Draft, comments welcome

New Zealand's macroeconomic reforms after 1984 and the neutral real rate of interest

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L. Christopher Plantier[1]

Abstract: Ex-post real short-term interest rates in New Zealand (NZ) averaged around 7.5 per cent between 1984 and 1989, which may relate to financial deregulation in NZ and elsewhere. With the passage of the Reserve Bank Act in late 1989 and the Fiscal Responsibility Act of 1994, one might expect declines in real interest rates due to NZ's commitment to price stability and fiscal prudence. In fact, real rates in NZ did decline following these macroeconomic reforms, and averaged about 6 per cent from 1994-99 and 3.75 per cent from 1999-2002. Despite these beneficial policy reforms, a persistent gap remains between real rates in NZ and the rest of the world. Using a panel of OECD countries, this paper examines what macroeconomic factors might explain this persistent gap, especially whether the above reforms helped lower it.

In particular, this paper estimates how much of the decline in NZ real interest rates can be accounted for by international factors common to all countries (e.g. lower inflation variability and lower net public debt in OECD countries) and country-specific factors (e.g. differences in net public debt, net foreign assets, and inflation variability). The results suggest that much of the decline in real rates can be explained by international factors, and some by fiscal policy changes. This panel approach also indicates that NZ's large negative NFA position is responsible for the persistent gap in real interest rates, as in Lane and Milesi-Ferretti (2002).

[1]Adviser, Economics Department, Reserve Bank of New Zealand, 2 The Terrace, PO Box 2498, Wellington, New Zealand. Phone: (64) 4-471-3876 email: plantierc@rbnz.govt.nz
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Introduction

Anyone who reads the financial press regularly in New Zealand knows that real interest rates are generally higher than in Australia, the United States, and Europe. The question of why real interest rates are higher in New Zealand (NZ) is a matter of some debate. A few people argue that the hawkish stance of the Reserve Bank of New Zealand (RBNZ) with respect to inflation has caused real interest rates to remain persistently above those of comparator countries. Under this logic, if only the RBNZ would follow a more relaxed approach to inflation control, then real interest rates would be more similar to Australia, although Australia still pays a premium over the US and Europe. Another school of thought is that NZ's indebtedness, particularly household indebtedness, has affected foreigners' willingness to lend to NZ. By this line of reasoning, if only households would reduce their overall indebtedness by saving a bit more, then foreigners would demand a lower real return on their borrowed funds. This paper uses a panel of OECD countries to assess whether any evidence exists that external indebtedness, measured by net foreign asset (NFA) positions as a per cent of GDP, relates to NZ's higher real interest rates, as in Lane and Milesi-Ferretti (2002). This paper also shows that reductions in public sector indebtedness and lower inflation variability have probably lowered real interest rates in NZ, all else equal, and suggests that further reductions in public sector indebtedness may lower real interest rates.[1]

Unlike past RBNZ studies that focus on short-term interest rates,[2] we focus on long-term interest rates because they are determined more by persistent domestic imbalances between national saving and investment, and foreigners' willingness to lend to NZ. By contrast, short-

[1] In "Monetary Policy Implications of Greater Fiscal Discipline", Taylor (1995) discusses the importance of fiscal policy in the determination of interest rates. Laubach (2003) empirically investigates the importance of fiscal policy using Congressional Budget Office forecasts of future deficits.

[2] Drew and Plantier (2000), Huang et al (2001), Plantier and Scrimgeour (2002), Huang (2002), and Buckle et al (2002) all suggest that the RBNZ's average cyclical response of short-term interest rates is not unusual.

term interest rates are more determined by the domestic business cycle and inflation positions, or by shocks the central bank expects to affect these positions. Despite the different key drivers of short and long rates, this paper presupposes that both rates share a common stochastic trend, through an arbitrage condition like the expectations hypothesis, so that the results based on long rates should be consistent with studies focussed on short rates.

Taylor rule studies that focus on short-term interest rates usually assume that rates fluctuate around a real interest rate with a constant mean. Because of this feature, one common result from these Taylor rule studies is particularly useful for our focus on long-term interest rates. In all of these Taylor rule studies, NZ faces a much higher neutral real rate (NRR) of interest than other countries, even once one accounts for differences in the state of the business cycle (ie the output gap), inflation, the response to the aforementioned arguments, and allows for interest rate smoothing.[3] Ultimately, relative cyclical positions can not provide the answer to why NZ has traditionally paid and currently pays higher real interest rates, so the question of why the NRR is so high remains.[4]

The neutral real rate (NRR) of interest concept goes back to at least Wicksell (1907) in economics, but remains an ill defined concept amongst central bankers. In fact, if you ask seven central bank economists their definition, you will likely get more than seven answers. This disagreement or lack of clarity partially relates to what one conditions on, as Wicksell's 1907 definition clearly assumes that all other factors are held constant. For example, the

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[3] Huang's (2002) paper uses a technique from English et al (2002) that does not distinguish between the neutral real rate (NRR) and the central bank's inflation target. For this reason, Australia and New Zealand have roughly the same constant in her regressions. That is, NZ may still have a higher real rate but lower inflation target over history, while AU has a lower real rate but a higher inflation target. For a discussion of this issue in the New Zealand context, see Plantier and Scrimgeour (2002). Given recent changes to New Zealand's Policy Targets Agreement (PTA), differences in effective inflation targets may be trivial going forward.

