Exchange rate valuation and its impact on the real economy

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Abstract

We examine the relationship between exchange rate movements and the real economy – an area that has been the focus of considerable debate in recent years. We consider different concepts of exchange rate equilibrium, and review recent evidence on whether the New Zealand dollar exchange rate is representative of its fundamental determinants. We also review the theoretical and empirical evidence on the relationship between movements in the exchange rate and the resultant impact on the wider economy. We find that the nature of the relationship between the movements in the exchange rate and the resulting adjustment in the real economy depends on the nature of the shocks that affect the economy. This has important policy implications: policymakers need to have a clear understanding of the type and nature of the shock when deciding on appropriate responses. We also find, however, that despite extensive analysis in New Zealand and other countries, this interaction between the exchange and the wider economy is still not fully understood. For example, while it is possible that exchange rate overvaluation may have a negative impact on broader economic performance, the existing empirical evidence does not allow us to reach a conclusive view. We propose areas of future research that may better equip policymakers to understand these potential negative effects of exchange rate shocks to the wider economy.

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1. INTRODUCTION

"Few issues in economics are more susceptible to political misrepresentation than exchange rates."

Niall Ferguson[1]

The relationship between exchange rate movements and the real economy has been a key focus of macroeconomic policy discussions in New Zealand in recent years. There has been considerable debate about the causes of the appreciation of the real exchange rate and the extent to which it reflects either changes in New Zealand's macroeconomic fundamentals relative to our trading partners or non-fundamental factors which have resulted in the exchange rate being overvalued relative to the level implied by fundamentals. The impact of this appreciation on the real economy has also provoked considerable discussion, with a wide range of views regarding the need for policy responses, and what type of policy interventions they should be.

In this paper, we begin by considering different concepts of exchange rate equilibrium and review the recent evidence on whether the New Zealand dollar exchange rate is misaligned relative to its fundamental determinants. We then review the theoretical and empirical evidence on the relationship between movements in the exchange rate and their impact on the real economy. A key theme through the paper is that the nature of the relationship between the movements in the exchange rate and adjustment in the real economy will depend on the nature of the shocks that are hitting the economy. In addition, the appropriate responses by policymakers will depend on understanding the types of shocks affecting the exchange rate and the real economy. Despite extensive analysis in New Zealand and overseas, there are still many aspects of the interaction between the exchange rate and the real economy that are not fully understood. Therefore, in the conclusion we suggest some areas for future research that may assist policymakers to respond appropriately to the potential negative effects of shocks which affect economy through changes in the exchange rate.

2. CONCEPTS OF EQUILIBRIUM

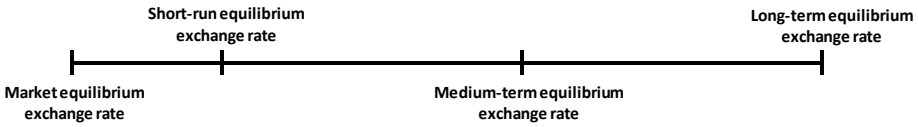
2.1 Overview

It is often asserted that the New Zealand dollar is overvalued, although there seems to be little agreement, not least in the public debate, about what the term 'overvaluation' really means. It necessarily implies that there is an equilibrium level of the exchange rate which is to some degree weaker than the current level. But as Driver and Westaway (2004) show, the concept and meaning of the 'equilibrium' is itself difficult to pin down. The concept of exchange rate equilibrium, or the rate determined by fundamentals, raises a number of issues, such as its existence, uniqueness, optimality, determination, evolution over time, and is it even valid to talk about disequilibrium.

Interpretations of exchange rate equilibrium vary. A key point to clarify when discussing equilibrium is the time horizon over which it might be achieved.

[1] Niall Ferguson "Currency wars are best fought quietly", *Financial Times*, 25 January 2013

Figure 1 – Concepts of exchange rate equilibrium



Driver and Westaway, extending the work of Williamson (1983), outline differing time horizons: At one extreme of the spectrum, given that the exchange rate is determined continuously by balancing demand and supply in the foreign exchange market, one might argue that the exchange rate is *always* at its equilibrium value and in line with fundamentals. However, the concept of equilibrium relevant for considering real sector impact is a longer-term concept. Accordingly, for our purposes, we need to go beyond this truism.

Moving across to the right we are getting into more interesting ground, with the short-, medium-, and long-term equilibria. Driver and Westaway define the short-term equilibrium as the one in which the fundamental determinants of the exchange rate are at their current settings (ie, not necessarily consistent with any supposedly long-term value). In this regard, it useful to think about the short-term equilibrium as the value of the exchange rate that is ***explainable***.

On the other hand, the medium- and long-term concepts of exchange rate equilibrium can more be thought of as the value of the exchange rate that is ***justified*** by fundamentals in the longer-run. Driver and Westaway define the medium-term equilibrium as that compatible with an economy at internal and external balance, and the long-term equilibrium as that in which the economy has reached the point from which there is no tendency to change. These concepts of equilibrium are discussed in more detail below.

2.2 Concepts of exchange rate valuation

2.2.1 Short-term equilibrium

A wide range of models and methods are used to assess the value of an exchange rate against its 'equilibrium' level across the range of horizons discussed above.

In theoretical terms, the set of measures that aim to capture short-run equilibrium exchange rate movements are often hardest to pin down. Driver and Westaway point to a wide range of short-term models, ranging from monetary models with both flexible and sticky prices, models with imperfect capital substitutability (thereby introducing risk premia), and also with non-zero interest rate differentials.

At very short frequencies the volatility of the exchange rate is much greater than the volatility of fundamentals. Short-term models of exchange rate movements are often based around their ability to forecast movements rather than representing an overriding theoretical framework.

2.2.2 Medium and long-term equilibrium

Driver and Westaway offer a large taxonomy of different empirical approaches at estimating equilibrium exchange rates in the medium and long term. It should be noted that the distinction between medium- and long-term equilibria is largely an academic concern with regard to whether an economy converges to stock-flow equilibrium or not.

The approaches essentially boil down to two methods: Purchasing Power Parity approaches, predicated on the Law of One Price exerting itself over time, and Underlying Balance Models encompassing the familiar Macroeconomic Balance and External Sustainability approaches, and Cline and Williamson's Fundamental Equilibrium Exchange Rate (FEER) methodology.

In their strictest form, PPP models predict that price levels in different countries will always be the same when measured in a common currency. In doing so, PPP models appeal to the Law of One Price (LOOP), and essentially boil down to whether the real effective exchange rate is stationary (i.e. mean-reverting) over time. In practice, there are numerous reasons why PPP does not hold strictly. The Balassa-Samuelson (BS) adjusted PPP approach aims to isolate the role of one factor that helps to explain why PPP may not hold – the fact that LOOP can only be expected to hold for tradable goods. Put simply, the standard BS model predicts that countries with highly productive tradable sectors have higher non-tradable prices – and therefore a higher overall price level – than countries with less productive tradable sectors. As a result, countries in which tradable productivity is growing faster than productivity in the non-tradable sector tend to have appreciating real exchange rates. In any case, typically, any mean reversion of a country's real exchange is, at best, a slow process. This suggests that alternative approaches to equilibrium are needed.

Underlying balance models are perhaps the most common way to measure exchange rate misalignment, with the partial equilibrium approaches of the Macro Balance and External Sustainability models most typically adopted.[2]

Macroeconomic Balance (MB)
A medium-run approach, estimating the change in the exchange rate required to close the gap between the "underlying" current account balance of a country and its "equilibrium" level.
Issues: Macro balance models require judgement as to the underlying and equilibrium levels of the current account deficit. Also requires judgement over the elasticity of the current account to changes in the exchange rate.

External Sustainability (ES)
A similar but more long-term approach to the Macroeconomic Balance method. External sustainability models estimate the required change in the exchange rate required to return the current account balance to the level required to stabilise net financial assets at a benchmark long-run value.

[2] An accusation sometimes levelled at partial equilibrium underlying balance models (such as MB and ES) is that because they are typically only performed for a single point in time, they are not particularly relevant in explaining real exchange rate movements over time. Barisone et al (2006) investigate this and actually find that underlying balances models have more success than PPP in explaining RER movements.

Issues: External sustainability models require judgement as to the forecast medium-term current account balance and the sustainable level of a country's net international investment position. In addition, as with the Macroeconomic Balance approach, they also require judgement over the elasticity of the current account to changes in the exchange rate.

The Fundamental Equilibrium Exchange Rate (FEER) approach, most closely associated with Cline and Williamson at the Peterson Institute for International Economics, employs a similar underlying balance method as in the partial equilibrium models (ie, internal and external balance) but is calculated using a large macro model in which international relationships within the model are endogenous. This helps to ensure consistency.

2.3 Other concepts of exchange rate valuation

Research has also been conducted to understand why exchange rates frequently do not adjust and evolve in line with the conventional models mentioned earlier. Such research can broadly be grouped into two areas, the first of which views the exchange rate as an asset price. This so-called 'asset market' approach was developed in the late 1970s and posits that an exchange rate can be thought of as an asset price whose value reflects not only current economic considerations but also a forward-looking component assessing future economic developments too. Engel and West (2010) argue that short-term movements in the exchange rate are influenced and driven by changes in these expectations of the future, thus helping to explain why the exchange rate can fluctuate in the short term even in the absence of new 'current' information. To the extent that the forward-looking component accurately assesses information on future developments in fundamentals, exchange rates can therefore forecast future changes in the fundamentals themselves. Engel and West (2005) and Chen et al (2010) both demonstrate that this theory holds empirically, particularly in the case of "commodity currencies" such as the New Zealand dollar. Benigno et al (2011) use a general equilibrium framework to show the exchange rate can also react to variation in uncertainty and risk. Their model shows an exchange rate can either rise or fall when uncertainty increases, depending on the nature of the volatility shock and the hedging properties of the currency.

The second area of research incorporates so-called 'behavioural theories' of exchange rate determination. These examine the inherent instabilities present in the foreign exchange market and the way that these may affect the convergence of an exchange rate towards an equilibrium level. De Grauwe and Grimaldi (2006) argue that the foreign exchange market is comprised of two types of agents; fundamentalists whose actions in the market reflect their views on long-run fundamental relationships, and chartists who rely on short-term trends and relationships. The authors argue that the manner in which these two types of agent interact helps to explain how changes in, and the value of, the exchange rate can become disconnected from fundamentals. In other words, the structure and nature of the foreign exchange markets themselves may inherently explain why exchange rates frequently deviate from any notion of a long-run fundamentals-based equilibrium.

2.4 How does the New Zealand dollar stack up?

Results for the New Zealand exchange rate are presented in the table below. A wide range of equilibrium models suggest the New Zealand dollar is overvalued relative to

its medium-long-term equilibrium, although estimates of the degree of over-valuation vary widely.

Table 1 – Estimates of New Zealand Dollar Misalignment

Institution	Method	Measure	Over/Undervalued?	Notes
IMF[1]	Macro balance & other CGER models	REER	In range of +10-20%	Subject to much uncertainty, but "the New Zealand dollar is currently stronger than is consistent with a level of the current account deficit that is more sustainable over the longer term".
Cline & Williamson (Peterson Institute)[2]	FEER	vs. USD	+15-20% (approx.)	FEER-consistent dollar rate estimated at 0.71.
BNZ[3]	Terms of trade-adjusted PPP	vs. GBP	+18% (approx.)	0.44
		vs. USD	+20% (approx.)	0.70
		vs. EUR	+15% (approx.)	0.56
		vs. AUD	+4% (approx.)	0.77
		vs. JPY	-11% (approx.)	77.5
				Current long-run equilibrium estimate levels.
RBNZ[4]	Macro balance	TWI	In range of +1-10%	

[1]IMF Staff Report for 2012 Article IV Consultation, May 2012

[2]Updated Estimates of Fundamental Equilibrium Exchange Rates, November 2012

[3]BNZ Currency Research, "Updating Our Long Run Valuation Model", 13 December 2012

[4]Various reports

3. REAL ECONOMY IMPACT OF EXCHANGE RATE VARIATION – THEORY

3.1 Overview

In the previous section we considered the role of fundamental shocks on equilibrium exchange rates and the extent to which the exchange rate may diverge from the value implied by fundamentals. In this section we examine the impact of exchange rate movements, driven by either fundamental or non-fundamental shocks on the real economy. In addition, we also consider the impact of shorter-term high frequency exchange rate volatility on the real economy.

