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A model of Equilibrium Exchange Rates for the New Zealand and Australian dollars

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Abstract[1]

This paper extends the 'Five Area Bilateral Equilibrium Exchange Rate' (FABEER) model used in Wren-Lewis (2003) to include New Zealand and Australia. This model calculates medium term exchange rates conditional on assumptions for 'sustainable' current accounts. The model suggests that the equilibrium value of both currencies has been declining over the last ten years and that both currencies were near fair value (on average) during 2002. Equilibrium values against the US dollar are estimated to be around 0.50 (New Zealand) and 0.59 (Australia), although these estimates are sensitive to the assumed equilibrium values for variables like commodity prices and the current account.

[1] This paper was written while the author was visiting the Reserve Bank of New Zealand. I am grateful to the staff there for many helpful comments, but the views expressed here are entirely my own. I also benefited from useful discussions at the Reserve Bank of Australia. Simon Wren-Lewis is based at the University of Exeter, United Kingdom.

1 Introduction

In Wren-Lewis (2003) I outlined four major methods of calculating an equilibrium exchange rate (EER): direct PPP calculations, regression based methods, partial equilibrium analysis and full model calculations. The analysis presented here falls into the third category. In a nutshell, we assume some value for the medium term equilibrium (or 'sustainable') current account,[2] and use a trade model to back out the real exchange rate that will deliver this current account. Medium term here means abstracting from business cycle and other short term effects.[3]

No attempt is made to model the sustainable current account, which will depend on medium term trends in private sector net saving and fiscal policy. Instead, the model is designed to examine the consequences for the exchange rate of different medium term current account positions, given that the overall balance of payments must be zero.

The equations for New Zealand and Australian trade are added on to a model used in Wren-Lewis (2003) to estimate the equilibrium value of the Sterling/Euro exchange rate. The 'Five Area Bilateral Equilibrium Exchange Rate' (FABEER) model has five country/currency area blocks: the Euro area, USA, Japan, UK and the Rest of the World, and the model determines bilateral exchange rates for the Euro, dollar, yen and sterling. The blocks of the original FABEER model are solved simultaneously. In adding trade models for New Zealand and Australia, I have made the useful and realistic assumption that these economies and currencies are small, so they are solved recursively, with no feedback to the major blocks.

The model will solve for bilateral medium term equilibrium values for the New Zealand and Australian dollar against the major four

[2] The term 'medium term current account' is clumsy and as a result different authors use other terms, like current account target, structural capital flows, or sustainable current account. Following Wren-Lewis (2003) I use 'sustainable' here, but unfortunately all these terms are open to misinterpretation.

[3] In particular, we also abstract from lags in the adjustment of trade flows to relative price movements.

currencies. In addition, it can help analyse how sensitive these two currencies are to medium term shifts in commodity prices.

Section 2 re-examines the theoretical basis for the approach, focusing in particular on the case of economies where a large proportion of exports are primary commodities. Section 3 discusses in detail some the key equations of the New Zealand and Australian blocs. Section 4 estimates equilibrium exchange rates from 1991 to 2002. Section 5 presents simulations of the model.

2 Adapting the theoretical approach to a commodity producer

The partial equilibrium approach to calculating equilibrium exchange rates has been used by a number of authors and institutions (most notably John Williamson and the IMF).[4] The underlying idea behind the approach is straightforward. Medium term trends in private net saving and fiscal policy, along with exogenous world conditions, will imply some medium term level of demand for domestic production. In a small open economy (where real interest rates are largely determined by overseas real rates), how is this demand made compatible with the supply of domestic production? The answer is through changes in the real exchange rate, which by changing the competitiveness of domestic production, moves demand to equal supply. Simple manipulation of identities shows that this statement is equivalent to saying that the real exchange rate moves the current account so that it is consistent with medium term capital flows (i.e. national net saving), which I term the sustainable current account.

These broad statements reveal two key underlying assumptions behind the analysis:

1. It applies to a 'medium term' time frame, where Keynesian business cycle effects have washed out, so supply must equal demand. Given conventional assumptions, this also means that the equilibrium exchange rate is independent of monetary policy.

2. There is a demand curve for domestic output. This is most easily rationalised by assuming that international trade consists of buying and selling differentiated goods in imperfectly competitive markets. In particular, different countries produce different goods (or varieties of goods), and downward sloping demand curves for these goods translate into a downward sloping demand curve for domestic output as a whole.

[4] For references see Wren-Lewis (2003), Driver and Wren-Lewis (1998) and Driver and Westaway (2003).

Analysis of equilibrium exchange rates using the macroeconomic balance approach predates the 'new international macroeconomics' (see Lane (2001) for a survey). Indeed, the aggregate trade relationships at the heart of this approach have a long history: an early example is Houttaker and Magee (1969). However it would be a mistake to condemn this approach as 'old fashioned'. In fact, it fits in with one of the central characteristics of the new international macroeconomics, which stresses the importance of imperfect competition in the market for traded goods.[5]

A base line model

Consider the following, deliberately simple, small open economy. There are two goods, one produced overseas (subscript w) and one produced domestically (subscript z). Assume that all domestically produced goods are exported, so that only overseas goods are consumed. Production only requires labour, and the production function is simply

$$Y_Z = a_Z L_Z = a_Z L \qquad (1)$$

where Y is output and L total labour supply. For simplicity, assume that labour supply is fixed. Producers face a demand curve for their product, given by

[5] A macroeconomic balance approach can be rationalised using more traditional microfoundations using perfect competition, as in Dvornik et al (2003) for example.

$$Y_Z = A(\frac{p_Z}{p_W})^{-\theta} \qquad (2)$$

where θ>1, and p_Z/p_W are the terms of trade, both measured in a common currency.

If we assume a time period in which prices are fully flexible, such that demand and supply are equal ('internal balance'), then we have

$$a_Z L = A(\frac{p_Z}{p_W})^{-\theta} \qquad (3)$$

This equation determines the terms of trade. A country specific increase in labour productivity (a) will require a depreciation (a fall in p_Z) to sell the additional goods, while an increase in world demand (A) will generate an appreciation. Viewing the real exchange rate as a relative price equating domestic aggregate supply and demand is a key characteristic of the macroeconomic balance approach.

We can define three measures of the real exchange rate in this economy:

- The terms of trade
- The price of output at home relative to overseas
- The price of consumption at home relative to overseas

In this very simple model the first two definitions are equal, while the third is always unity, if we assume the economy is small so that overseas consumers mainly consume good w.