[4] In "Trans-Tasman interest rates – why is New Zealand paying more?" Conway and Orr (2001) attempt to explain short-term interest rate differentials using a number of cyclical factors. They conclude "We have argued that there are no real reasons for higher interest rates in NZ other than the balancing of risks between the central banks." However, balance of risks is unlikely to explain a permanent difference in real rates.

Taylor rule provides one definition of the NRR that is conditional on the output gap and inflation relative to target, see Plantier and Scrimgeour (2002) for its evolution. However, a much broader interpretation would be one that conditions on a wider set of variables, possibly including variables that have stochastic trends like a country's output, see Laubach and Williams (2001) or Glick and Rogoff (1995) who differentiate between global and country specific productivity shocks.

In a related paper, Archibald and Hunter (2001) discuss the neutral real rate of interest extensively, and focus on a number of different ways of thinking about the concept. Their discussion of the issue highlights why many views of the NRR co-exist, and why central bankers find the NRR a useful concept.[5] For our purposes, we focus on variables that help explain the trends in real long-term interest rates across countries, and why a persistent real interest rate gap exists between NZ and the rest of the world. In this paper, our preferred definition of neutral real rate is one that is conditional on persistent domestic imbalances between national saving and investment, hence our focus on long-term interest rates, and on risk factors like inflation variability.[6]

In regards to international trends in interest rates and foreigners' willingness to lend to NZ, the RBNZ discussion paper by Eckhold (1998) is quite illuminating. Eckhold (1998) shows the importance of foreign long-term interest rates, especially Australian long-term interest rates, in explaining much of the trend in NZ long term interest rates. This analysis suggests that foreign long rates represent an important opportunity cost for holders of NZ's liabilities,

[5] Also, Governor Ian McFarlane discusses the NRR concept in a September 2002 RBA bulletin article entitled "What Does Good Monetary Policy Look Like?" He states that "For a healthy economy, the inflation rate would neither rise nor fall in trend terms, and so the long-run average *real* interest rate would also be stable. It is this rate which is often referred to as the 'neutral rate of interest'." Svennson (2001) provides a definition quite similar to Wicksell (1907).

[6] For example, Conway and Orr (2001) state that "the neutral interest rate depends on factors that determine the supply and demand for savings in the economy."

and that declines in foreign long rates can explain much of the decline in NZ long-term interest rates, see figures 1 and 3. However, from the analysis, it is unclear that the appropriate foreign interest rate is the same for all countries, ie European long-term bonds tend to be priced off of German long-term bonds, while Australian bonds tend to be priced off of US bonds. Therefore, the analysis is most consistent with segmented capital markets that relate to each other through various linkages, rather than a single global market. Moreover, it is unclear whether there is something more systematic behind the relationship between foreign interest rates and NZ interest rates. Despite this view of the data, others have found some results suggesting a convergence toward a global capital market, see Breedon, Henry, and Williams (1999), and figures 2 and 4 provide evidence of less variability of long rates across countries over time, ie sigma convergence.

Supporting this view of a global capital market, Conway and Orr (2002) assume that each country faces a common world real interest rate, but that persistent domestic imbalances between savings and investment and various risk factors can affect the actual real rates that a country faces.[7] In particular, large and permanent net government debt positions can create a permanent wedge between the world real rate and a particular country's real rate. Even in this analysis however, there is still quite a bit of judgement required in order to get sensible results. In other words, capital markets again appear to be segmented somewhat, since these risk factors do not always apply equally to all countries, ie the United States and Switzerland are viewed as safe havens that do not have to pay for their risk factors. Another issue is whether the world real interest rate varies over time. Since we are less concerned with forecasting than Conway and Orr (2002), we allow the world real interest rate to vary on an annual basis. By doing so, we capture observed and unobserved world factors that vary over time, which allows us to focus more on the factors that determine why countries differ from

[7] Conway and Orr (2002) essentially use the technique outlined in Orr et al (1995).

this common time-varying world rate.[8] Additionally, these common world factors may often cancel out what appears to be driving real rates lower in NZ, eg the decline in inflation variability in NZ may just be part of a wider worldwide phenomenon. Finally, we do not use a moving average of current accounts to gauge a country's indebtedness or appetite to borrow. Instead, we use net foreign asset (NFA) data from a recent cross-country study.