We divide the impact of exchange rate movements on the real economy into three channels:

1. **Fundamental shocks**, which change the equilibrium exchange rate[3]

2. **Non-fundamental shocks**, which push the actual exchange rate away from equilibrium for an extended period.

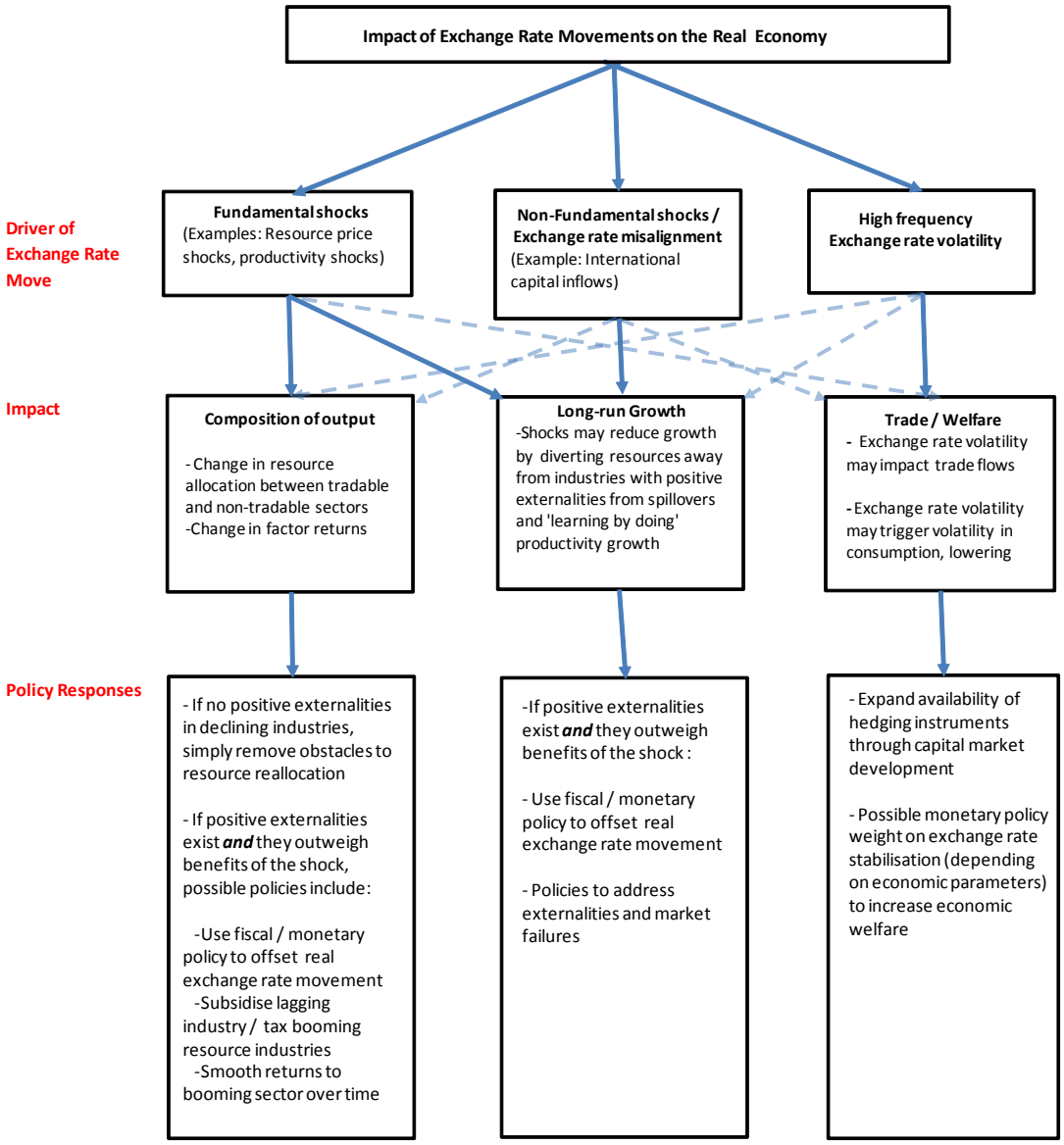
3. **High-frequency volatility**, caused by foreign exchange market trading conditions

The main strands of the theoretical literature are summarised in Figure 2. Solid arrows represent the main channels of different exchange effects on the real economy, and

[3] The impact of a fundamental shock on the exchange rate and other macroeconomic variables can be temporary or permanent. For example, a shock which permanently changes domestic preferences between current and future consumption relative to preferences in the rest of the world will change steady-state levels of foreign debt, the trade balance and the real exchange rate.

possible policy responses. Dashed arrows represent other possible channels, which may exist, but have received less attention in the literature.

Figure 2 – Summary of real economy effects of exchange rate movements



3.2 Setting the scene – The New Zealand context

In emerging market economies, where governments have adopted export-oriented growth strategies, much of the debate is around the impact of the exchange rate on export growth.[4] In contrast, in New Zealand, as a developed economy, in which domestic demand makes a larger contribution to GDP growth, policy discussions regarding the real impact of exchange rate fluctuations have focussed on the divergence between output growth in tradable and non tradable sectors since the mid-

[4] See Rodrik (2008).

2000s (Figure 3).[5] Over the same period, the real exchange rate has risen by around 10-20%, depending on the measure used (Figure 4).[6] In addition, the world prices of New Zealand's commodity exports have doubled in nominal terms, which have contributed to an improvement in the terms of trade (Figure 5).

There are several possible explanations for this pattern:

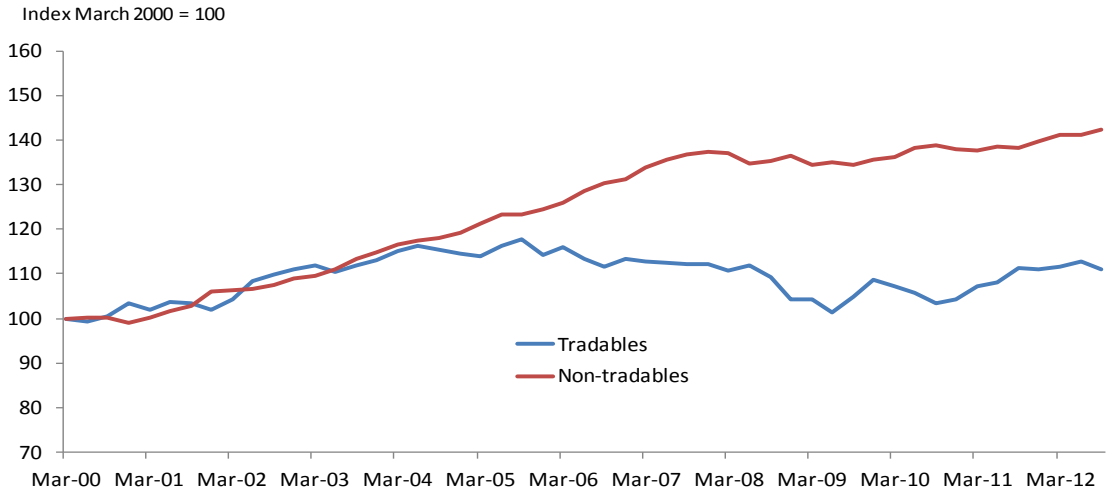
1. A fundamental shock, such as an increase in the terms of trade, has impacted the real exchange rate and led to a shift in resources from the tradables sector to the non-tradables sector.

2. A non-fundamental shock has pushed the exchange rate above the equilibrium level implied by fundamentals, leading to lower growth in tradables and stronger growth in non-tradables output

3. Exchange rate volatility has had a negative impact on activity in the tradables sector.

In the following sections, we summarise the theoretical literature which can be used to examine these explanations.

Figure 3 – Tradables and Non-Tradable GDP

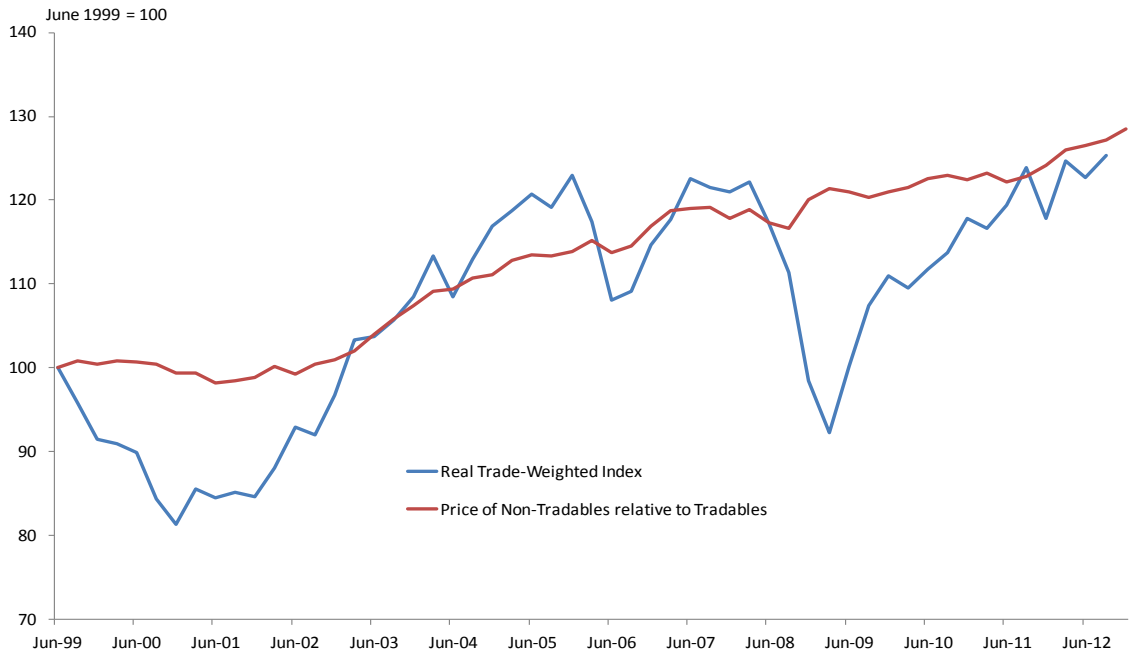


Source: Statistics New Zealand and authors' calculations

[5] For example, *Briefing to the Incoming Minister of Finance, 2011*, New Zealand Treasury. However, calculating the tradable and non-tradable components of GDP is subject to uncertainty. See Special Topic, *Monthly Economic Indicators*, April 2012, New Zealand Treasury.

