlated with falling prices for the commodities New

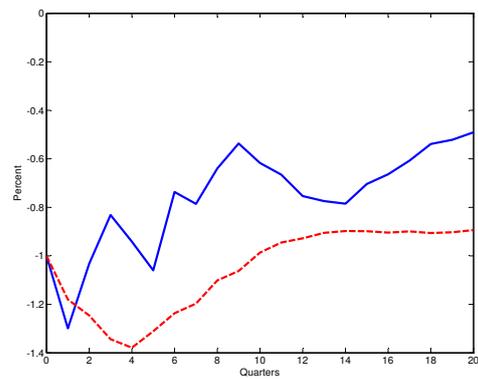
Figure 6
Effects of a 1 percent exchange rate depreciation, by cause

Commodity price cause of exchange rate movement in red, other causes in blue.

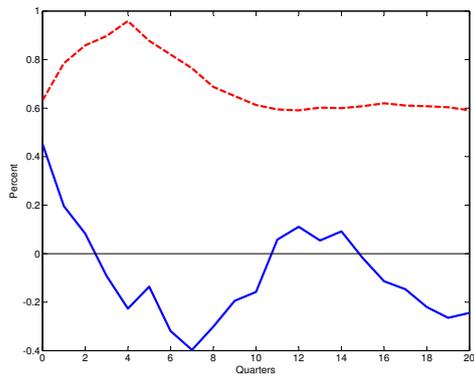
ANZ commodity prices (world terms)