Lane and Milesi-Ferretti (2001) examine the level of indebtedness of numerous countries, developed and developing, and provide net indebtedness positions for these countries back to 1970 on a consistent basis. Their NFA data forms an important input into this study, since it helps address one of the key problems often involved in panel data studies, ie consistent data. In a second paper using their NFA data, Lane and Milesi-Ferretti (2002) attempt to explain the level of indebtedness by fundamental factors like demographic factors, per capita GDP, and fiscal imbalances using an error correction method (ECM). Also, they investigate the link between a country's NFA position and its real long-term interest rate. According to their results, they find that countries with more negative NFA positions relative to exports (or GDP) tend to pay higher real interest rates on average, roughly "a 20 percentage point improvement in the ratio of net foreign assets to exports position is associated with an 50 basis point reduction in the real interest rate differential." Our results support their finding of a portfolio balance effect despite some differences in our approach.[9] For instance, Lane and Milesi-Ferretti (2002) use a DOLS approach that allows for leads and lags of the regressors, where we do not allow for leads in our estimation of the relationship.

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[8] Ford and Laxton (1999) find that the aggregate OECD government debt level affects real interest rates in various countries, suggesting bond market integration and crowding out effects, even though many other studies find conflicting evidence of country specific government debt.

[9] The results in Lane and Milesi-Ferretti (2002) are quite robust. They note that "the effect is also significant for the 1980-98 period and the estimated point coefficient typically larger for the more recent period. These findings are little affected by inclusion of the stock of public debt and the rate of real exchange rate appreciation. Even stronger results are obtained when the net foreign asset position is instrumented by the level of the GDP per capita, public debt and demographic variables, suggesting that the relation is not being generated by reverse causality running from the real interest rate differential on the net foreign asset position."

More recent structural models of the NRR include Laubach and Williams (2001) and Nelson and Neiss (2001). Both of these papers focus more on the closed economy case, and show that the NRR has cyclical variation that is typically ignored in expositions of the NRR concept. For example, persistent shocks to productivity can alter the NRR in both models. Despite the focus on the closed economy case, Nelson and Neiss (2001) claim that the results also apply to the open economy case, except that the adjustment costs may differ as well as the dynamics to various shocks. We do not attempt to explore how productivity or other shocks propagate through the economy, nor do we examine their effects on our definition of the NRR. Rather, we focus more on the cross-sectional aspect of why the NRR varies across countries, so it is unclear if these two studies directly relate. This is especially true since they are more concerned about time series properties of the NRR, and they do not concentrate on the effects of a country's NFA position. Moreover, both of studies above do not examine the impact of fiscal imbalances on the NRR, like Conway and Orr (2002), nor do they control for the effects of observed and unobserved world factors, as we do, that may impinge upon domestic real interest rates in an open economy context. In a related paper, Laubach (2003) shows how increases (decreases) in Congressional Budget Office (CBO) forecasts of budget deficits coincide with increases (decreases) in US long-term interest rates.

The panel data set

We focus on 22 OECD countries in our widest panel, ie countries that have most series available back to at least the middle 1980s. Overall, we exclude 8 countries from the 30 in the OECD, including the transition countries of central Europe, Greece, Korea, Mexico, and Turkey.[10] The data for this study comes from several sources, but in each case every attempt

[10] For a complete listing of OECD countries, see link below
http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-countrylist-0-nodirectorate-no-no-159-0,00.html

was made to use series from the same source and with roughly the same definition. For example, the long term interest rate series are from Datastream with most series being 10-year government bond interest rate, but in some cases a slightly longer or shorter term was used based on availability.[11] To calculate inflation and inflation variability, we employ the consumer price index in the various countries drawn from Datastream, but also use CPI data for AU and NZ that excludes interest costs and GST. To calculate exchange rate changes and variability relative to the US dollar, we employ the exchange rate data from the St. Louis Federal Reserve Bank website, see **http://research.stlouisfed.org/fred/index.html**.

The most difficult data to gather and compare across countries is net foreign asset (NFA) positions of countries. This task was made significantly easier by Lane and Milesi-Ferreti (2001), who compile annual NFA data for various developed and developing countries, and try to model the structural determinants of it. Because they apply a consistent methodology and adjust for valuation changes, their NFA positions are well suited for our purposes. The NFA data from Lane and Milesi-Ferretti (2001) are available at **http://econserv2.bess.tcd.ie/plane/data.html** for those interested in using the data, or wishing to know more about how they were constructed. Since the data are annual, we linearly interpolate them to the quarterly frequency. The practical effect of interpolation is unlikely to be large, since much of the variation in these series is cross-sectional, and we are interested more in the low frequency movements of NFA positions.