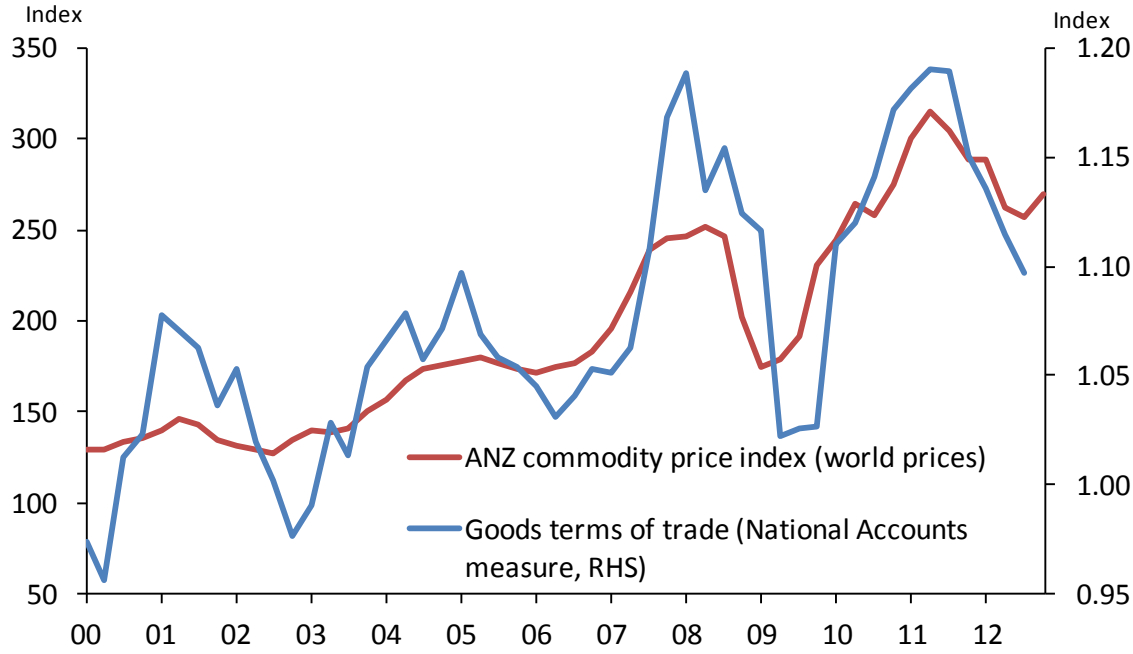
[6] The appropriate definition of the real exchange rate depends on which modelling framework is used. For further discussion, see Dwyer and Lowe (1993).

Figure 4 – New Zealand Real Exchange Rates



Sources: Reserve Bank of New Zealand, Statistics New Zealand, authors' calculations

Figure 5 – New Zealand Commodity Export Prices and Terms of Trade



Sources: Statistics New Zealand, ANZ

3.3 Fundamental Shocks

3.3.1 Overview

There is no unique definition of how to split shocks into fundamental and non-fundamental factors which affect the exchange rate. Definitions of fundamental shocks vary across exchange rate models, but can include productivity shocks, monetary shocks, consumer preference shocks, terms-of-trade and commodity price shocks. There is significant debate about which macroeconomic fundamentals drive exchange rates, and in general all exchange rate models based on fundamentals have performed poorly in explaining exchange rate movements. Meese and Rogoff (1983) found forecasts from a wide range of exchange rate models based on fundamentals could not outperform random walk forecasts. Most subsequent studies found a similar result. Moosa (2013) uses a simulation exercise to show that as exchange rate volatility rises, the root mean squared error of the forecasts from any model will rise faster than the forecast errors of the random walk. As noted in the previous section, the poor forecasting performance of exchange rate models based on fundamentals has contributed to the argument by some researchers that the exchange rate should be treated as a forward-looking asset price. However, others have argued that current fundamentals still play a role in determining exchange rates, and the poor forecasting performance is due to factors such as parameter instability and misspecification due to measurement error of many macroeconomic fundamentals.[7] For example, in the 'scapegoat' model of exchange rates, traders are uncertain about the parameters on individual fundamental variables in the short to medium term. As a result, they attribute exchange rate movements to a particular fundamental, which becomes the scapegoat. The fundamental chosen changes frequently. This happens when traders do not know the true exchange rate model and some of the exchange rate's drivers are unobservable.[8]

3.3.2 The Dependent Economy Model

In a small open economy such as New Zealand, which takes world prices as given, fundamental shocks can lead to reallocation of resources between sectors, with the real exchange rate adjusting to facilitate the reallocation. The most common framework for studying this process is the 'dependent economy model',[9] which assumes output can be split into composite tradable and non-tradable goods. The dependent economy model was first introduced by Salter (1959) and Swan (1960) to study how real exchange rate adjustment can generate internal and external balance.

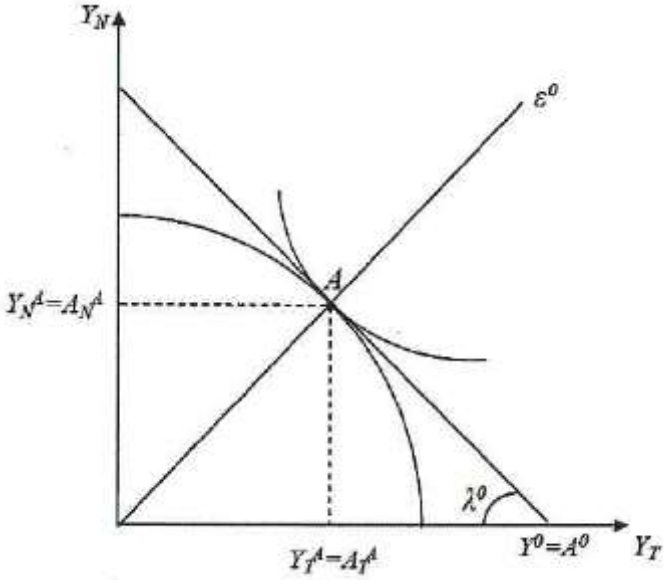
The simplest form of the dependent economy model assumes capital is specific to production in the tradable and non-tradable sectors, and the labour is the only flexible factor of production. The real exchange rate in the model is defined as the ratio of the price of tradable goods to the price of non-tradable goods. Assume we start from position of internal balance (factors of production are fully employed) and external balance (the trade balance is zero). In this case (Figure 6.A), the relative price of non-tradables to tradables (λ_0) is tangent to the production possibility frontier and consumers' utility maximising indifference curve.

[7] See Wang (2008).
[8] See Fratzscher et al (2012).
[9] The dependent economy model is also referred to as the 'Australian model' and the 'Scandinavian model' in the literature.

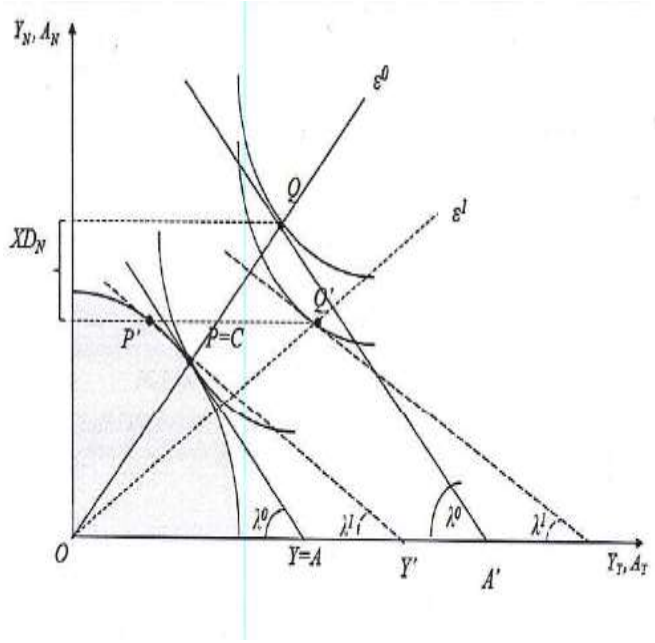
Now, consider a shock which increases the level of income and domestic demand (Figure 6.B). At the previous real exchange rate (λ_0) and allocation of resources, there would be excess demand for both tradables and non-tradables. Excess demand for tradables can be partly met by increased imports, leading to a trade deficit, but demand for non-tradables can only be met by greater domestic output. An increase in the real exchange rate (λ_1) generates a transfer of labour (the only mobile factor) from tradables production to non-tradables production. So the new equilibrium has a real exchange rate appreciation, a negative trade balance (the vertical gap Q'P') and a greater share of output in non-tradables.

Figure 6 – The Dependent Economy Model

A – Initial equilibrium – Internal and External Balance



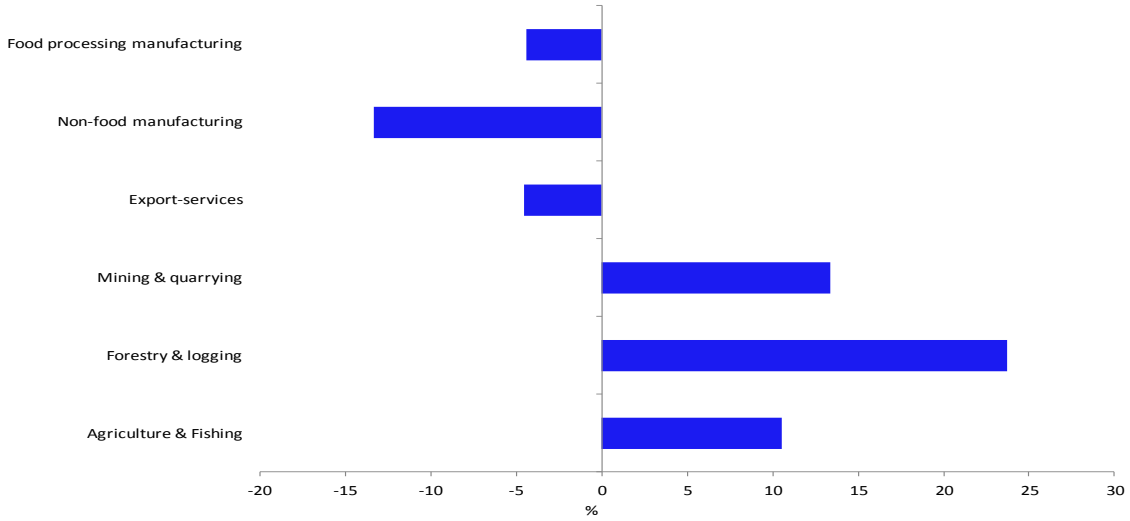
B – An Expansion in Domestic Demand



3.3.3 Extending the Dependent Economy Model

The simple Dependent Economy model can only be used to model a limited range of fundamental economic shocks. Notably, it cannot model a shock to the terms of trade, as the price of export goods equals the price of imports by assumption, so only a single composite tradable good can be modelled. However, disaggregating New Zealand's tradable GDP (Figure 7) shows different outcomes across industries over the period when tradable and non-tradable GDP have diverged. While manufacturing and services exports have declined, agricultural output and production in resource-based industries has risen sharply. This suggests the impact of shocks has differed across tradable industries.

Figure 7 – Tradable Industries Output Growth 2004Q1-2012Q3



Source: Statistics New Zealand and authors' calculations

The lack of a close relationship between tradable industries is confirmed by factor analysis.[10] Factor analysis examines whether output growth in tradable industries is jointly driven by a small number of underlying factors.[11] The first principal component explains only around 30% of the total variation in the growth rates. Although this is higher than we would expect if the six series were completely uncorrelated[12], it still indicates that a common factor plays a fairly limited role in explaining movements in tradable output. The weights (factor loadings) on each series in the first principal component do not have a clear macroeconomic interpretation, with negative weights on agricultural and fishing sector growth, and positive weights on growth in the other sectors.

[10] In addition to the factor analysis on the growth rates, cointegration testing rejects the null hypothesis of a cointegrating relationship between the levels of industrial output.

[11] Standardising the quarterly growth rates (by subtracting the mean and dividing by the standard deviations) to control for differences in volatility across series does not change the results very much. The estimation period is 2000Q1-2012Q3.