The consumption real exchange rate becomes endogenous if we add non-traded goods. Denote these by subscript n. Consumer preferences across the two goods are given by

$$U = c_N^{\varepsilon} c_W^{1-\varepsilon} \qquad (4)$$

so we get the standard result that the share of each good in total consumption is constant, i.e.

$$c_N p_N = \varepsilon(c_N p_N + c_W p_W) = \varepsilon(Y_N p_N + Y_Z p_Z) \qquad (5)$$

assuming no savings.

The mark-up in the exports producing sector from profit maximisation is given by

$$p_Z = \frac{w}{a_Z}\frac{\theta}{\theta-1} \qquad (6)$$

If wages are equal for labour in the traded and non-traded sectors, then relative prices will be given by

$$\frac{p_Z}{p_N} = \frac{a_N}{a_Z} B(..) \qquad (7)$$

where a_N represents productivity in the non-traded sector, and B(..) will be a function of variables such as demand elasticities. Given the demand function for non-traded goods (and $C_N = Y_N$), we can write

$$a_Z L = A(\frac{p_Z}{p_W})^{-\theta} B'(\varepsilon, \theta, ..) \qquad (8)$$

Once again the terms of trade move to equate domestic demand and supply. The output price real exchange rate will move with the terms of trade, but it will also depend on relative productivity movements between traded and non-traded goods.

Given preferences, the CPI will be given by

$$CPI = p_N^{\varepsilon} p_W^{1-\varepsilon} \qquad (9)$$

We can immediately see that the consumer price real exchange rate will no longer be constant, but will depend on the terms of trade (with an elasticity ε). In addition, relative productivity movements between traded and non-traded goods will influence this definition of the real exchange rate, which is the Balassa Samuelson effect.

The macroeconomic balance approach is often described as finding the real exchange rate that brings about a particular current account. In this simple economy with no financial assets, the current account is always zero. Exports are given by the demand function (2) above, while imports are given by the demand curve

$$c_W p_W = (1-\varepsilon)(Y_N p_N + Y_Z p_Z) \qquad (10)$$

Equating exports and import solves for the terms of trade in exactly the same way as (8). Export equations typically used in macroeconomic balance models are exactly of the form (2), where A is some measure of world trade or world demand. Import equations typically take the traditional form

$$c_W = M(Y, \frac{p_W}{p_D}) \qquad (11)$$

where Y is a measure of total output, and p_D is the price of that output. This formulation again follows naturally from (10).[6]

In this simple model, export prices are a simple mark-up on domestic costs, and import prices (in overseas currency terms) are exogenously determined overseas. Empirical data for the major developed economies strongly suggests a more complex picture, where export prices are influenced in part by competitors' prices, and import prices depend in part on the price of domestically produced goods. These competitor price effects are difficult to rationalise in a set-up based on monopolistic competition, and more easily modelled in a framework like Cournot. If p_{MD} and p_{XD} denote the price of actual imports and exports respectively, we can write

$$\begin{aligned} p_{MD} &= p_W^{\gamma} p_D^{1-\gamma} \\ p_{XD} &= p_W^{\delta} p_D^{1-\delta} \end{aligned} \qquad (12)$$

[6] Once we allow for saving, so that the current account may not be balanced, then whether the activity term should be total output or total domestic demand becomes an issue.

The trade balance can then be written as

$$p_{XD} A(\frac{p_{XD}}{p_W})^{-\vartheta} - p_{MD} M(Y, \frac{p_{MD}}{p_D}) \qquad (13)$$

Assuming some value for the trade balance, world demand A and total domestic output Y, we can use (13) and (12) to solve for the output price real exchange rate p_D/p_W.

Adding commodity trade

Not all trade in advanced industrial countries can be characterised as selling differentiated goods in imperfectly competitive markets. However, if we identify such trade as involving commodities (i.e. not manufactured goods or services)[7], then the proportion of such goods in imports for most industrialised countries is typically small: often around 10 per cent and rarely exceeding 25 per cent. In such cases, a very simple way to incorporate such trade into the macroeconomic balance framework is to define total import and export prices, p_M and p_X, as

$$\begin{aligned} p_M &= p_{MD}^{\kappa} p_C^{1-\kappa} \\ p_X &= p_{XD}^{\lambda} p_C^{1-\lambda} \end{aligned} \qquad (14)$$

where p_C are world commodity prices, and 1-κ and 1-λ are the share of these commodities in total trade. The trade balance can then be written as

$$p_X A(\frac{p_{XD}}{p_W})^{-\vartheta} - p_M M(Y, \frac{p_{MD}}{p_D}) \qquad (15)$$

This is how commodity production is treated in the FABEER model. While this approach may be an appropriate simplification when commodity production is small, it becomes problematic when a significant proportion of exports involve commodities. In Australia and New Zealand, nearly half of exports are commodities.

[7] Of course, in reality, some manufactures or services may be fairly homogenous goods and some national commodity production may face a downward sloping demand curve.

If all domestic exports involved commodities, then the macroeconomic balance approach would no longer be an appropriate way to determine real exchange rates. The price of exported goods would now be determined on world markets, and so the terms of trade would be exogenously given by world conditions. Shifts in domestic supply would have no impact on the terms of trade. Note, however, that PPP would not hold for such an economy, because shifts in the price of exported commodities would influence non-traded goods prices, and therefore the CPI.

The more interesting case (at least for Australia and New Zealand) is where there is mixed commodity/differentiated goods production. In one extreme case, adding commodity production would make no difference to the way we model trade – if the proportion of labour going to produce commodity exports was fixed. The terms of trade for differentiated goods production (p_{XD}/p_{MD}) would still move to equate demand for exports with supply, where supply was now some fixed proportion of total labour. However this extreme case is unlikely to be realistic: an increase in the price of commodities relative to differentiated exports goods would attract labour into the commodity producing sector.

An alternative extreme case is where the production function for commodities is linear. In this case commodity prices would effectively set wages, and given (6), the price of differentiated goods exports. The demand curve for these goods would simply give the proportion of labour in this sector, with any residual labour used to produce commodities.

A more likely case is where commodity production is subject to decreasing returns to scale. As a simple example, suppose commodity production (denoted by suffix O) is governed by the following production function

$$L_O = a_{O1} Y_O + \frac{a_{O2}}{2} Y_O^2 \qquad (16)$$

Wage equalisation implies

$$Y_O = \frac{1}{a_{O2}} \left(\frac{\theta - 1}{\theta a_Z} \frac{p_O}{p_Z} - a_{O1} \right) \qquad (17)$$

Total exports now become

$$p_X [A(\frac{p_{XD}}{p_W})^{-\vartheta} + \frac{1}{a_{O2}} (\frac{\theta - 1}{\theta a_Z} \frac{p_O}{p_Z} - a_{O1})] \qquad (18)$$

This is a hybrid demand and supply relationship. The volume of total exports continues to be influenced by world demand and competitiveness, but now the share of differentiated goods production in total exports reduces their impact. A rise in relative commodity prices for a given level of differentiated goods competitiveness will raise total exports, by shifting labour into the commodity producing sector. In the model as a whole, of course, such a relative price shift would reduce the supply of differentiated goods production, requiring a rise in its price to choke off demand.