While the decision of which countries to include or exclude is unlikely to be random and may introduce some bias into the results, we believe the inclusion of more countries helps focus on the cross-sectional aspects of why real interest rates differ. Consequently, we have tried to keep the country set as wide as possible. However, because of data limitations on net public

[11] In order to include Iceland, we had to use short rates in place of long-term interest rates. However, we check that our results are not sensitive to this issue by excluding Iceland.

debt ratios, but also in order to facilitate comparison to a recent paper by Conway and Orr (2002), we limit ourselves to the six countries they studied most intensively. Our results appear robust in their smaller subset, and are not that dissimilar to their results. By using their data on net government debt ratios, we can also see whether there exists a difference between net private debt, NFA ratio minus net public debt ratio, and the net public debt ratio. Figures 5 through 9 illustrate the patterns for the key variables in AU and NZ compared to the panel mean, including the patterns of net private and public debt ratios. From the data on net private debt ratios in Figure 7, AU and NZ net private debt is significantly larger than the mean of the six country panel. We only report public debt for the six countries studied most intensively by Conway and Orr (2002), but have examined a broader set of net public debt ratios from OECD data.

The presence of unit roots in the data, especially long-term interest rates, is clearly a concern. At the moment, we have not done thorough tests on the presence or absence of unit roots, nor have we examined how well the variables in our panel cointegrate if they are unit roots. The results arrived at so far do rely on the assumption that a reasonable cointegrating vector exists. Based on the more thorough work of Lane and Milesi-Ferretti (2002), we feel confident that the results will hold up to more rigorous inspection, and are currently exploring panel unit root tests and homogeneity tests for coefficients of interest.

Panel methodology

The general model used to analyse long-term interest rates across countries is

(1) $$y_{it} = \alpha_i + \gamma_t + X_{it}^{\prime}\beta_i + \varepsilon_{it}$$ for i = N and t = T.[12]

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[12] We express the equation in its most general form, but do not employ fixed effects in any of our reported regressions. In the future, we may test for the presence of fixed country effects.

For country i in period t, y is the nominal long-term (10 year bond) interest rate minus the expected inflation rate, a is constant term that allows for fixed country effects, γ is a time dummy to capture common time period effects, and X is a vector of regressors for observed factors. ß is a vector of parameters for country i that can be restricted to be the same across countries, or allowed to be country specific. e is an N x T matrix of error terms that are assumed to be both independent and identically distributed (iid), as well as normally distributed.

Specifically, the augmented UIP condition below is estimated in Tables 1 and 2 in the regression appendix.

(2) $$\begin{aligned} y_{it} &= \gamma_t + \beta_1 NFA_{it} + \beta_2 \Delta_4 \ln(S_{it}) + \\ &\beta_3 Var(\pi_{it}) + \beta_4 Var(S_{it}) + \rho y_{it} + \varepsilon_{it} \end{aligned}$$ for i = N and t = T.

In equation (2), y is the nominal long-term (10 year bond) interest rate minus the expected inflation rate as above, γ is a time dummy to capture common time period effects as above, NFA is the net foreign asset position as a percentage of GDP, and S is the nominal exchange rate. Var (π) and Var (S) are the moving average of the variability of inflation and the exchange rate, measured by the standard deviation of quarterly and monthly changes over the last five years, respectively. $?_1$ through B_4 are common coefficients on these observed factors, and ρ is a common AR(1) coefficient.

In this paper, we establish a base panel model that relies on the assumption of a constant or time-varying real world interest rate that is the same for all countries, ie we do not allow for fixed effects. After that, we make allowance for persistent domestic imbalances between savings and investment and various risk factors as in Conway and Orr (2002). The time-varying real world interest rate is an important departure from Conway and Orr (2002), and helps explain roughly half of the fall in real interest rates in NZ. Another key difference from Conway and Orr (2002) is that we do not proxy for expected inflation with the HP filtered trend of inflation, since this introduces some artificial dynamics that could drive results. Consequently, we use current annual CPI inflation instead of the HP filtered trend of inflation. In this sense, our study is closer to that of Lane and Milesi-Ferretti (2002) who utilise next year's inflation rate. We then gradually alter the base model to deal with various issues, and examine how sensitive results are to different specifications.