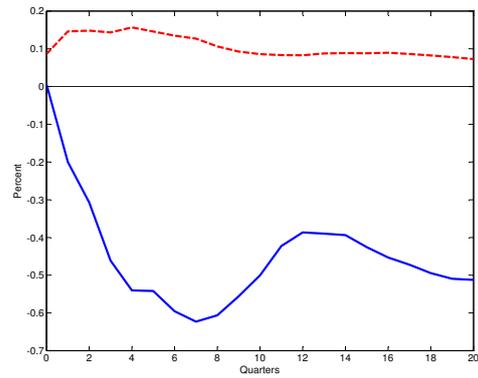
New Zealand dollar TWI



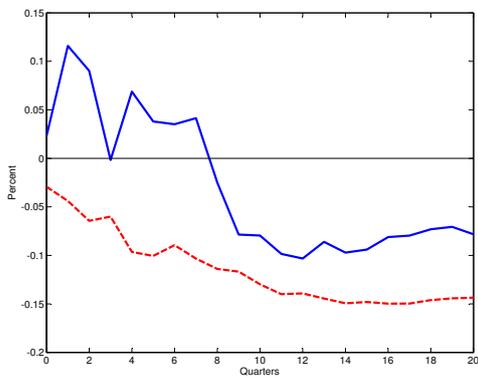
Import prices



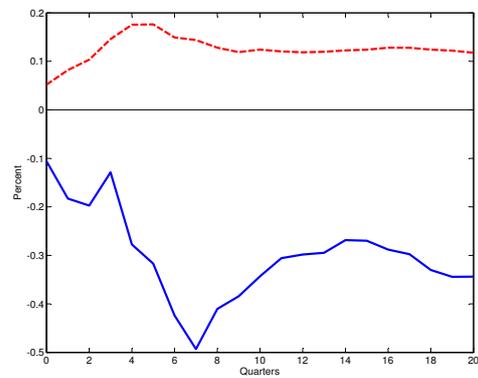
Producer output prices



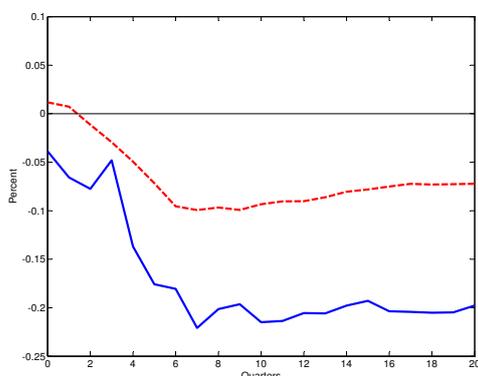
Real wages



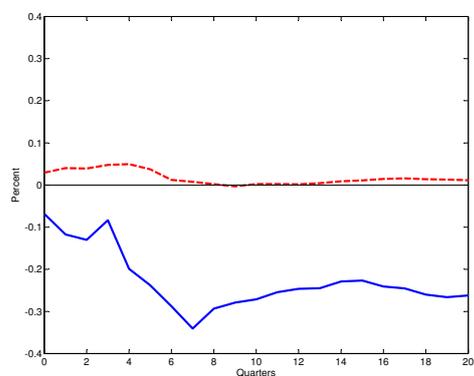
Tradables CPI



Non-tradables CPI



Constructed impact on headline CPI



Source: Parker and Wong (2014)

Zealand imports, such as petrol.

Non-tradable consumer prices also fall following a downward shock to commodity prices. The channel here is likely to be indirect – falling international prices for commodities New Zealand exports reduce New Zealand's terms of trade, lowering national income and spending power. This lower income puts downward pressure on the price of all goods and services bought by households, but particularly non-tradables. While headline CPI is not explicitly modelled, it is possible to construct an aggregate impact by combining the tradables and non-tradables using their current respective weights. The overall maximum impact on headline CPI is a 0.3 percent fall, which occurs around two years after the initial fall in the exchange rate (figure 6h).

The results for a 1 percent fall in the exchange rate caused by other factors are markedly different. Import prices and producer output prices increase; the peak response in these prices occurs just over a year after the original exchange rate shock. The response of consumer prices is also notably different, with tradables prices increasing. Non-tradables prices fall in this scenario, as under the commodity price scenario. Quite why, over the period studied here, is less clear. Overall there is little net effect on headline consumer prices in this case, contrasting with the fall in consumer prices witnessed following lower world commodity prices.

The magnitude of the effect of the exchange rate depreciation diminishes as it passes through the domestic

price channels. The original depreciation is around 1 percent in the first quarter, peaking around 1.4 percent after a year. The pass-through to import prices is lower, with the peak response less than 1 percent. The pass-through to tradable consumer prices is lower still, with the peak response around just 0.2 percent after a year.

Parker and Wong investigate the impact of exchange rate movements on the output prices of various industries and find effects on many, even those traditionally viewed as being non-tradable. In many cases, this is not too surprising given the important role that tradable inputs have in industries such as construction (steel and timber, for example), but it is a reminder that useful as the analytical distinction between tradables and non-tradables often is, the empirical boundaries can sometimes be fuzzy.

The starkly different responses of domestic prices, depending on whether the exchange rate changes results from export commodity price changes or other factors, highlights how important it is for forecasters and policymakers to understand the underlying cause of exchange rate movements in assessing the likely inflationary consequences. This can be challenging because the exchange rate is observed minute-by-minute, while hard data on many of the other factors that influence the exchange rate often emerge only with a lag.

8 Conclusion

Exchange rate changes and international price developments in the rest of the world affect prices in New Zealand through a number of channels. These channels include the prices paid by New Zealand consumers for final goods purchased from abroad, the costs of imported raw materials and machinery used by New Zealand businesses, and income and purchasing power effects caused by changes to the terms of trade.

How tradable product prices change following an exchange rate change differs widely. Petrol prices adjust substantially and quickly. But a significant share of New Zealand's imports appear to be priced for the local market and, however they are priced, there is a large domestic distribution component for most tradable goods. That means prices for traded goods in New Zealand will adjust by a smaller percentage than any given percentage movement in the exchange rate, and may diverge from those in the rest of the world for protracted periods.

Exchange rate movements are typically symptoms of other economic developments rather than being the originating source – the exchange rate does not move in a vacuum. So what causes the exchange rate to move can greatly affect how domestic prices change. In particular, changes in the exchange rate associated with changes in export commodity prices appear to have had quite different

inflationary implications, over the past 25 years, than other changes in the exchange rate. Changes in commodity prices appear to have become a more important factor in exchange rate fluctuations in New Zealand over the past decade or so. Understanding how different factors drive the exchange rate, and the implications of those for the wider economy and inflation pressures, is part of ongoing research at the Reserve Bank.

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