[12] If the six series were completely uncorrelated, then each of the six factors would explain the same proportion of variation, i.e. 100/6 = 16.6%.

Table 2 – Principal components analysis on tradable GDP sectors

Eigenvalues: (Sum = 6, Average = 1)

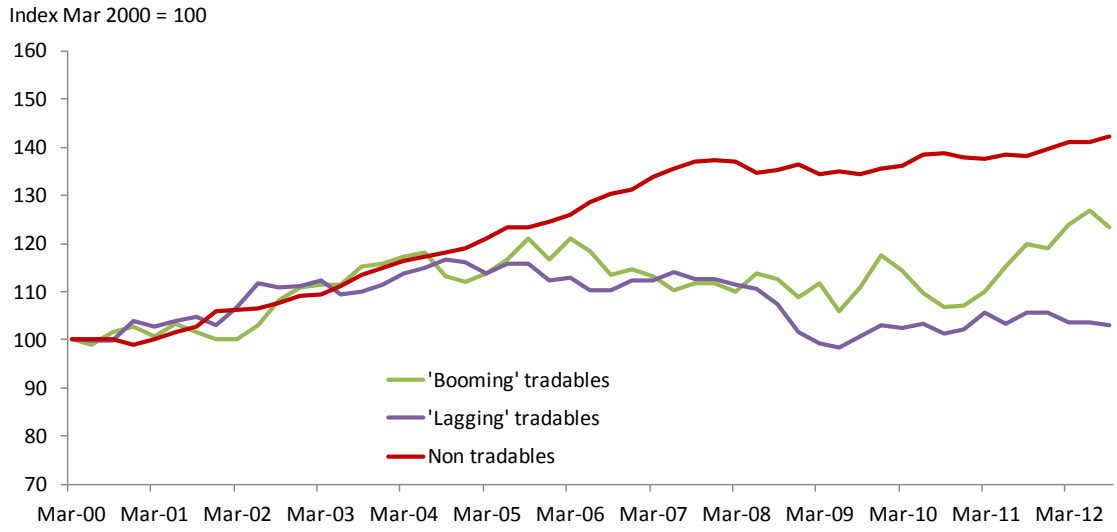
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	1.724297	0.510438	0.2874	1.724297	0.2874
2	1.213858	0.065404	0.2023	2.938155	0.4897
3	1.148454	0.358329	0.1914	4.086609	0.6811
4	0.790126	0.084739	0.1317	4.876735	0.8128
5	0.705387	0.287508	0.1176	5.582122	0.9304
6	0.417878	---	0.0696	6.000000	1.0000

Factor loadings

Variable	PC 1
Agriculture	-0.515090
Exports of Services	0.378178
Fishing	-0.066124
Forestry and Logging	0.312748
Manufacturing	0.377175
Mining and Quarrying	0.589252

The Dependent Economy Model was extended by Corden (1984) and Corden and Neary (1982) to model the impact of shocks to resource prices on non resource-based traded industries and non-tradables. In the expanded version of the model, the tradables sector is divided into 'booming' resource industries and 'lagging' non-resource tradable industries. Figure 8 below disaggregates New Zealand tradables output into booming and lagging sectors. Since 2009, activity in the booming sector has grown faster than non-tradable sector output.

Figure 8 – Decomposing Tradables GDP according to the Corden-Neary model



Sources: Statistics New Zealand and authors' calculations. Booming sector is agriculture, fishing, forestry and logging, mining and quarrying and food processing manufacturing. Lagging sector is exports of services and non-food processing manufacturing.

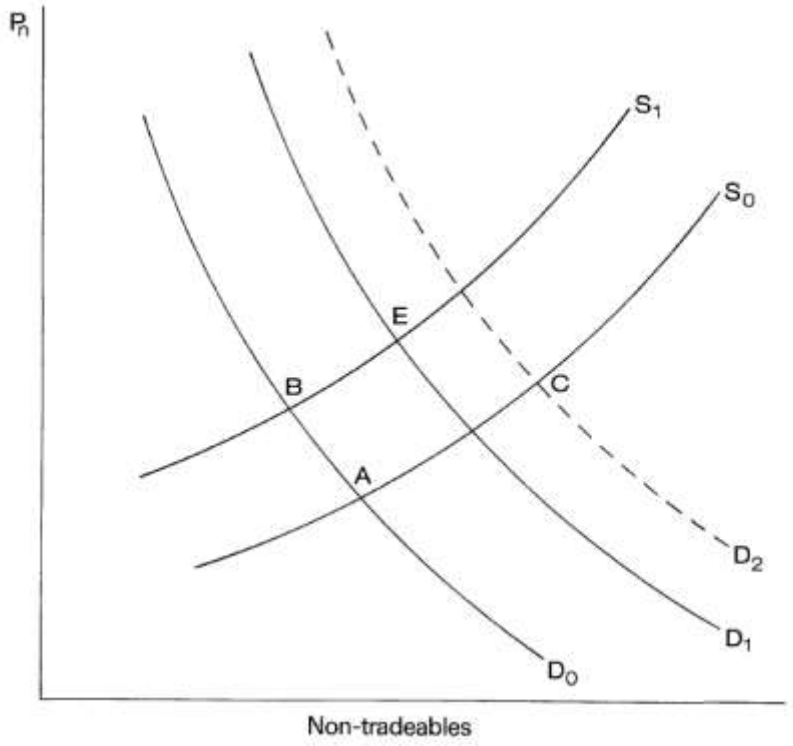
In the Corden and Neary model, higher world prices for natural resources affect activity in the lagging industries through two main channels (Figure 9):

1. **Spending Effect** – If some of the extra income earned from higher resource prices is spent on non-tradables (demand curve for non-tradables shifts from D_0 to D_1) the relative price of non-tradables will rise, representing a real exchange rate appreciation. This shifts some labour resources out of the booming and lagging industries into non-tradables.

2. **Resource Movement Effect** – As the marginal value product of labour rises in the booming sector, wages in all sectors increase. This has two effects. First, there is a reduction in activity and labour demand in the lagging sector. Corden calls this *'direct de-industrialisation'*, as it does not require a change in the real exchange rate to happen. Second, labour moves out of the non-tradables sector into the booming sector, shifting the non-tradables supply curve in from S_0 to S_1. This increases excess demand for non-tradables and puts further upward pressure on the real exchange rate. This rise in the relative price of non-tradables leads to additional upward pressure on wages, which shifts more labour out of the lagging industries ('*indirect de-industrialisation'*).

Overall, output in the lagging industries unambiguously falls. However, output of non-tradables could rise or fall, depending on whether the spending effect (increases non-tradable output) or the resource movement effect (lowers non-tradable output) is dominant.

Figure 9 – Resource Boom in the Corden and Neary Model



Source: Corden (1984)

So far we have summarised a simple static modelling framework used in the literature for analysing the impact of a fundamental shock on the real exchange rate for small

open economies such as New Zealand which affects the balance of output between tradables and non-tradables. The Dependent Economy framework has been widely used to examine the impact of shocks such as Dutch Disease. Corden (2012) applies the model to analysing the impact of the booming mineral and energy sectors on the Australian economy. He suggests the best policy response would be to do nothing, as allowing the real exchange rate to appreciate lifts real consumption wages (as a result of lower import prices), or alternatively, if some policy action is required, to run a tight fiscal policy and stimulatory monetary policy to moderate the exchange rate appreciation. Running a fiscal surplus mitigates the spending effect of the resource sector boom and smoothes expenditure to reduce output volatility.[13] Corden argues that fiscal and monetary policy responses are less distortionary than other possible responses such as tax changes or direct protection of lagging industries.

In summary, if there are no market distortions or market failures, the optimum policy response to a fundamental shock is to allow firms to reallocate resources from declining industries to ones that are growing, as this will increase overall economic welfare. However, if there are distortions in the economy, then welfare may be increased by policies which try to offset or smooth the adjustment. For example, if there are positive externalities associated with maintaining a significant manufacturing sector (which will be discussed in more detail in the next section), and these externalities are sufficiently large to offset the welfare gains from the shock, then a range of policies could be considered.

3.4 Non-fundamental shocks / exchange rate misalignments

3.4.1 Overview

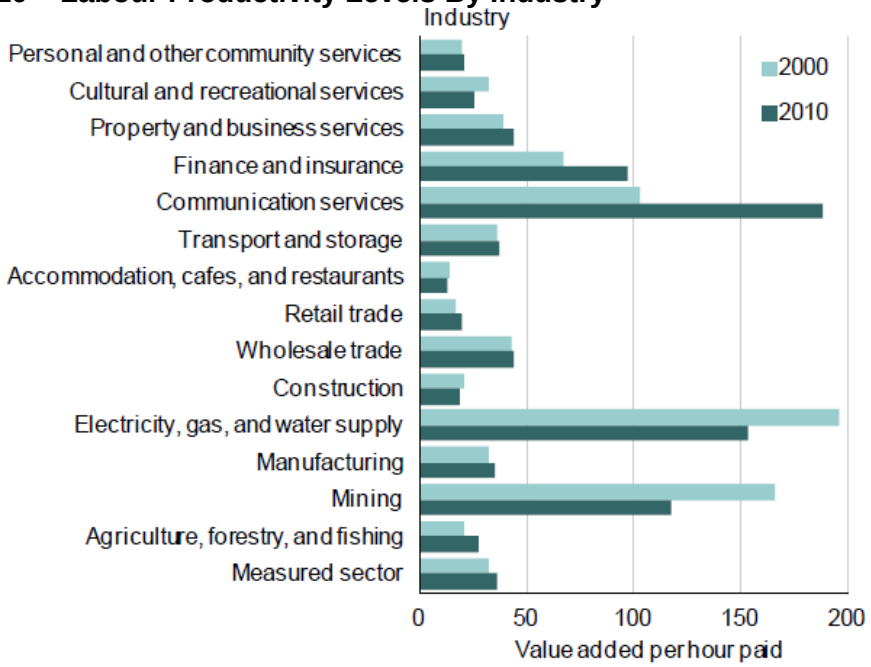
Non-fundamental shocks can cause the exchange rate to diverge from the level determined by fundamentals. In addition to the static reallocation of resources from the tradable sector to the non-tradable sector, much of the academic literature on the real impact of non-fundamental shocks has focussed on the impact of the exchange rate on long-term growth rates.

In many countries, including New Zealand, arguments for the negative effect of a misaligned (and overvalued) exchange rate on growth have focussed on the potential for faster productivity growth in the tradable sector relative to the non-tradable sector. In New Zealand, tradable GDP has often been used as a proxy for the high productivity growth sector of the economy. In practice, however, the relationship between productivity and tradability is more complex.[14] Di Maio and Sonerson (2012) show that productivity levels and growth vary widely across industries in the tradable and non-tradable sectors (Figure 10). Procter (2012) also analyses productivity within the tradable sector at the industry level, and discusses the different degrees of scope for lifting productivity in different industries.

[13] Magud and Sosa (2010) also recommend using fiscal policy to offset the negative effects of Dutch Disease.

[14] Industry-level labour productivity levels should be interpreted in terms of the different capital intensities across industries. The industries in Figure 10 with the highest labour productivity also have the highest capital-labour ratios. Cross-country comparisons can also be used to industry productivity levels in context. See Mason and Osbourne (2007) for further discussion.

Figure 10 – Labour Productivity Levels By Industry



Source: Statistics New Zealand

3.4.2 Growth models and the exchange rate

Despite the widespread discussion by policymakers of the impact of the exchange rate on growth, there is relatively little theoretical discussion of a causal relationship from movements in the real exchange rate to economic growth. In the conventional neoclassical growth model, growth is driven primarily by technological progress, which is exogenous to the model.[15] In order to incorporate the impact of misaligned exchange rates on growth, endogenous growth models are needed, in which growth can be sustained without exogenous technological progress.