Data availability and model specification

For the four major blocs in the FABEER model, trade is determined by equations of the form (12), (14) and (15). Data on non-commodity trade prices is not generally available, so we use manufacturing trade prices as a proxy. The GDP deflator is used as a measure of P_D.

In the case of Australia, manufacturing trade prices appeared not to be available. However a series for the price of manufacturing output is published. Denote these by P_I. It seems reasonable that we can augment (12) in the following way

$$\begin{aligned} p_{MD} &= p_W^{\gamma} p_I^{1-\gamma} \\ p_{XD} &= p_W^{\delta} p_I^{1-\delta} \\ p_I &= p_W^{\kappa} p_D^{1-\kappa} \end{aligned} \qquad (12A)$$

As a result, we can substitute P_I for P_{XD} and P_{MD} in the trade volume equations.

The partial equilibrium approach

The system just described represents one part of a complete macroeconomy: for that complete model we need to add equations for domestic output and overseas demand, as well as determinates of the capital flows that have to match any trade balance. In fact such a structure does represent many, if not most, large macroeconometric models (see Williamson, 1994, for example). However the partial equilibrium approach to calculating equilibrium exchange rates treats these variables as exogenous inputs.

For such a partial equilibrium approach to be completely valid the economy would have to have a recursive structure, where the real exchange rate did not influence medium term capital flows or the trend level of output. There are a number of economic mechanisms that mean that this assumption is bound to be false: the key issue is rather whether it represents a useful approximation. There is a partial discussion of this issue in Driver and Wren-Lewis (1999).

3 Calibrated equations

In this section we explain some of the key equations we use for New Zealand and Australia. Equations are calibrated rather than estimated, and further work could usefully explore estimating key parameters.

Equations (12 or 12A), (14) and (15) in the previous section describe the trade balance part of the model for New Zealand and Australia. To this is added an equation for net interest payments (described below), which collectively equal an exogenous value for the medium term (sustainable) current account.

These equations abstract from the disaggregation across country blocs (and commodity indices) in the model. For example, net interest payments (NIPD) depend on the real exchange rate because overseas assets are held in overseas currencies (so an appreciation reduces the domestic currency value of interest receipts from these assets), but the model in fact disaggregates these assets into those

held in US dollars, those held in Euros etc. The entirely arbitrary calibration that has been used here is

Table 1:
Currency composition of assets

%	US dollars	Euro	Yen	Sterling	Australia /New Zealand
New Zealand	80	5	5	0	10
Australia	75	10	10	0	5

Export volumes

The equation for real exports has already been discussed in the previous section. WD is a weighted average of real imports from the other country blocs, where the weights are loosely based on 1995 trade destination shares.

Table 2:
Export market share weights

%	US	Euro	Japan	UK	Australia/ New Zealand	RoW
New Zealand	10	8	15	6	20	41
Australia	6	9	23	3	7	52

The elasticity on world trade is fixed at 0.5 for both countries, as roughly half their exports are primary commodities.[8]

In principle, the competitiveness term for exports should be the price of exported differentiated goods over competing goods produced overseas. In the FABEER model, the price of differentiated goods is proxied by manufacturing goods prices. In the case of New Zealand, we have data on manufacturing export and import prices. The

[8] As some primary commodity exports may face a downward sloping demand curve, and vice versa, there seems little point in imposing any precise share.

competitiveness term in the export volume equation is therefore manufacturing export prices over a weighted coverage of other countries manufacturing export prices. Table 3 gives the weights used to construct the competitors export price series, which reflect competition in third markets.

Table 3:
Competitor export prices weights

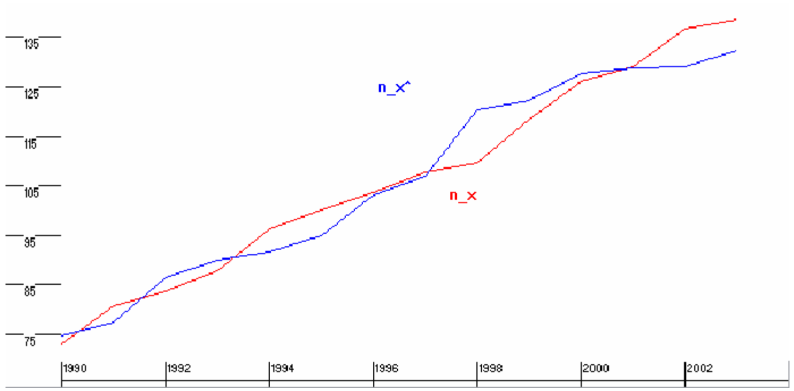
%	US	Euro	Japan	UK
New Zealand	29	13	26	2
Australia	25	19	25	2

We have assumed competition between New Zealand and Australia in third markets is negligible.

For New Zealand we have calibrated the aggregate competitiveness elasticity at 0.5 (as in Brook and Hargreaves, 2000). This represents an elasticity of about unity for differentiated goods. We have assumed an elasticity of 0.25 on real commodity export prices. (Thus a ceteris paribus 10 per cent permanent increase in these prices will raise the exports of commodity producers by 5 per cent.) The trend picks up the fact that these exports would rise over time even if real commodity prices were constant: we assume an aggregate trend of 2.5 per cent pa. (In the other equations in the model, both the trends and constants in each equation are estimated by static OLS. However as we only have data for New Zealand manufacturing export prices from 1990, we have imposed the coefficient on the trend in this case.)