In every specification, we correct for heteroskedasicity and weight the residuals according to differences in the variances of each equation. The equations also possess significant serial correlation, so we address the serial correlation by modelling the residuals as a common AR(1) process. In the future, we will model this serial correlation more rigorously by checking the residuals for higher order serial correlation, but have only used an AR(1) in all the regressions because this specification soaks up most of the serial correlation based on the partial autocorrelation functions.[13] In some cases, however, an AR(2) may be more appropriate, yet the general results do not seem affected by whether one uses an AR(1) or AR(2) to correct for serial correlation. Essentially, we are assuming that the interest rate converges back to the real world rate plus the other factors that determine persistent differences in real long-term interest rates. This approach is quite similar to Conway and Orr (2002), who estimate an error correction method using a systems based approach in order to deal with any endogeneity and cross correlation problems. Unfortunately, we have only employed an AR(1) correction thus far, but do not believe that the results change dramatically due to endogeneity based on Lane and Milesi-Ferreti (2002).

[13] In the case of the residuals for the last column of Table 3a, our preferred model at this point, NZ and AU residuals possess little and no higher order serial correlation, respectively, based on the Ljung-Box Q-statistics. However, the residuals for the other countries still possess some higher order serial correlation, which suggests we need to address this issue more thoroughly.

Empirical Results

Tables 1 through 3 present the results achieved thus far for different specifications and countries. Table 1a is the base model for 22 countries that includes only a constant world real interest rate and the various economic reasons why real interest rate might differ across countries. From the first column of results in Table 1a, the most basic model captures much of the variation between and within countries, and the signs of the variables are correctly signed. The coefficient on the key variable of interest, the NFA ratio, is negative and significant, and suggests that a 10 percentage point decline in the NFA ratio, moving from -50 to -60 per cent, leads to a 29 basis point increase in a country's real interest rate. Also, inflation and exchange rate variability are both positive and significant, and suggest that more uncertainty in these measures leads to higher real interest rates.

Unfortunately, the residuals display significant serial correlation, so we employ a common AR(1) coefficient to model the residuals in the second column of results. The effect of this correction makes the inflation and exchange rate variability coefficients insignificant, but leaves most of the other coefficients roughly the same. To examine whether modelling the premium a country pays over the US affects the results, the last column shows the results when the dependent variable is real long rate of each country minus the real long rate of the US. While this makes the constant world real interest rate insignificantly different than zero, the NFA position, change in the exchange rate, and the common AR(1) coefficient remain significant. Also, the model still explains much of the variation within and between countries. Overall, the effect of a country's indebtedness position, the NFA variable, holds up quite well at around 25 basis points per 10 percentage point deterioration, and is a significant factor in 22 countries studied in Table 1a.[14]

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[14] Tables 1a, 2a, and 3a use the NFA position lagged 12 quarters in order to extend data set out to 2001, since Lane and Milesi-Ferretti (2002) only report data up to 1998. Based on comments received, Tables 1b, 2b, and

Table 2a examines the effects of annual time dummy variables in place of a constant world real interest rate, and provides some additional robustness checks. Column 1 of Table 2a shows that the world real interest rate declines over time, falling from 4.94 per cent in 1990 to 2.54 per cent in 2001, and that the effect is relatively minor on the coefficient estimates. As an additional check, Column 2 demonstrates that the exclusion of Japan from the sample does not dramatically change the results, and suggests that the results are not being driven by Japan's inclusion in the sample. Column 3 in Table 2a employs the real long rate in each country minus the US real long rate as the dependent variable, so that we can investigate whether modelling differentials over the US long-term interest rate alters the results. As before, the coefficients are robust, but an interesting pattern exists in the time dummies. For 1990 and 1991, the rest of the world pays a significant premium over the US, but it gradually falls, and is negative and insignificant in the latter part of the sample. In this instance, the time dummy may be capturing some general convergence or integration process that we have not explicitly modelled.

Table 3a restricts the panel to the six countries studied most intensively by Conway and Orr (2002), and uses their net government debt ratios to construct private and public debt ratios as separate regressors.[15] For the six country panel base model in column 1, both private and government debt ratios are important, and government debt is statistically larger in absolute value. Again, the time dummies show a decline in the world real interest rate and the inflation and exchange rate variability are insignificant. Column 2 and 3 correct for serial correlation with a common AR(1) coefficient, and compare the effects of having a constant versus a time-varying world real interest rate. Overall, the results are roughly the same, but

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3b report regression results when the NFA position is contemporaneous, thereby ending the data set in 1998. The general pattern of the results does not change, and the NFA coefficient remains roughly the same. Figure 10 demonstrates that NFA appears important in explaining cross-section variation.

the effect of government debt is slightly larger in absolute value in columns 2 and 3. One interesting result is that inflation variability is positive and significant in column 2, with the coefficient being about 0.5. Since NZ's inflation variability falls from about 5 per cent to less than 1 per cent, this effect may explain 2 percentage points of the decline in real long term interest rates in NZ.