Many endogenous growth models achieve this by incorporating human capital into the capital stock, which unlike physical capital is not subject to diminishing marginal returns. The simplest endogenous growth model is the AK model, in which firms have a linear production function,[16]

$$y = f(k) = Ak,$$

where

y = output per person,
A = the level of technology,
k = (human and physical) capital per person.

In this model growth can be sustained indefinitely without technological progress if the rate of capital accumulation is faster than the rate of depreciation plus the rate of labour force growth.

[15] In the neoclassical growth model, countries with low real income per capita can also achieve growth through convergence to real income levels in rich countries.
[16] See Barro and Sala-i-Martin (1995) for a detailed description.

One strand of the endogenous growth literature assumes productivity growth occurs by 'learning by doing', with workers becoming more productive at a task as they perform it repeatedly.[17] It is also often assumed that knowledge of productivity innovations by a firm becomes available to other firms in the economy, so there are knowledge spillovers or positive externalities for the rest of the economy associated with innovations made by individual firms.

Many models assume that the potential for these spillovers is strongest in tradable industries such as manufacturing. For example, Van Wijnbergen (1984) develops a two-period model in which tradables productivity in the second period depends on tradables production in the first period as a result of learning by doing. Sachs and Warner (1995) use an overlapping generations endogenous growth framework with non-tradable, manufacturing and natural resource sectors, in which human capital is accumulated by employment in the manufacturing sector. Therefore, an overvalued misaligned exchange rate, which leads to contraction of the tradables sector could reduce the scope for productivity growth through knowledge spillovers. These effects could also be generated by negative dynamic effects of Dutch Disease, especially in emerging market economies attempting to diversify away from natural resource production and develop manufactured industries for export. However, Torvik (2001) argues the assumption that learning by doing and knowledge spillovers are concentrated only in the traded sector may not be appropriate for all countries, with the classification of what is traded and non-traded varying significantly across countries. Even if learning by doing is primarily in the tradables sector, Lama and Medina (2012) indicate that monetary policy targeting exchange rate stabilisation is a "blunt instrument" to address the externality, which is not necessarily welfare enhancing as it results in a misallocation of resources among sectors.

In addition to knowledge spillovers, Rodrik (2008) offers an additional explanation for positive growth effects from the tradable sector, linked to institutional structures. The impact of economic institutions has been widely discussed in the recent economic growth literature.[18] Because production of tradables tends to be more complex and involves more steps than non-tradables, it may require better third-party enforcement of contracts and so be more vulnerable to weak institutions. In this case, an undervalued exchange rate can be a second-best mechanism for encouraging more tradables investment.

In summary, shocks which lead to exchange rate misalignments and fundamental shocks can both have a persistent impact on long-run growth if productivity growth in the tradable sector has greater potential for learning by doing and knowledge spillovers. These positive externalities would mean that the market allocation of resources to the tradables sector would be below the social optimum, and raise the possibility of policy actions to address the externalities. In this case, the optimal policy response will depend on the scale and nature of the externalities.

It should be noted, however, that much of the theoretical literature on the growth effects of the tradables sector is focussed on boosting export growth for developing economies. There is relatively little discussion on the relative impact of knowledge spillovers in tradable and non-tradable sectors in advanced economies, so it is not

[17]The modern learning-by-doing growth literature was started by Romer (1986) using the framework developed by Arrow (1962).
[18] See, for example, Acemoglu and Robinson (2012).

clear to what extent the conclusions in the endogenous growth literature can be applied to New Zealand.

3.5 Exchange Rate Volatility

So far we have considered the impact of fundamental and non-fundamental shocks which have a persistent impact on the exchange rate and the real economy. In this section we consider the impact of shocks which generate more short-term volatility in the exchange rate and the possible impact on the real economy.

3.5.1 Measuring exchange rate volatility

Despite the extensive discussion in the literature of the possible effects of exchange rate volatility, there is little consensus on how volatility should be measured.[19] Theoretical models of firms' behaviour under exchange rate uncertainty do not provide any guidance on what the appropriate definition of volatility should be. So questions such as which time horizon is appropriate, the level of aggregation (i.e. volatility of bilateral exchange rates or the effective exchange rate) and whether unconditional volatility should be used or the deviation between the exchange rate and the expected value remain a topic of debate.

3.5.2 Exchange rate volatility and trade

There is a large literature on the impact of exchange rate volatility and uncertainty on trade flows.[20] Many theoretical models find a negative relationship between exchange rate volatility and trade flows. For example, Clark (1973) considers a competitive price-taking firm which produces one output, which is sold entirely to a single foreign market at a price denominated in foreign currency. Clark assumes that because of costs of adjusting the level of production, the firm must make its production decision before knowing the exchange rate at which it will convert its foreign currency receipts back into domestic currency. As a result, exchange rate volatility will lead to volatility in the firm's realised profits. If the firm is risk averse, this volatility will lead to a reduction in output and hence exports, to reduce its exposure.

The negative impact of exchange rate volatility on trade would be expected to be especially large if there were irreversible initial costs associated with entering export markets. A seminal paper by Baldwin and Krugman (1989) shows that the existence of a sunk entry cost into the export market generates a persistent effect of real exchange rate movements on bilateral exports. Their model also suggests that a larger sunk entry cost generates a more persistent effect, or equivalently a lower reaction of exports to real exchange rate movements. The nature of this sunk cost can take a number of forms such as language and/or cultural barriers, heavy levels of regulation / customs bureaucracy, as well as distance from trade partners. More recent work has argued that the firms' sensitivity to exchange rate volatility would be greater if they are credit constrained or financially vulnerable, as discussed by Hericourt and Poncet (2013). Sunk or fixed costs of participating in export markets also play a key role in the 'New-New Trade Theory'.[21] In this literature, productivity varies across firms in an industry.

[19] See Clark et al (2004) for further discussion.
[20] For more detailed surveys, see HM Treasury (2003) and Clark et al (2004).
[21] The New-New Trade Theory follows Melitz (2003). See Ciuriak et al (2011) for an introduction.

Firms face sunk costs of entering international markets and uncertainty about their future productivity. As a result, less profitable firms face negative profits and exit from export markets. The reallocation of their market share to the more productive firms which remain in export markets leads to gains in both aggregate productivity and welfare.

However, the theoretical result of a negative relationship between exchange rate volatility and trade depends on several assumptions. First, it assumes firms cannot adjust their production or composition of inputs in response to exchange rate movements. Gros (1987) and De Grauwe (1988) show that allowing firms to adjust their factor inputs in response to exchange rate movements creates additional profit opportunities, as firms maximise the advantage of high prices when the exchange rate is low and minimise the negative impact of low prices when the exchange rate appreciates. In this environment, greater exchange rate volatility could increase firms' profitability and incentives to export, as long as firms' behaviour is not dominated by risk aversion as profits become more variable.

The second key assumption underlying the negative relationship between exchange rate volatility and trade is that firms cannot hedge the exchange rate risk with financial instruments. In principle, firms should be able to hedge their exposure to exchange rate volatility if they have access to well-developed financial markets. However, the theoretical literature on optimal hedging strategy in response to exchange rate risk provides mixed results. According to the Miller-Modigliani theorem, under certain assumptions, a firm's choice of financing policy should not affect its value.[22] If the Miller-Modigliani theorem held, one of the consequences would be that decisions to hedge exchange rate risk should not impact on a firm's value. Fabling and Grimes (2008a) discuss possible rationales for why firms would choose to hedge. Possible reasons include avoiding costs associated with bankruptcy or breaching debt covenants, avoiding the risk of underinvestment by making the supply of internal funding more reliable, and managerial risk aversion.

3.5.3 Exchange rate volatility and welfare

In addition to the literature on the impact of exchange rate volatility on trade, there is also a large theoretical literature on the impact of exchange rate volatility on economic welfare and the extent to which it is optimal for monetary policy to stabilise the exchange rate to maximise welfare. Much of this literature follows the framework developed by Obstfeld and Rogoff (1996), based on a New Keynesian general equilibrium structure with nominal price rigidities. The modelling framework has been used in both a two-country setting and for single small open economies. As the literature has developed, the range of sectors and shocks incorporated into the models has expanded.[23]

Early theoretical work assumed that maximising trade flows was equivalent to maximising economic welfare. If the trade flows between two countries are determined by comparative advantage, then expanding opportunities for trade should also increase

[22] The Miller-Modigliani Theorem assumes there are no taxes, no costs of financial distress, on information asymmetries, no transaction costs and investors can perform the same transactions as the firm.

[23] For example, Dib (2008) assesses the impact of exchange rate variability on the Canadian economy with a three production sectors (commodities, manufacturing and non-tradables) and nine different types of structural shocks.

the welfare of both countries. However, these early models did not incorporate exchange rate uncertainty and its associated risks.[24] Bacchetta and Van Wincoop (2000)[25] show that trade is determined by firms' revenue and costs in the home market relative to the foreign market, whereas welfare is determined by the volatility of consumption and leisure. Welfare depends only indirectly on the variance of the exchange rate, through its impact on consumption and leisure. They note exchange rate stability is not necessarily associated with increased trade, and there is no simple relationship between the level of trade and welfare.

Exchange rate flexibility was found to be desirable in many of the early models in the literature, as it allows relative prices to adjust in response to country-specific shocks even if nominal prices are sticky.[26] Many of these models are based on a two-country structure, although Gali and Monacelli (2005) apply the framework to a small open economy. Gali and Monacelli show that in an environment of full exchange rate passthrough, welfare is maximised by a monetary policy rule which targets domestic price stability and allows full exchange rate flexibility.

In these circumstances, exchange rate movements driven by fundamental shocks can increase welfare by adjusting relative prices and switching consumer expenditure between local and foreign goods to restore external balance. The 'expenditure-switching' argument in favour of exchange rate flexibility dominates if exchange rates movements are driven primarily by *actual* fundamental shocks. However, if exchange rates behave as asset prices and fluctuations are driven by *expectations* of future changes in fundamentals, rather than current changes in fundamentals, then this can cause exchange rate misalignment and cause international relative prices to deviate from efficient levels that reflect underlying costs.[27]

The expenditure-switching argument for allowing exchange rate volatility also assumes that firms price goods in their own currency (i.e. Producer Currency Pricing). However, international empirical evidence has generally found firms set prices in the currency of their customers (Local Currency Pricing, LCP), and there is often low exchange rate passthrough.

Devereux and Engel (2003) show that if producers set prices in their customers' currency then there is no benefit to exchange rate flexibility, and it is optimal (i.e. welfare enhancing) for monetary policy to reduce exchange rate variability, as this increases consumption risk sharing. The relationship between the degree of exchange rate pass-through into prices, optimal exchange rate volatility and welfare has been widely debated following Devereux and Engel's result. Sutherland (2005) finds the optimal degree of exchange rate volatility depends on the degree of pass-through, the size and openness of the economy, the elasticity of labour supply and the volatility of foreign producer prices. Welfare can be either an increasing or decreasing function of exchange rate volatility. Senay and Sutherland (2010) find the optimal degree of exchange rate stabilisation also depends on the degree of local currency pricing by foreign producers.

[24] See Kumar and Whitt (1992) for further discussion.
[25] The uncertainty in Bacchetta and Van Wincoop's model arises only from domestic and foreign monetary shocks.
[26] The argument in favour of exchange rate flexibility to allow relative price adjustment when nominal prices are sticky was originally put forward by Milton Friedman in the 1950s.
[27] See Engel (2010) for further discussion.