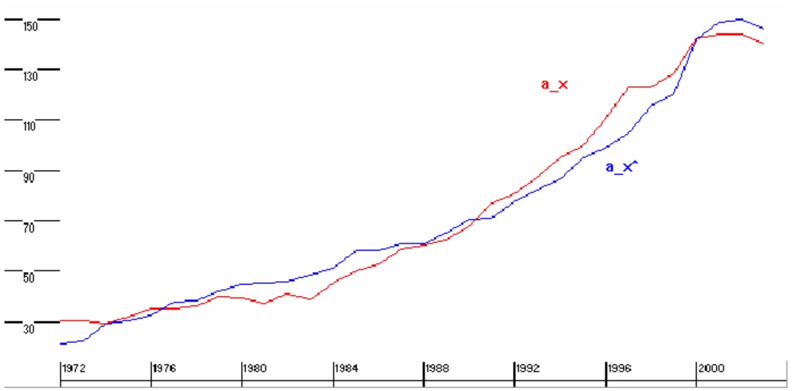
The following figure compares predicted and actual values for the equation, including estimated values for 2003. The equation is static (as the model is meant to represent a medium term equilibrium), so these are like the residuals on a cointegrating vector (CV), although no attempt has been made to estimate any CVs or test for cointegration. Predicted values are below actual export shares at the end of the period, which is important when it comes to calculating a recent equilibrium exchange rate (see the next section).

Figure 1:
New Zealand exports (predicted denoted by ^)



In the case of Australia, we do not have any data on manufacturing trade prices. Instead we have used data on the price of domestically produced manufactures. If we assume (as the model does) that trade prices are a weighted average of domestic and competitors prices, then direct substitution of domestic prices for export prices is legitimate. Apart from the constant and trend, we assume identical parameter values to New Zealand, except that the competitiveness elasticity as a bit lower at 0.4, because manufacturing export prices are likely to move less than 1 to 1 with domestic manufacturing prices. Figure 2 plots actual and fitted from a static regression from 1972 to 2003, where both the trend and constant are estimated. (Attempts to estimate the other parameters using static OLS over this period produced wrong signs.) The trend is quite high at 3.8 per cent pa, suggesting a rather better underlying performance than New Zealand, although there is some suggestion that performance has been less good in recent years. (Dvornak et al, 2003 include a positive trend from 1986 in their manufacturing export equation.)

Figure 2:
Australian exports (predicted denoted by ^)



Export prices

In the model total export prices are a weighted average of manufacturing prices and commodity prices, where the latter are divided into five commodity groups. Manufacturing export prices in New Zealand are a weighted average of competitors export prices and the GDP deflator. Both equations include trends: this helps capture trend differences in the price of services and manufactures.

Table 4:
Export price equations

<table>
<tr><td>New Zealand</td><td colspan="2">Manufacturing</td><td colspan="2">Total</td></tr>
<tr><td></td><td>GDP deflator</td><td>Trend</td><td>Commodities</td><td>Trend</td></tr>
<tr><td></td><td>44%</td><td>-0.3% pa</td><td>47%</td><td>0.2% pa</td></tr>
<tr><td>Australia</td><td colspan="4">Total</td></tr>
<tr><td></td><td>Commodities</td><td colspan="2">Domestic manufacturing</td><td>Trend</td></tr>
<tr><td></td><td>33%</td><td colspan="2">44%</td><td>-0.6% pa</td></tr>
</table>

For New Zealand, the model assumes that 47 per cent of total trade prices are determined by world commodity prices (based on 1995

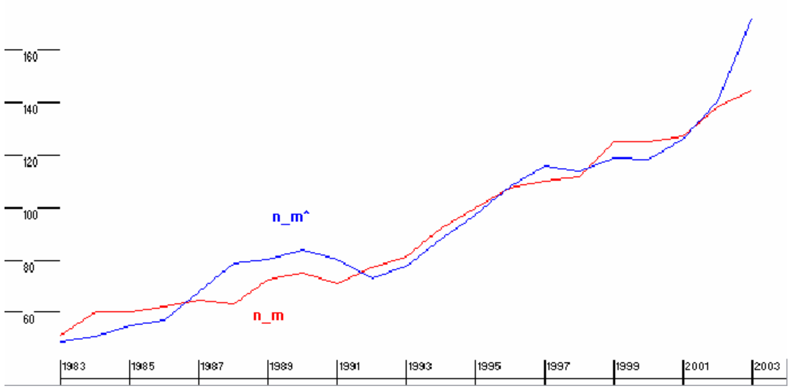
commodity shares), and there is a 0.2 per cent ceteris paribus rise in New Zealand export prices per year. (This coefficient is estimated from a static regression from 1990 to 2002. If the commodity share weight is also estimated, it is around 0.3. Estimated values for this commodity weight tend to fall below values implied by commodity breakdowns of actual trade. This is probably reflecting an error in variables problem because the commodities each country exports or imports can be quite different from the mix implicit in the aggregate UN indices.) New Zealand manufacturing export prices are influenced almost 50/50 by domestic prices (the GDP deflator) and competitors export prices, and the annual trend fall is 0.3 per cent per year. (All parameters are estimated in a static regression from 1990 to 2002. The trend presumably reflects the high service content of the GDP deflator compared to traded goods.)

For Australia, the weight on commodities is again imposed, and the remaining parameters estimated from 1980-2002. (If freely estimated by static regression, the commodity weight would be 0.23.)

Import volumes

Import volumes are determined by real GDP and a competitiveness term, which for New Zealand is manufacturing import prices over the GDP deflator. The latter is calibrated at 1.0, similar to the figure in Brook and Hargreaves, 2000. (Static estimation would give a much lower value.) The estimated activity elasticity from a static regression from 1983-2002 is just over 1.5. Predicted and actual values are shown in figure 3.

Figure 3:
New Zealand import volumes, 1983-2003
(^ denotes predicted)

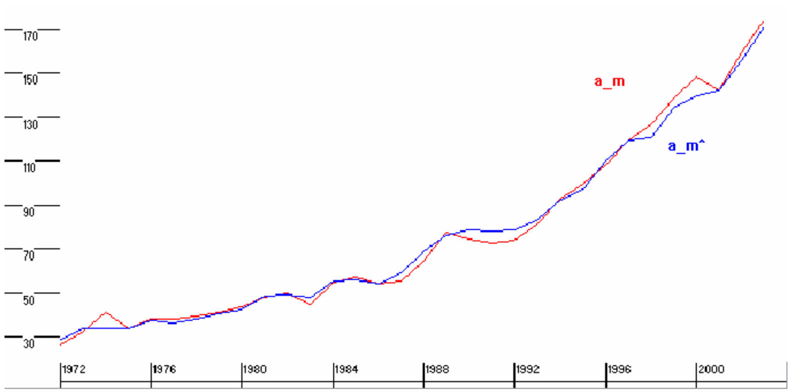


Although the activity elasticity of 1.5 is not unusually high, it understates the trend rise in import volumes. As the competitiveness measure is the price of manufacturing imports over the GDP deflator, it tends to fall over time. As a result, the competitiveness elasticity tends to add over 1 per cent a year to imports.[9]

[9] If we impose a lower competitiveness elasticity, the activity elasticity increases to 'soak up the trend' in the actual data.