Despite this positive finding that inflation variability reduces the real long term interest rate in NZ, the largest and most robust effect comes from the improvement in the NZ government's net debt position. Net government debt in NZ fell from 50 per cent of GDP to less than 20 per cent of GDP. The effect of this fiscal improvement probably reduced real long term interest rates in NZ by around 150 basis points, or 1.5 percentage points. Further reductions in the government's net debt may also lower NZ's neutral real interest rate, especially if it helps address the persistent domestic imbalances between savings and investment, see Taylor (1995). This analysis highlights the importance of persistent domestic imbalances between savings and investment in permanently changing the real interest rate, even in a small open economy like NZ.

For a more concrete example, we utilise the estimated coefficients in last column of Table 3a to demonstrate what explains the gap between real long rates in NZ and AU from the time-varying world real rate based on time dummies. Figure 11 demonstrates why NZ has had a persistent gap after the economic reform period. In the mid to late 1980s, the gap consisted of about 150 basis points (bps) for inflation variability and 200 bps for public sector debt. After the passage of the Reserve Bank Act of 1989, a significant reduction in inflation variability occurs that eventually sees this factor's effect diminish to around 30 bps. The passage of the Fiscal Responsibility Act of 1994 also seems to coincide with a reduction in net public debt.

[15] The six countries are Australia, Canada, Germany, New Zealand, Sweden, and the UK.

The effect of net public sector debt on the gap from the world rate falls from around 200 bps to less than 100 bps over the mid to late 1990s. Even with these beneficial reforms, the response of the private sector offsets some of the decline in the gap by borrowing more.[16] From the mid to late 1980s, the net private sector indebtedness effect rises from almost zero to around 125 bps. The overall picture conveyed by figure 11 is that the macroeconomic reforms that helped ensure price stability and fiscal prudence were very beneficial in terms of reducing real long rates, but that the private sector offset some of these benefits by borrowing significantly more.

In Figure 12, we do the same decomposition exercise to show that while the gap for AU looks relatively stable, its components change somewhat over time. Figure 12 shows that the effects of AU policy changes look much less dramatic when compared with NZ. On the whole, large private sector indebtedness very likely explains why AU and NZ continue to pay, and have paid somewhat higher real interest rates than other countries, at least according to the empirical results in this paper and in Lane and Milesi-Ferretti (2002). However, public sector indebtedness and reduced inflation uncertainty has generally reduced the gap between real interest rates in NZ compared to the rest of the world.

Conclusion

The empirical results in this paper confirm the findings in Lane and Milesi-Ferretti (2002) that the NFA position of a country is negatively related to the country's real long-term interest rate. In other words, countries with large negative NFA positions can expect to pay higher real interest rates relative to the rest of the world, all else equal. However, this paper

[16] A natural question is whether there is a negative correlation between public sector and private sector debt ratios generally that may be causing a multicollinearity problem. In all the countries, public sector and private sector debt ratios are positively correlated to varying degrees, although the contemporaneous correlation is not excessive and averages around 0.6. Barro (1974) discusses why private sector may offset changes in government's fiscal position.

also explores whether other variables, such as inflation variability, exchange rate variability, and the government's net debt position, have an effect on real interest rate differentials. While inflation and exchange rate variability are significant and positively related to real rates across countries in some specifications, these results do not hold up when we model the serial correlation as an AR(1) or use time dummies to control for common world effects. Nevertheless, the decline in NZ of inflation variability may have contributed to lower real rates in NZ, but the general worldwide decline in inflation variability compared to the 1970s and early 1980s may dominate any country-specific effects, see Figure 5. To that end, about half of the overall decline in real long-term interest rates in NZ relates to declining world real interest rates, yet this effect can not explain NZ's persistent gap between world rates.

A key contribution of this paper is that the composition of the NFA position can also affect the real interest rate because government indebtedness has a larger effect than private indebtedness. In our smaller six country panel, we broke a country's indebtedness into private and public sector debt ratios, and reject that they have they same effect at the 10% level of significance for some specifications. The difference in magnitude in the preferred specification, column 3 of Table3, implies that a ten percentage point reduction in net government debt, ceteris paribus, leads to a reduction in the real long-term interest rate of about 45 basis points. Even if NZ household's behave in an offsetting manner and simultaneously increase net private debt, as they appear to have done in the 1990s, real long-term interest rate still fall by about 20 basis points for a ten percentage point reduction in net government debt. To conclude, reductions in the net indebtedness of the NZ government, around and after the Fiscal Responsibility Act of 1994, have probably lowered real interest rates by almost 150 basis points in the 1990s, all else equal. If the Crown's net indebtedness continues to improve as forecast, further reductions in real long-term interest rates can be achieved, even if the households diminish the effect somewhat by increasing their indebtedness.[17]

[17] We do not discuss how a government achieves this reduction in net indebtedness, either by paying off debt or holding assets, and leave the question of the optimal mix for others. We also ignore the question of what happens when and if a government actually becomes a net creditor, since all the governments in the six country panel are currently net debtors.