Bergin et al (2006) extend the literature by examining the impact on optimal exchange rate stabilisation policy of habits in consumption and 'original sin' in asset markets.[28] Introducing habits in consumption is found to have little impact on the welfare-maximising degree of exchange rate stabilisation. However, because original sin increases a country's need for precautionary saving, reducing exchange rate volatility is found to significantly increase welfare.

So, in summary, the theoretical literature has considered extensively the potential effects of exchange rate volatility on trade and welfare. The impact of exchange rate variability on trade depends on several key factors, including firms' degree of risk aversion, the costs of adjusting production and inputs and the ability to hedge against exchange rate risk. However, the optimal hedging strategy can be complicated and depends on a firm's planning horizon and its financial structure. The main role for policy actions is like to be ensuring that exporting firms have access to financial instruments to hedge exchange rate risk. As a result, developing the scale and scope of capital markets may help broaden the range of instruments and lower the cost of hedging instruments.

Similarly, the economic welfare effects of exchange rate movements are extremely complicated and depend on a range of factors and parameters, particularly the degree of exchange rate pass-through and the extent to which exchange rates are driven by actual fundamental shocks versus expected fundamentals. In principle, having a role for monetary policy in stabilising the exchange rate may lift economic welfare, it is not clear how quantitatively significant the improvement in welfare would be. In addition, most of the models are based on a representative agent structure, so it is not clear what the distributional impact of the monetary policy changes would be.

[28] Original sin refers to countries being unable to issue debt in international markets in their own currency, because investors perceive there is a high risk that the country will inflate away the real value of its obligations.

Summary of the Impact of Exchange Rate Movements on the Real Economy across Theoretical Model Frameworks

	Static Models		Dynamic Models	
	Salter-Swan / Dependent Economy Model	**Corden-Neary Model**	**Neoclassical growth models**	**Endogenous growth models**
Key Features	• Two sectors – Non-tradables, tradables • Sector-specific capital, flexible labour inputs • Fully flexible prices (so factors fully employed) • Terms of trade fixed	• Three sectors – Non-tradables, booming tradables, lagging tradables • Sector-specific capital, flexible labour inputs • Fully flexible prices (so factors fully employed)	• Growth determined by exogenous technological progress in the long run • Physical capital only, no human capital • Physical capital subject to diminishing marginal returns	• Allow for both human and physical capital • Long-run growth determined by human capital accumulation, not just technological progress • Human capital not subject to diminishing marginal returns
Strengths	• Models impact of fundamental shocks on tradable / non-tradable sectors	• Models impact of fundamental shocks on tradeable / non-tradable sectors • Splits tradable sector into 'booming' and 'lagging' industries • Can model terms of trade shocks	• Dynamic structure	• Dynamic structure • Endogenous drivers of growth other than technological progress • Can incorporate exchange rate effects on growth through impact on 'Learning by Doing' productivity growth and knowledge spillovers in the tradable sector.
Weakenesses	• Cannot model terms of trade shocks • No growth dynamics. Only comparative statics • No nominal side • No spillovers / externalities in production	• No growth dynamics. Only comparative statics • No nominal side • No spillovers / externalities in production	• Long-run growth driven by exogenous technological progress • No explicit role for exchange rate on growth	• Externalities and spillovers are difficult to measure

4. REAL ECONOMY IMPACT OF EXCHANGE RATE VARIATION - EMPIRICAL EVIDENCE

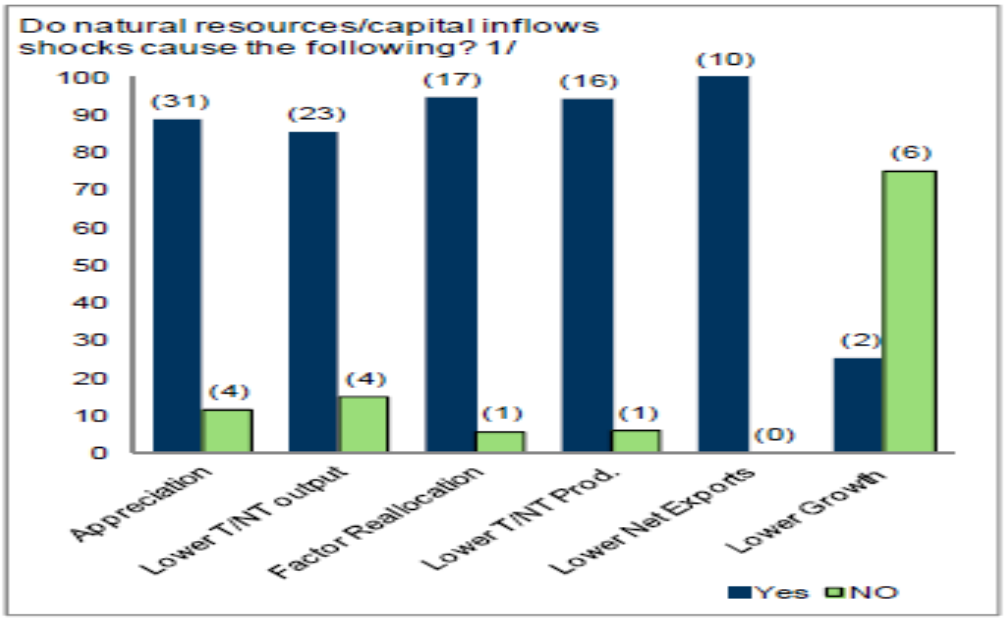
4.1 Fundamental shocks and the exchange rate

There is a large empirical literature considering the real impact of fundamental shocks which affect the real exchange rate, especially as result of Dutch Disease. This literature is surveyed by Magud and Sosa (2010). Overall, Magud and Sosa find widespread evidence of the impact of Dutch Disease, as a result of shocks resulting in significant foreign capital inflows (for example, natural resource booms, export price booms, foreign aid and remittances). Overall, the literature finds that these shocks lead to:

- Real exchange rate appreciation
- Factor reallocation away from tradables and towards non-tradables
- A reduction in manufacturing output and net exports.

However, there is relatively limited evidence of Dutch Disease impacting on growth (Figure 11), with most of the empirical studies focussing on the reallocation of resources between sectors. In addition, there is relatively little focus in the empirical literature on whether the adverse effects of the shock, such as the possible loss of externalities in the tradable sector, are larger or smaller than the beneficial effects. Overall, Magud and Sosa argue that if the change in the real exchange rate is driven by a permanent shock which alters the equilibrium, then the effects of Dutch Disease should not be a concern for policymakers. However, they acknowledge that the actual exchange rate may still overshoot the new equilibrium, and lead to a misalignment, for example, if economic agents overestimate the persistence of the shock. In this situation, policymakers have a role in minimising the degree of exchange rate overshooting and overheating in the domestic economy.

Figure 11 – Summary of Empirical Findings of the Impact of Dutch Disease



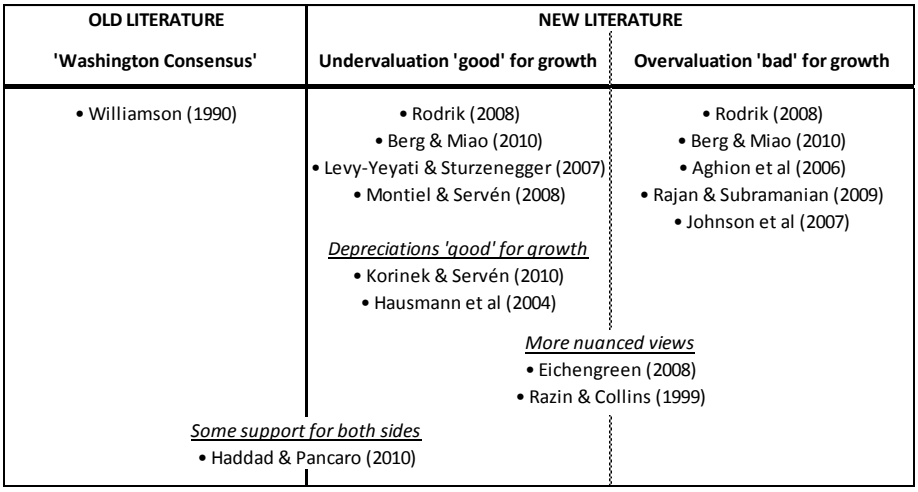
1/ In percent of total studies. Number of Observations in parentheses
Source: Magud and Sosa (2010)

4.2 Non-fundamental shocks and exchange rate misalignment

There is a sizeable international literature on the impact of the level of the exchange rate on the real economy. The literature is broadly split into an older literature, based on the 'Washington Consensus', whereby any deviation from the 'equilibrium' exchange rate is viewed as bad for the real economy, and the 'new' more asymmetric literature that sees an undervalued exchange rate as positive, and an overvalued one negative.

Not all of this literature is directly relevant for New Zealand. Many of the studies focus on developing economies and their experiences of undervalued exchange rates. (See the Appendix for a more detailed summary of the individual studies.) There is also substantial disagreement *within* the new branch on the channels through which the exchange rate impacts on growth too. Papers such as Eichengreen (2008) suggest that the exchange rate is just one highly endogenous factor affecting developments in the economy.

But beyond the question of symmetric or asymmetric effects, there is a broader question of what metric should be used to assess the impact of the exchange rate on the real economy. Several approaches are followed in the literature. The first approach considers the impact of the exchange rate (in terms of its level and volatility) on growth. The second strand examines the impact of exchange rate volatility on economic welfare, based on the utility from the optimal choice of consumption and leisure. At a more micro level, some of the literature also considers optimal hedging behaviour in response to exchange rate volatility and possible hysteresis effects.



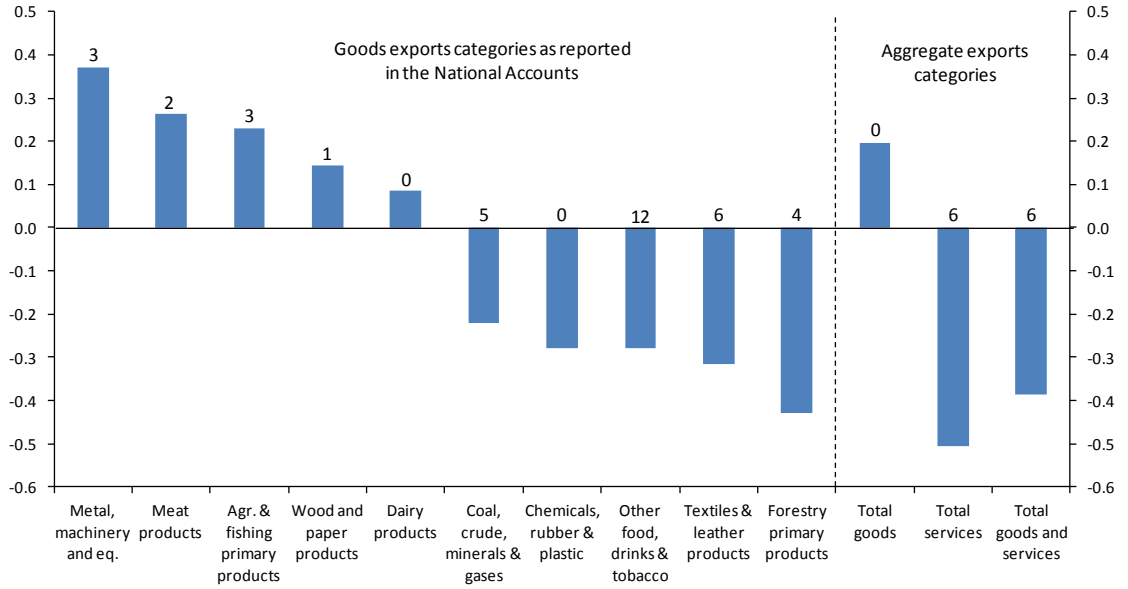
Magud and Sosa (2010) provide an overview of the international literature's findings. Some features stand out:

- There is strong evidence that real exchange rate *over*valuation lowers growth, but the evidence is much more inconclusive for an undervalued currency. As the paper mentions, if anything, an undervalued exchange rate is seen as lowering growth – potentially supporting the 'Washington Consensus' view mentioned above.