In the case of Australia, the competitiveness term is domestic manufacturing prices over a world manufacturing price measure, using import share weights. The elasticity from a static regression from 1972-2002 is 0.54, and the activity elasticity is 1.76. In this case, the activity elasticity appears robust to changes in the competitiveness elasticity. Actual and fitted are shown in figure 4 below.

Figure 4:
Australian import volumes, 1972-2003
(^ denotes predicted)



For comparison, Dvornak et al, 2003 have an activity elasticity of 1.8 for goods, but only 1.1 for services, and a relative price elasticity (using the PPI) of 0.7.

Import prices

Table 5:
Import price equations

New Zealand	Manufacturing		Total	
	GDP deflator	Trend	Commodities	Trend
	28%	-0.6% pa	11%	-0.6% pa
Australia	Total			
	Commodities	Domestic manufacturing		Trend
	9%	19%		-0.8% pa

For New Zealand, manufacturing import prices are influenced by domestic prices (the GDP deflator), although the weight is less than one third (static regression 1983-2001), with the remainder determined by weighted world prices (import origin weights) and a trend. The weight on commodities for total import prices is imposed at its 1995 commodity composition weight, with the remainder determined by manufacturing import prices and a trend. The weights for Australia come from a static regression estimated from 1980-2002: the commodity weight is imposed at 9 per cent based on 1995 shares (it is 5 per cent if freely estimated). Domestic manufacturing prices have a significant influence, although again weighted world prices have the major influence (72 per cent). One surprising feature is the strong negative trend.

Trend activity

Our estimate of an equilibrium exchange rate is designed to be medium term, so it needs to abstract from the effects of the business cycle. In the model trend GDP is estimated over the past using actual data for the capital stock and the labour force, but making an assumption about trend TFP growth. From 1990, New Zealand TFP is assumed to grow at 1 per cent per year, and Australian TFP at 1.2 per cent. Based on OECD estimates (Economic Outlook Dec 2003), New Zealand GDP is assumed to be 0.4 per cent above trend in 2000, with Australian GDP 1.2 per cent above trend. The

relationship between trend and actual GDP for New Zealand and Australia is shown below.

Figure 5:
Trend and actual GDP, New Zealand
(soln denotes trend, base denotes actual)

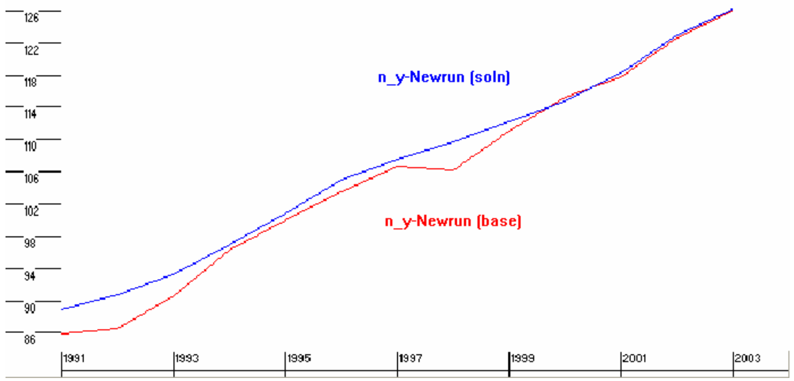
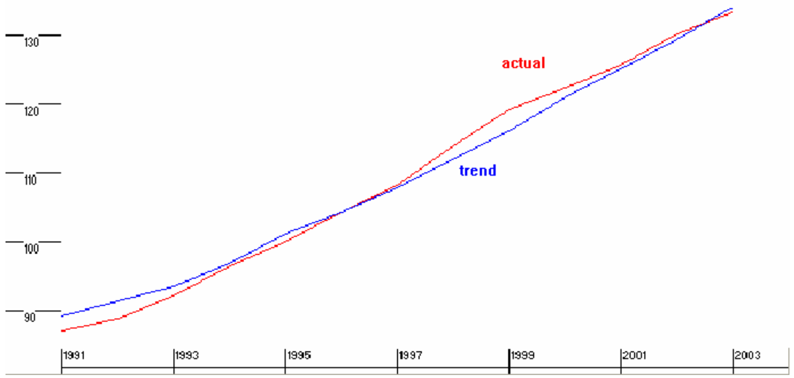


Figure 6:
Trend and actual GDP, Australia



Our assumptions imply GDP was over 2 per cent below trend in 1991, although OECD calculations have a much larger gap of 5 per cent, presumably because their TFP growth assumptions are lower.

Trend commodity prices

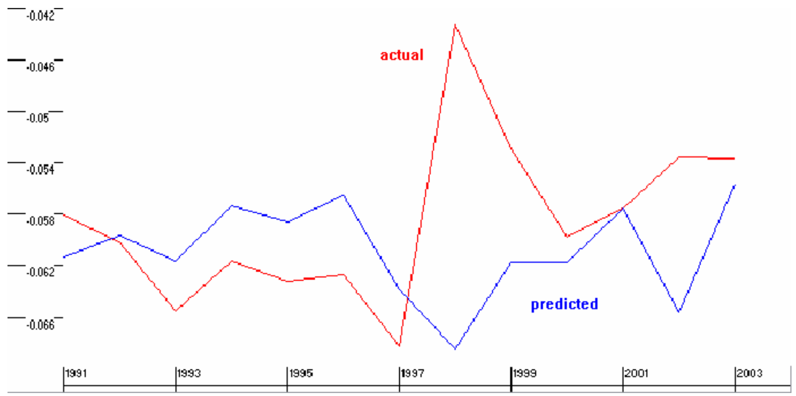
In the original FABEER model (Wren-Lewis, 2003), commodity prices were exogenous, but it seems more reasonable to at least allow for potential endogeneity to the world business cycle. There are five commodity indices: food, beverages, agricultural non-food, metals and oil. The middle three of these, when deflated by a world manufacturing price index (export prices for the main four groups weighted by GDP), are clearly pro-cyclical. 'Trend' real food prices, which are crucial for New Zealand exports, are assumed to be constant over time. As the UN food price index has been falling in real terms since 1996, this implies that trend food prices were about 20 per cent above actual levels in 2002, which improves the underlying New Zealand current account relative to the actual.

The opposite is the case for metals, which are particularly important for Australia. The equation contains a negative trend, while the actual price index has been relatively stable in recent years, so the model has underlying prices some 12 per cent below actuals. There is a positive trend for real oil prices, and underlying levels in 2002 are around 12 per cent below actual levels.