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Figure 1: Nominal 10-year bond rates in AU and NZ

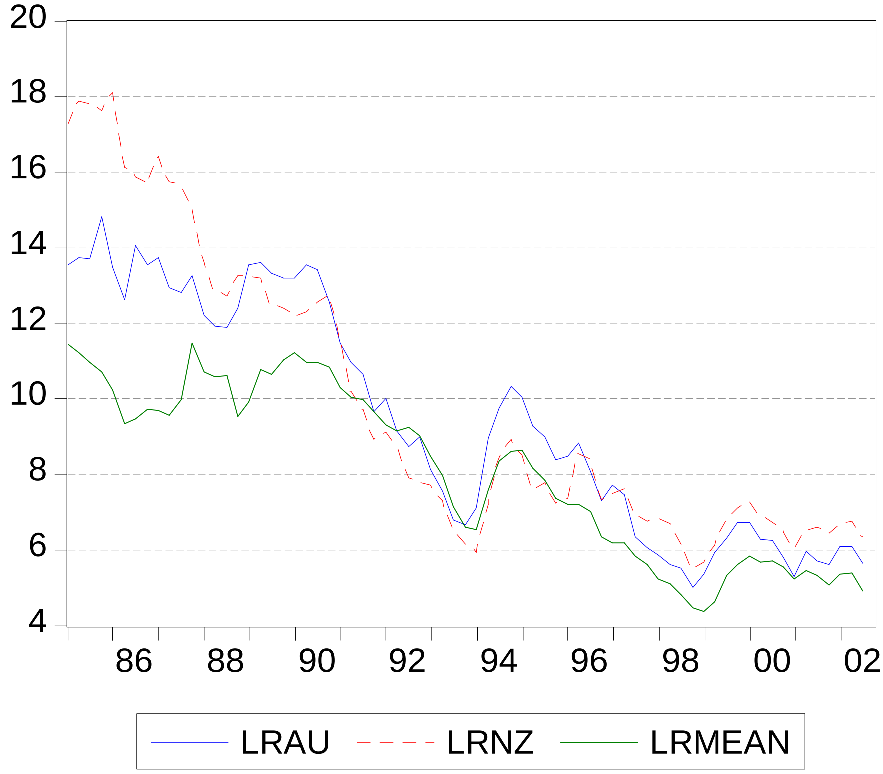


Figure 2: Sigma convergence, cross sectional std dev in long rate

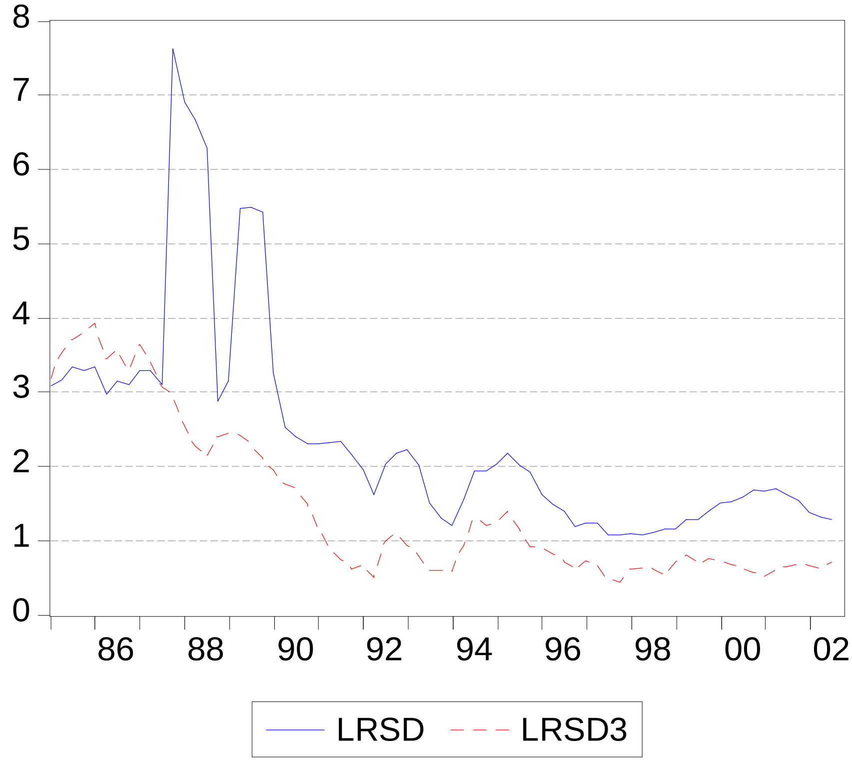


Figure 3: Nominal 10-year bond rates minus inflation in AU and NZ