- There have been relatively few studies looking at the impact of changes in the real exchange rate level on growth. Those that do broadly support the view that an overvaluation (undervaluation) lowers (increases) growth.

For New Zealand, Smith (2004) examines the impact of the level of the real exchange rate and the gap between the actual exchange rate and its trend on the deviation of export volumes from trend. Smith calculates the trends for the exchange rate and export volumes using a standard Hodrick-Prescott filter. The gap can be interpreted as an indicator of exchange rate misalignment as a result of non-fundamental shocks. He finds the size of the real exchange rate gap has a statistically significant, but economically small impact on export volumes. Overall, a 10 percent increase in the real TWI relative to its equilibrium reduces export volumes by around 1.4 percent after 18 months. In addition, exchange rate misalignment accounts for less than 20 percent of the total cyclical variation in aggregate exports over the sample period. Other variables, such as US and Australian GDP, also play an important role in explaining movements in export volumes. Smith also finds evidence of uneven impacts across sectors, with non-primary export volumes more sensitive to the exchange rate misalignment than primary export volumes. This is probably due to manufactured exports and service exports such as tourism being more sensitive to the exchange rate. An update of his analysis confirms his sectoral results (Figure 12), with services exports having the most negative correlation with real exchange rate misalignments. He concludes that exchange rate misalignments feed more into domestic export prices and exporters' incomes rather than volumes. This is probably due to short-run supply constraints and non-recoverable set-up costs of entering export markets.

Figure 12 – Correlation between the Real TWI and Export Volumes (1990-2012Q1)*
(Numbers indicate the quarter lag with the highest correlation, up to 12 quarters)



*Real TWI and Export Volumes are deviations from trend estimated with a Hodrick-Prescott filter
Sources: Statistics New Zealand, authors' calculations

OECD (2011) looks at the impact of the exchange rate level and volatility on the trade balances in Chile and New Zealand, and finds a depreciation would not lead to a large change in the New Zealand trade balance. The paper finds exports respond less to exchange rate *volatility* than imports, possibly because commodity export volumes are

largely determined by world commodity prices. Non-agricultural exports are also more sensitive than agricultural exports to the *level* of the exchange rate. Disaggregating across New Zealand's trading partners, exports to the euro area are found to be more exchange rate-sensitive than exports to China and the US.

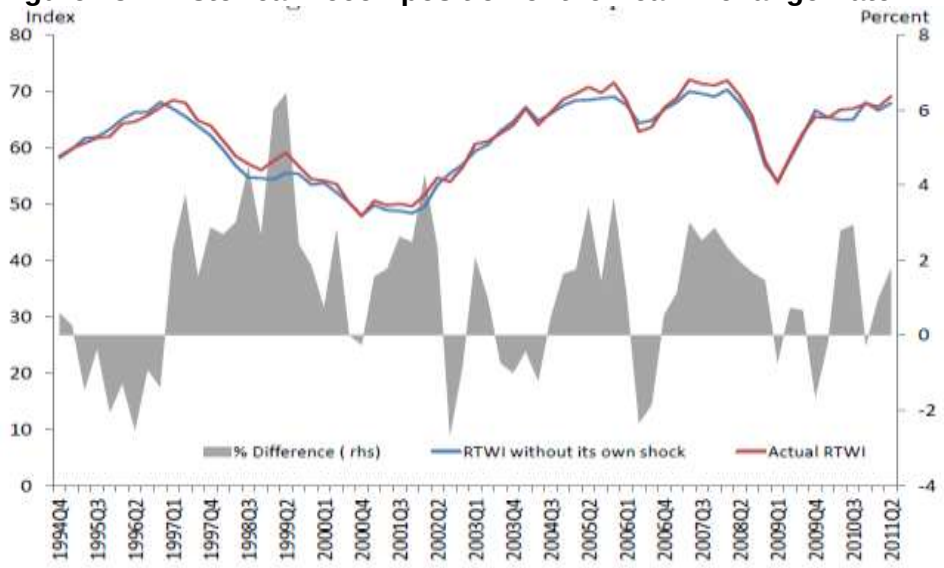
Karagedikli et al (2012) use a factor-augmented vector autoregression (FAVAR) model to identify underlying exchange rate shocks and examine the impact on output in different industries in New Zealand. The FAVAR framework allows them to examine the relationship between the exchange rate and more than three hundred New Zealand and international macroeconomic variables by reducing this large set down to a much smaller number of underlying common factors.[29]

The study confirms that the tradable / non-tradable disaggregation of economic activity is too aggregated to understand the relationship of the real economy with the exchange rate, with a wide range of exchange rate sensitivities across tradable and non-tradable industries. The largest negative impact from an exchange rate shock is found to be on construction output, which is a non-tradable industry. The second largest effect of an exchange rate shock is on the (tradable) manufacturing sector. The impact on agricultural output is fairly limited. Karagedikli et al argue the large impact of exchange rate shocks on the construction sector arises from the interaction of the exchange rate, New Zealand's business cycle relative to other countries (especially Australia), migration and housing. When the exchange rate unexpectedly appreciates, New Zealand economic activity weakens, reducing employment prospects and triggering larger net migration outflows. Larger outflows of migrants reduce demand for housing and depress activity in the construction industry.

Overall, however, most of the variation in the trade-weighted index since the mid 1990s is found to be accounted for by shocks to cyclical economic drivers. Shocks originating from the exchange rate itself (such as portfolio shifts) typically account for only around 2-3% of the level of the exchange rate (Figure 13). Even during the mid-late 2000s, when the New Zealand nominal exchange rate was affected by a high degree of carry trade activity, pure exchange rate shocks explained only around 3 percent of the level of the nominal Trade-Weighted Index.

[29] The first five factors, which explain nearly half of the total variation in the data, reflect New Zealand domestic economic activity, domestic inflation expectations, international financial and monetary conditions, domestic labour market conditions and various countries' effective exchange rates.

Figure 13 – Historical Decomposition of the Real Exchange Rate



Source: Karagedikli et al (2012)

4.3 Learning by Doing and Knowledge Spillovers

Despite the common assumption in theoretical models of Learning-by-Doing productivity gains and knowledge spillovers in the tradables sector, empirical evidence for the existence of positive externalities is, at best, mixed. A wide range of spillovers are tested in the literature, including productivity gains from Learning by Doing, increased productivity from proximity to exporting firms and increased export propensity from being close to exporters. Eichengreen (2008) surveys the empirical literature and finds that while some studies find evidence that the proximity of a firm to exporting firms increases the likelihood that the firm itself will also export and benefit from the associated profit and productivity gains, other studies find no evidence of such spillovers. Syverson (2010) surveys the recent firm-level evidence on productivity and argues that while spillovers are likely to exist, the large and persistent differences in productivity between firms within the same industry suggest that any spillovers or emulation effects are far from perfect. However, cross-country analysis by Rodrik (2012) finds evidence of unconditional convergence in manufacturing sector labour productivity over recent decades. Given this uncertainty, Lederman and Maloney (2012) argue that while positive externalities in the export sector probably exist, there are no clear-cut and empirically robust results in the literature about which goods have the largest spillovers and growth-enhancing effects. As a result of this uncertainty about specific products, Lederman and Maloney argue governments should focus on addressing other externalities and market failures, such as the provision of infrastructure, accumulation of human capital and the establishment of trade networks.

In terms of New Zealand evidence, Buckle, Hyslop and Law (2007) test for exchange rate effects on labour productivity using firm unit record data from Statistics New Zealand's Business Activity Indicator (BAI) and Business Demography Statistics (BDS). Exchange rate level and volatility are both found to have little impact on labour productivity of firms in general, although there is some weak evidence of an impact on the productivity of exporting firms. Fabling and Sanderson (2012) use Statistics New Zealand's Longitudinal Business Database (LBD) to examine the difference in

productivity between exporting and non-exporting firms.[30] They find New Zealand firms carry out significant capital deepening in the first year after entering export markets, which raises their productivity. Despite this, there is little evidence of gains in multi-factor productivity from 'learning by exporting', which would be expected to be stronger after entry into high-income country export markets, where firms would theoretically have greater opportunities to learn. However, Fabling, Grimes and Sanderson (2011) find evidence that proximity to exporting firms increases the probability that a firm producing similar products will also enter export markets as a result of demonstration effects.

The reasons for such limited evidence for spillovers are still unclear. It is possible that they are partly due to measurement errors, as capturing externalities is often difficult. Eichengreen offers two other possible explanations for the inconclusive results. One possibility is that spillovers depend on some facilitating conditions. For example, firms would need to have organisational flexibility to take advantage of new innovations in order to lift productivity. The other possible explanation for the lack of spillovers is that the empirical results are distorted by omitted variable bias. Firms located in a particular area may all have a greater tendency to export due to some unobserved factor, such as links to the same overseas immigrant network. Clearly, more work needs to be carried out to understand the nature of these spillovers and their relationship to exchange rate movements.

4.4 Exchange Rate Volatility and Trade

Overall, the empirical literature finds little evidence of a significant impact from short-term exchange rate volatility on trade flows. In review prepared for the assessment of whether the United Kingdom should join the euro area, HM Treasury (2003)[31] finds the empirical relationship between exchange rate volatility and trade is very mixed. Many studies fail to find a statistically significant relationship, and the studies that do find a link suggest that the impact of exchange rate volatility on trade is fairly small, and long-term misalignment has a greater impact on trade than short-run volatility. Across all the empirical studies reviewed by the UK Treasury, the consensus estimate is that the total elimination of exchange rate volatility would increase trade volumes by less than 10 percent. Taylor (2002) notes that studies focussing on longer-term misalignment are more successful at finding an empirical link between the exchange rate and trade than studies which concentrate on short-term volatility.

More recent empirical work has provided additional insights. Grier and Smallwood (2007) find stronger evidence of a negative impact of exchange rate volatility for emerging market economies than for developed economies. Firms in developed economies are likely to have better access to financial instruments to hedge exchange rate risk than exporters in developing economies. Similarly, Hericourt and Poncet (2013) analyse the exporting behaviour of a panel of Chinese firms and find that the magnitude of the negative impact of exchange rate volatility on trade depends mainly on the extent of financial constraints and the level of financial development. In addition, Broda and Romalis (2010) argue that causality runs in both directions between trade flows and exchange rate volatility. Using disaggregated trade data for a large number of countries, they find that increased trade flows and deeper integration between countries tends to dampen exchange rate volatility.

[30] The paper focuses primarily on exports of goods as the Longitudinal Business Database has only limited information on exports of services.
[31] See also Clark et al (2004) and Mabin (2011).

Although short-run volatility does not appear to have a strong effect on trade for developed economies, there is some evidence that large sunk costs to enter export markets do play some role. Berthou (2008) estimates gravity equations to model the bilateral trade flows among twenty OECD and fifty-two emerging market economies. He finds that larger sunk entry costs tend to reduce the sensitivity of exports to real exchange rate movements, a result consistent with Baldwin and Krugman's hysteresis effect.