IPD payments

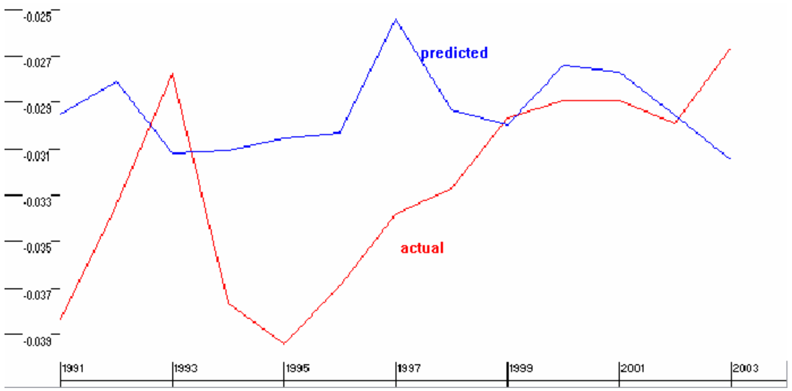
Wren-Lewis (2003) discusses the way IPD flows are treated in FABEER. Essentially the model applies a 'cyclically adjusted' world interest rate to actual assets and liabilities, with an allowance for country specific risk-premium. The figure below shows how this works for New Zealand, when there is a 1.5 per cent risk premium on liabilities. It is important to note that the model fails to pick up all of the improvement in the deficit in recent years.

Figure 7:
New Zealand actual and predicted net IPD share



We have a similar model for Australia, although the risk premium on liabilities is only 1 per cent. Once again the improvement in recent years is not picked up by the model.

Figure 8:
Australian actual and predicted net IPD share



4 Equilibrium exchange rate estimates

In this section we use the model outlined above to calculate equilibrium exchange rates. The equilibrium exchange rate in the partial equilibrium approach is the rate that delivers an exogenously determined value for the 'sustainable' current account. We make no attempt to model underlying capital flows, but simply take a value of 4 per cent of GDP for both New Zealand and Australia. We explore the sensitivity of results to this assumption in the next section.

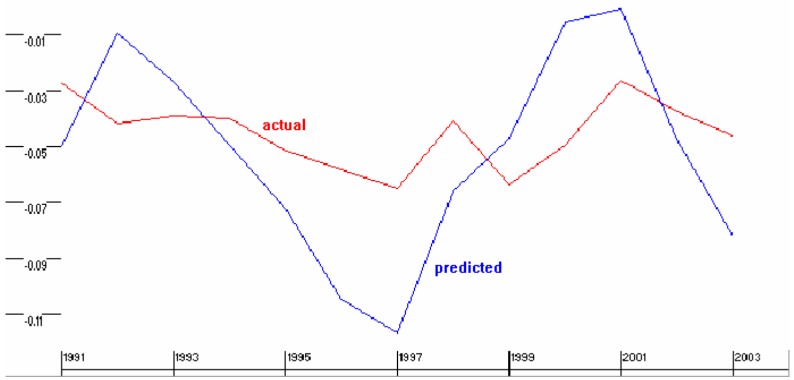
The model is entirely made up of real variables and relative prices. To get it to deliver estimates for nominal exchange rates we simply apply historical values for nominal prices. Of course, if domestic price inflation has been greater than overseas price inflation over any historical period, then this will produce a depreciation in the equilibrium nominal exchange rate even if the real equilibrium rate is constant. Luckily over the last ten years or so inflation has been fairly similar in most countries, the only exception being Japan, where it has been zero or negative (using the GDP deflator).

The working of the model becomes clearer if we split the model solution into two stages. In the first stage we calculate the 'trend'

current account, which is the current account that would have occurred if the domestic and world economies had been stripped of business cycle and other erratic effects, *but exchange rates had remained at historical levels*. The second stage then involves moving the exchange rate so that the current account becomes equal to its sustainable level.

A key feature of the FABEER approach is that the 'trend' current account is derived from the predicted values of equations, rather than by adjusting actual data to take out erratic effects. (For an example of the latter approach, see Brook and Hargreaves, 2000.) As these equations are static, they imply that the effects of the exchange rate on the current account come through immediately. There is no J curve. This is clearly evident in the figure below.

Figure 9:
New Zealand actual and trend current account share



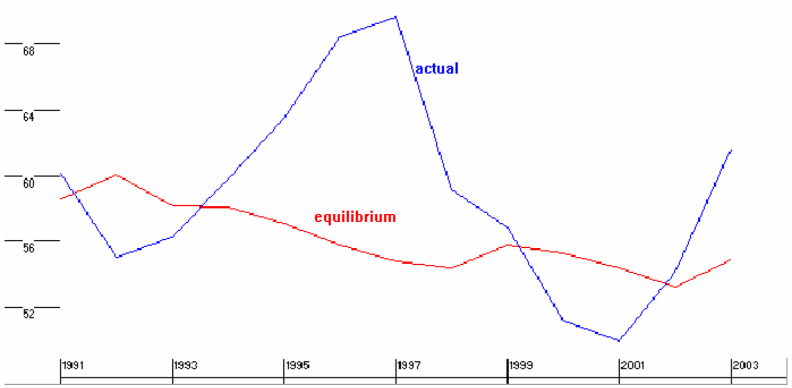
The trend current account is much worse than the actual during the mid-90s, when the New Zealand currency was also strong. In contrast the trend current account is better than the actual at the beginning and end of the period, when the New Zealand currency had depreciated (see figure 10). Where the actual data will reflect well-known lags in competitiveness effects, the model ignores these.

There are other factors leading to differences between the actual and trend current account. Predicted IPD outflows are worse than actual in the late 1990s, but better in the early 1990s (see previous section).

Eliminating the recession in 97/98 raises imports and worsens the current account. However the effects of these factors are relatively small.

Stage 2 endogenises the exchange rate, which closes the gap between the trend and sustainable current account. Although FABEER works with bilateral weights, we have constructed a synthetic TWI,[10] and equilibrium and actual TWI are shown below.

Figure 10:
Equilibrium and actual New Zealand 'TWI'



The most notable feature of this equilibrium path is that the equilibrium rate has been declining over time.[11] In the early 1990s the equilibrium TWI was close to 60, whereas in 2002 it had fallen to 53.3, just below the actual value of 54.1. There is some recovery in 2003 (to 54.9), although this value is conditional on estimated values for asset stocks and is therefore extremely vulnerable to data revision.

10 The equation used weights of 31 per cent, 20 per cent, 18 per cent, 23 per cent and 8 per cent on the US dollar, Yen, Australian dollar, Euro and Sterling respectively.

11 The equilibrium rate is not completely smooth because it is calculated using actual historical data for asset stocks and the labour force.

There are a number of factors behind this trend decline:

- Whereas trend real food prices are assumed constant throughout this period, trend oil prices are assumed to be on an upward trend.
- New Zealand's net asset position has deteriorated over the period, implying higher interest payments and the need for a larger trade surplus.
- There is a small effect to compensate for lower/negative inflation in Japan.
- A tendency for net trade volumes to deteriorate at constant levels of competitiveness.

This last factor requires some explanation. Between 1991 and 2002 trend GDP increases by 42 per cent, which, with an activity elasticity of 1.53 in the imports equation, implies growth in import volumes of 64 per cent. In addition, the fact that the GDP deflator grows by more than manufacturing import prices because of the Balassa Samuelson effect adds around 16 per cent, which compounds to over 90 per cent.[12] (Actual imports over this period grew by 95 per cent.) Trend world trade grew by 84 per cent over this period, which increased New Zealand exports by 42 per cent. The trend representing commodity exports added 2.5 per cent a year, giving another 27 per cent, compounding to 80 per cent. (Actual export volumes grew by 69 per cent.) So there is a gap, which has to be compensated for by a depreciation in the real exchange rate to preserve a constant current account, other things being equal.

Is this trend an artefact of the model? Two factors suggest not. First, the actual current account share at the beginning and the end of the period is similar, even though the actual TWI at the beginning of the period was much higher than at the end. Second, trends in actual export and import volumes have been worse than the model's predictions.

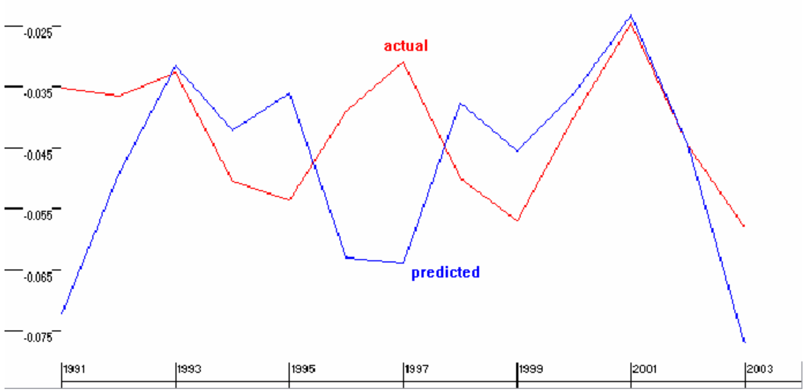
12 The impact of this Balassa Samuelson effect is large because the competitiveness term in the equation is unity. However, if we decrease this competitiveness elasticity, the estimated activity elasticity increases, so the problem remains. This is not surprising, given actual trends over this period.

Of course historical trends need not continue into the future.[13] The discussion above suggests that one of two things probably need to change if they are not. First, export volumes need to start growing faster, either because commodity exports start rising by significantly more, or because the market share of non-commodity trade starts increasing (as Australia's appears to have done in the 1990s). Second, the import propensity needs to increase more slowly.

Focusing on the recent past rather than historic trends, we can see that the equilibrium TWI in 2002 is just below the actual.[14]

The trend Australian current account is fairly similar to actual values in 2002, and both are a bit above the sustainable 4 per cent. The trend deficit declines more rapidly in 2003 than the actual, as we would expect given the dollar's appreciation.

Figure 11:
Australian actual and trend current account share

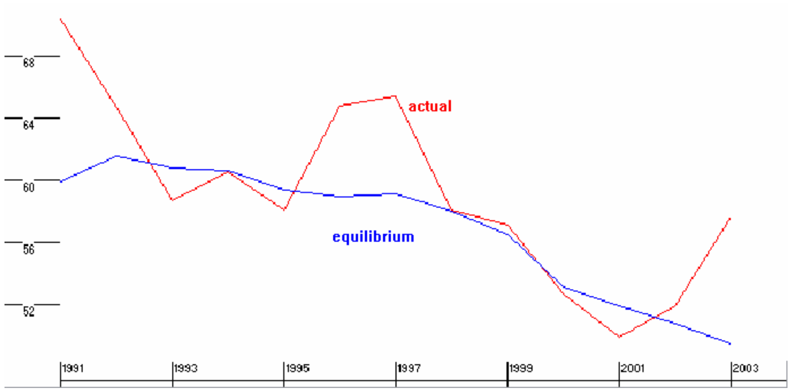


Using a very simple version of the Australian TWI,[15] we get the following relationship between actual and equilibrium.

[13] Our period may also be influenced by NZ liberalisation of trade flows that began in the 1980s.

[14] This might appear to conflict with the fact that the trend current account deficit in 2002 is calculated at 4.7 per cent, which is greater than the sustainable 4 per cent. However the former figure takes all exchange rates, including the US dollar, as given. The depreciation of the US dollar to its EER in 2002 tends to improve the NZ current account.

Figure 12:
Equilibrium and actual Australian 'TWI'



The equilibrium TWI declines over time, in a similar manner to the New Zealand TWI. Some of the same factors are responsible, but there are some important differences:

- The underlying terms of trade for Australia has deteriorated by more than for New Zealand, because of the importance of metal prices for the former.
- Trends in net trade volumes are more favourable in Australia than New Zealand, essentially because of a better export volume performance (see section 3 above).

Once again this declining equilibrium 'fits' with the fact that the actual TWI has also declined over time, but there has been no improvement in the current account.

The values for the equilibrium TWI derived in Dvornak et al (2003) are more erratic than those here, but their figure of 52 for 2000 is not very different from our estimate of about 53 for that year. Our estimate for 2002 is around 51, compared to an actual of about 52.

[15] The equation using weights of 27 per cent, 35 per cent, 9 per cent, 21 per cent and 8 per cent on the US dollar, Yen, NZ dollar, Euro and Sterling respectively.

The table below gives particular bilateral equilibrium rates for 2002, with actual rates in brackets. (The numbers represent the number of the column currency that can be bought with one unit of row currency.)

Table 6:
Selected equilibrium bilateral rates for 2002

	US $	NZ $	Aust$	Euro	Yen	Sterling
US $		2.0111 (2.1551)	1.697 (1.8406)	0.9255 (1.1074)	102.9 (121.9)	0.665 (0.6838)
NZ$	0.50		0.84 (0.85)	0.46 (0.51)	51 (56)	0.33 (0.32)
Aust $	0.59	1.19		0.55	61	0.39
Euro	1.08 (0.9)	2.17	1.83		111.2	0.72
Sterling	1.5	3.0	2.55	1.39 (1.62)	155	

Figures for the major 4 differ slightly from those in Wren-Lewis (2003) for a number of reasons, including more recent data and because trend rather than actual commodity prices have been used.