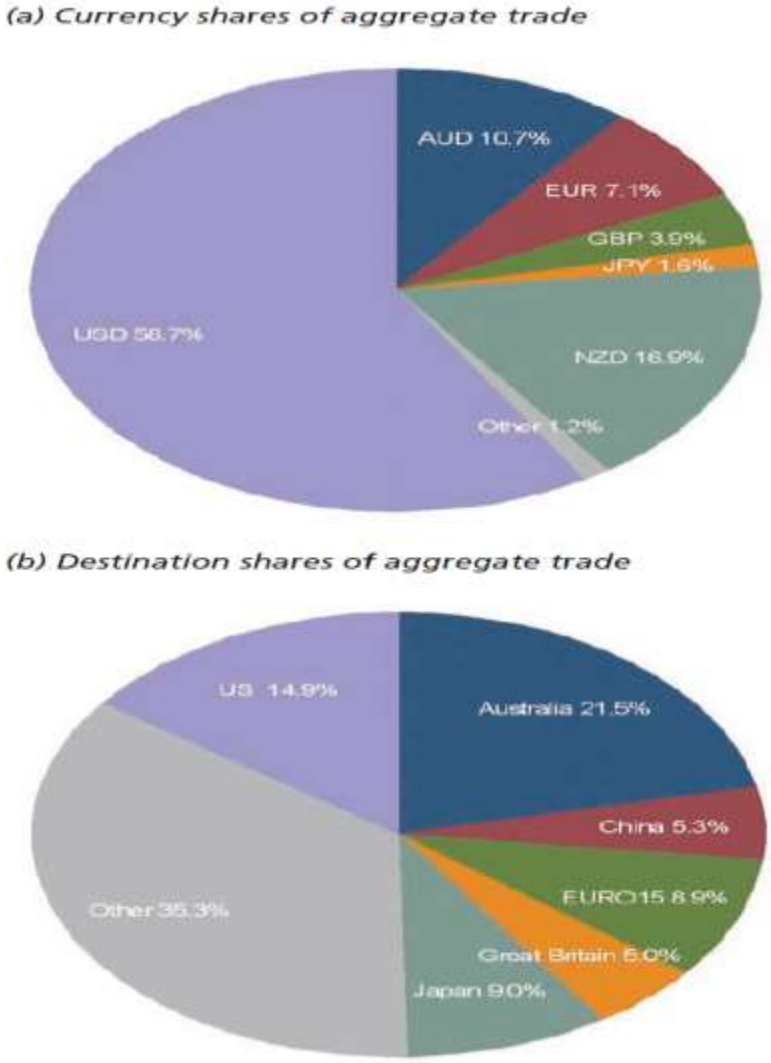
In a reflection of New Zealand's relative geographic isolation, and the fact that we export to countries with on average lower quality institutions than the trading partners of many other OECD members (and thus incur higher fixed costs to trade), the study finds that New Zealand's elasticity of exports to the exchange rate is comparatively low (compared to the rest of the OECD). All else equal, the reaction of New Zealand's exports to real exchange rate movements is 40% smaller than the reaction of Belgian exports (the country with the highest export elasticity), reflecting differences in the geographical structure of their exports, and therefore in their exposure to trade costs.

Recent work carried out at the Reserve Bank of New Zealand has also used disaggregated firm-level data from Statistics New Zealand's Longitudinal Business Database (LBD) to analyse the export behaviour of New Zealand firms. Much of this work is summarised by Sanderson (2009). In contrast to some overseas results, the New Zealand work finds short-run exchange rate volatility has an adverse effect on both the number of exporting firms per market and the value of exports per exporting firm, but there is no evidence of a significant effect at the aggregate level. This is likely to be because small firms self-select out of more volatile markets, leaving only the larger firms.

Exchange rate hedging behaviour by New Zealand firms is examined by Fabling and Grimes (2008b) and Sanderson (2009). Among the key stylised facts, they find:

- Less than 20% of the value of New Zealand export transactions are denominated in New Zealand dollars (and therefore not exposed to exchange rate risk) (Figure 14).
- Among export transactions priced in other currencies, the proportion that is hedged varies considerably over time.
- Hedging is generally carried out for short periods.
- Firms tend to be selective in their hedging, which appears to be inversely related to the exchange rate. Firms appear to increase hedging when the exchange rate falls to lock in a lower rate.

Figure 14 – New Zealand aggregate 2007 trade shares by destination and currency of trade



Source: Sanderson (2009)

The financial instruments most commonly used by New Zealand exporters to hedge exchange rate risk are forward currency contracts, and to a lesser extent, foreign currency options. In a forward contract, exporters agree an exchange rate at which they will do a foreign currency transaction with a counterparty (usually a bank) ahead of the transaction occurring. Under a foreign currency option, exporters have the right, but not the obligation to buy or sell foreign currency at a set price (the strike price).

Brooks et al (2000) consider different hedging strategies used by New Zealand firms. Forward contracts are used mainly for hedging short-term foreign exchange flows. There are several reasons why forward contracts are not used for longer-term exchange rate risk. First, over long horizons, the level of the spot exchange rate is highly uncertain. By locking in an agreed exchange rate through a forward contract, an exporter looses the possibility to take advantage of a more profitable rate if the spot exchange rate has fallen. Furthermore, if the shocks that pushed the exchange rate lower also reduced demand for New Zealand exports and lowered exporters' revenue flows, the firms may find they had excess forward cover, which would be costly. So at long horizons, a forward contract would act as an exposure rather than a hedge.

Second, if domestic inflation rises unexpectedly, hedged export revenue flows may be insufficient to cover a firm's costs. In this case, firms using forward contracts would be swapping exchange rate risk for inflation risk. Finally, using forward contracts generally use up part of firms' credit lines with their banks. The longer the forward contract period, the larger is the credit line allocation made the bank.

Greater use of options at long horizons would address many of the problems of using forward contracts. Brooks *et al* note that many New Zealand firms are unwilling to use options for hedging due to the cost (the premium) involved. However, the option premium overstates the total cost of hedging, as it ignores the positive return firms will earn if they exercise the options. An alternative strategy for long-horizon exchange rate hedging is for exporters to construct 'natural hedges' on their balance sheet. So, for example, New Zealand firms exporting to Australia could source their inputs from Australia or locate their production facilities in Australia, offsetting the exposure of their revenue flows to exchange rate volatility.

5. CONCLUSION

In conclusion, there is no simple answer to how exchange rate movements affect the real economy. Exchange rates respond to many different types of shocks. These shocks may be fundamental shocks which have a persistent effect on the equilibrium exchange rate or non-fundamental disturbances which push the exchange rate away from its equilibrium level. Misalignments may be persistent or extremely transitory. In order to understand the relationship between the exchange rate and the real economy it is necessary to understand what types of shocks are affecting the exchange rate. There is a large theoretical literature covering the effects of shocks on the real economy through their impact on the exchange rate. Static models demonstrate the impact of fundamental shocks, such as increases in world export prices, on the balance of output between tradable and non-tradable sectors, with real exchange rate adjusting to transfer resources between sectors. The dynamic effects of shocks can be captured in endogenous growth models, which incorporate learning-by-doing productivity growth and knowledge spillovers in the tradables sector. The impact of short-term exchange rate volatility on trade flows and economic welfare has also been studied extensively.

However, despite this detailed theoretical literature and extensive empirical testing, there are few definitive conclusions or clear guidance for policymakers. This is particularly true for advanced economies such as New Zealand, as most empirical work has focussed on emerging market economies. Most other advanced economies are relatively closed or have large domestic markets, so the impact of shocks on the real economy through the exchange rate is not a significant focus. So conclusions that can be drawn from the literature are:

- While the New Zealand dollar exchange rate may be above its equilibrium value, fundamental shocks may also have played a significant role in its recent appreciation. This suggests the equilibrium value of the exchange rate may also have risen.
- Tradable sector output has declined since the mid 2000s, but within the tradable sector, activity in resource-based industries has risen strongly, while manufacturing output and exports of services has declined.
- Sensitivity to exchange rate movements varies across New Zealand economic sectors and industries. The agricultural sector is relatively insensitive to exchange rate movements, while the manufacturing and service sectors are more vulnerable.

Putting this evidence together, it is difficult to answer conclusively what the causes of the divergence between tradables and non-tradables output in New Zealand have been since the mid 2000s. The decline in manufacturing activity and service exports, combined with strong growth in resource-based industries is consistent with fundamental shocks, possibly driven by higher export commodity prices. Empirical analysis also suggests much of the rise in the exchange rate has been driven by fundamental shocks. However, the contraction in the lagging tradable industries may also reflect their greater sensitivity to an overvalued exchange rate, as suggested by the estimates of misalignment. Short-run exchange rate volatility, which appears to have a negative impact on exporting by New Zealand firms, may have also played some role.

As a result of this uncertainty, we can identify several areas for further analysis:

- Additional empirical work needs to be carried out to better understand the shocks which have led to growth in non-tradables output and the resource-based industries. To what extent has this been caused by 'Dutch Disease' effects from the rising prices for New Zealand export commodities such as dairy products, and to what extent has it been caused by exchange rate misalignment? If fundamental shocks have made a significant contribution, does that reduce the likelihood of rebalancing occurring in the New Zealand economy?
- There is little conclusive overseas evidence on the long-run effects on growth of rising commodity export prices. If the change in the distribution of resources across sectors is partly due to the impact of rising commodity prices, how will this affect New Zealand's potential growth rate?
- Productivity growth generated by learning by doing and knowledge spillovers across firms are often assumed to be strongest in the manufacturing sector, but are often difficult to detect empirically. Should there be more focus on trying to identify New Zealand industries and products where these externalities are strongest, or should policymakers try to address other market failures such as developing infrastructure, improving human capital and improving knowledge of export markets?
- Short-run exchange rate volatility is usually found to have little impact on export flows for developed countries. However, some firm-level empirical evidence for New Zealand suggests some adverse effects on the number of exporting firms and the value of their exports. Do New Zealand firms have sufficient access to financial instruments to hedge exchange rate risk?

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APPENDIX – Summary of international literature on the impact of exchange rate misalignment on the real economy

Paper	Methodology	Countries covered	Real or nominal?	Focuses on...	Relevance for NZ
Rodrik (2008)	Panel regression	184 over 11 five-year periods	PPP-based real (adjusted for BS effect)	Undervaluations, developing countries	*
Berg & Miao (2010)	Panel regression	As Rodrik (2008)	As Rodrik (2008)	Comparison of Rodrik (2008) and Williamson (1990)	*
Levy-Yeyati & Sturzenegger (2007)	Various panel regressions	179 over 1974-2004	As Rodrik (2008)	Developing countries, 'fear of appreciations'	**
Montiel & Servén (2008)	Some empirical, otherwise model-based approach	94 over 1975-2005	PPP-based real (similar to Rodrik (2008))	Disproving Levy-Yeyati & Sturzenegger (2007)	**
Aghion et al (2006)	Panel regression	83 over 1960-2000	Real	Developing countries, level of financial development	**
Johnson et al (2007)	Benchmarking exercise	Various sub-Saharan African	Similar to Rodrik (2008)	Sub-Saharan African countries	**
Rajan & Subramanian (2009)	Panel regression	Various developing countries	Similar to Rodrik (2008)	Developing countries, the impact of aid on the exchange rate	**
Razin & Collins (1999)	Panel regression	93 over 1975-1992	PPP-based real (similar to Rodrik (2008))	Excahnge rate misvaluations on growth	*
Eichengreen (2008)	Wide review of literature	Wide range of countries	Real	The link between exchange rates and growth, and the channels through which they impact	*
Korinek & Servén (2010)	Model-based approach - not empirical	n/a	Real	Channels through which under/devaluation affect growth	**
Hausmann et al (2004)	Correlations and panel regressions	110 countries, with periods of 'growth	Real	The role of under/devaluations in international 'growth spurts'	**
Haddad & Pancaro (2010)	Panel regression	Similar to Rodrik (2008)	PPP-based real (similar to Rodrik (2008))	Developing countries, the impact of the exchange rate on growth and exports	**

* Most direct (covers developed countries)
** Less direct (focuses on developing countries)