The New Zealand/US dollar figure of 2.01 is close to PPP based estimates of around 1.9, but considerably above the figure estimated by Brook and Hargreaves (2001) of 1.67.

5 Sensitivity analysis

Changes in sustainable current accounts

The figures in the previous section are based on fairly arbitrary, if conventional, assumptions about sustainable current accounts. We first examine how sensitive the estimates are to alternative assumptions. Not only are we interested in own country effects (ie how much the New Zealand currency would change if the New Zealand sustainable current account changed), but also cross-country

effects (ie how much the New Zealand currency would change if the Australian sustainable current account changed).

Table 7:
Alternative sustainable current accounts, 2002

% change	New Zealand TWI	Aus TWI	New Zealand$/ US$	A$/US$	New Zealand$/ A$
New Zealand CA -3%	-2.5	+0.2	+2.5	+0.0	+2.5
New Zealand CA -5%	+2.6	-0.2	-2.6	-0.0	-2.6
Aust CA -5%	-0.4	+3.5	-0.2%	-3.5	+3.3

The fairly large competitiveness elasticities in the New Zealand trade equations mean that the equilibrium rate is not too sensitive to sustainable current account assumptions. A 1 per cent change in the sustainable current account to GDP ratio leads to around a 2.5 per cent change in the EER. The model is also pretty symmetric. The equilibrium value of the Australian dollar is more sensitive, with a 3.5 per cent appreciation following a 1 per cent higher sustainable current account. Although trade elasticities play some part in this difference, the main reason is simply that the New Zealand economy is more open than Australia.

Of particular interest is the extent to which New Zealand equilibrium cross rates are influenced by changes in the medium term Australian economy. Wren-Lewis (2003) found that the Euro/Sterling rate was strongly influenced by changes in the sustainable US current account, because UK trade was more orientated to the US economy than the Euro area. Might the same be true for the New Zealand/US dollar rate and the sustainable Australian current account?

The results above suggest much less so. An increase of 1 per cent in the New Zealand sustainable current account leads to an appreciation in the NZ$/US$ bilateral of 2.6 per cent, while an increase of the same size in the Australian sustainable current account generates a 0.2 per cent appreciation in the NZ$/US$ bilateral. A higher Australian surplus generates an appreciation in the Australian dollar. This raises New Zealand import prices: with a unit price elasticity on the New Zealand imports equation, this has offsetting effects on the price and volume of New Zealand imports. The Australian appreciation also raises the volume of Australian imports. However, the elasticity on world demand in the New Zealand export volume equation is only 0.5, reflecting the importance of commodity exports. This is one major difference between the New Zealand and UK cases: the UK benefits more from an increase in US imports. The other major difference is in export competitiveness. Whereas UK exports compete with US exports in third markets, and therefore gain a competitive advantage from a US appreciation, we have assumed no competition between New Zealand and Australian exports in third markets.

Commodity prices

The table below looks at the sensitivity of EER estimates to changes in commodity prices.

Table 8:
Impact of medium term commodity price changes

% changes	New Zealand 'TWI'	Australian 'TWI'
All +10%	+5.0	+5.0
Food +10%	+3.8	+1.1
Metals +10%	-0.0	+0.7

A 10 per cent increase in all commodity prices directly raises the price of Australian and New Zealand exports, tending to improve the current account. In addition, the improvement in commodity prices leads to an increase in the supply of commodity exports, which adds to this effect. The currency therefore needs to appreciate to return the current account to its sustainable level. The appreciations shown here are for the TWI, but appreciations against the US dollar are very similar.

Chen and Rogoff (2003) examined the impact of commodity prices on the New Zealand and Australian dollar exchange rates using single regressions. Their estimated elasticities range between 0.4 and 1.1 depending on the specification of the regression, and our figures sit at the lower end of this range.

New Zealand risk premium

As we noted above, in the data there appears to be a 1.5 per cent risk premium on New Zealand liabilities, and a 1 per cent premium for Australia. What would be the impact of the risk premium disappearing? A zero risk premium would reduce real interest rates, with a substantial benefit to the current account through lower interest payments overseas. To hit the same sustainable current account, the New Zealand and Australian dollars need to appreciate.

% change	New Zealand TWI	Australian TWI
No risk premium	5.9	2.9

The effect is bigger for New Zealand, partly because the risk premium is larger, but also because New Zealand liabilities are a larger proportion of GDP.

Of course changes in real interest rates may have other effects that are not captured by this partial equilibrium model. In particular, we might expect a shift in trend output, which would reduce this appreciation. There might also be an impact on the sustainable current account itself.

References

Brook, A-M and D Hargreaves (2000), "A macroeconomic balance measure of New Zealand's equilibrium exchange rate", *Reserve Bank of New Zealand Discussion Paper* 2000-10.

Brook, A-M and D Hargreaves (2001), "PPP-based analysis of New Zealand's equilibrium exchange rate", *Reserve Bank of New Zealand Discussion Paper* 2001-01.

Chen, Y and Rogoff, K (2003) "Commodity currencies", *Journal of International Economics* 60, 133-160.

Driver, R and P Westaway (2003), "*Concepts of Equilibrium Exchange Rates, in Exchange rates Capital Flows and Policy*", ed(s) Driver, R, Sinclair, P and Theonissen, C, Routledge.

Driver, R and S Wren-Lewis (1998), "Exchange Rates for the Year 2000", Institute for International Economics, Washington.

Driver, R and S Wren-Lewis (1999), "*FEERs: A Sensitivity Analysis, in Equilibrium Exchange Rates*", ed(s) MacDonald, R and Stein, J, Kluwer.

Dvornak, N, Kohler, M and G Menzies (2003), "Australia's medium term exchange rate: A macroeconomic balance approach", *Reserve Bank of Australia Discussion Paper* 2003-03.

Houthakker, H, and S P Magee (1969), "Income and price elasticities in world trade", *Review of Economics and Statistics*, 51, 111-125.

Lane, P (2001) "The new international macroeconomics: a survey", *Journal of International Economics*, 54, 235-266.

Obstfeld, M and K Rogoff (1995), "Exchange rate dynamics redux", *Journal of Political Economy*, 103, 624-660.

Williamson, J (1994), "*Estimating Equilibrium Exchange Rates*", Washington.

Wren-Lewis, S (2003), "Estimates of Equilibrium Exchange Rates for Sterling against the Euro", H.M. Treasury.