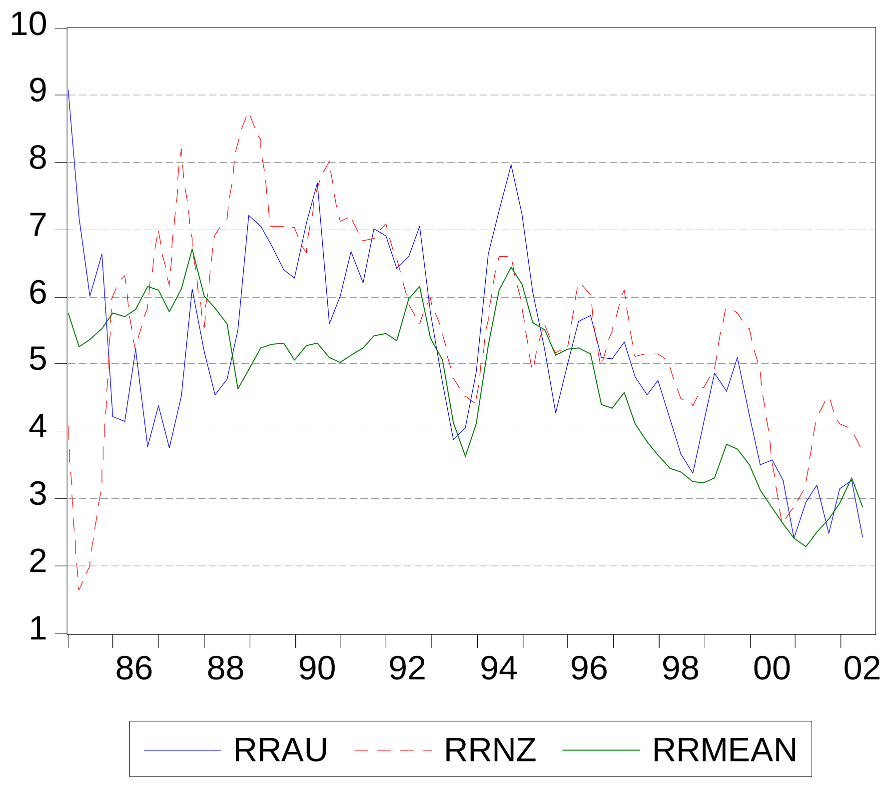


Figure 4: Sigma convergence, cross sectional std dev in real rate

Figure 5: Inflation variability - std of previous 5 years, quarterly

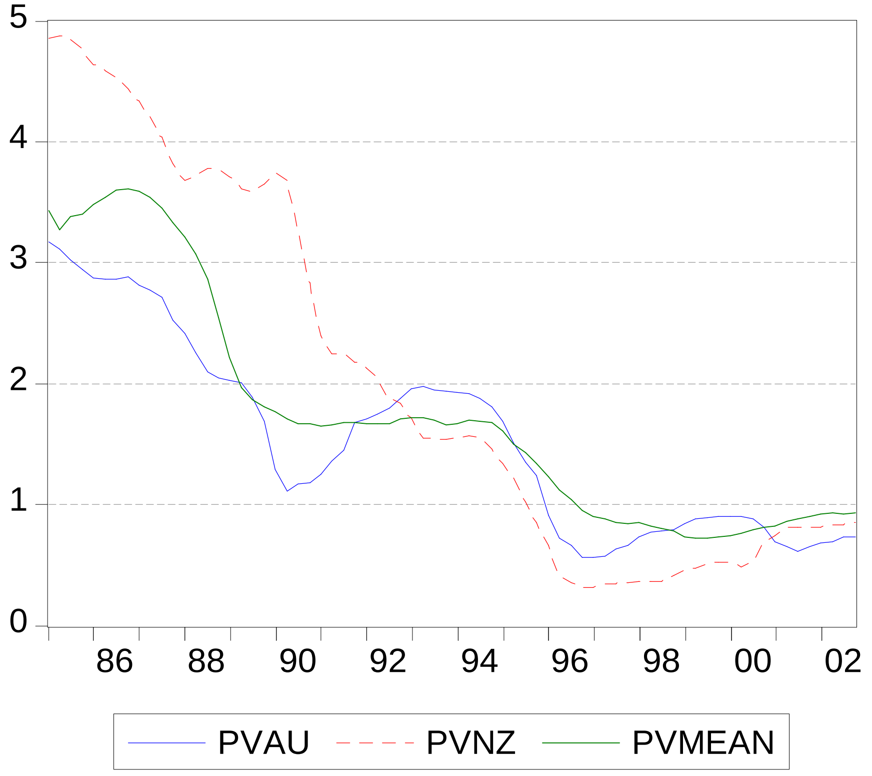


Figure 6: Exchange rate variability - std of previous 5 years, monthly

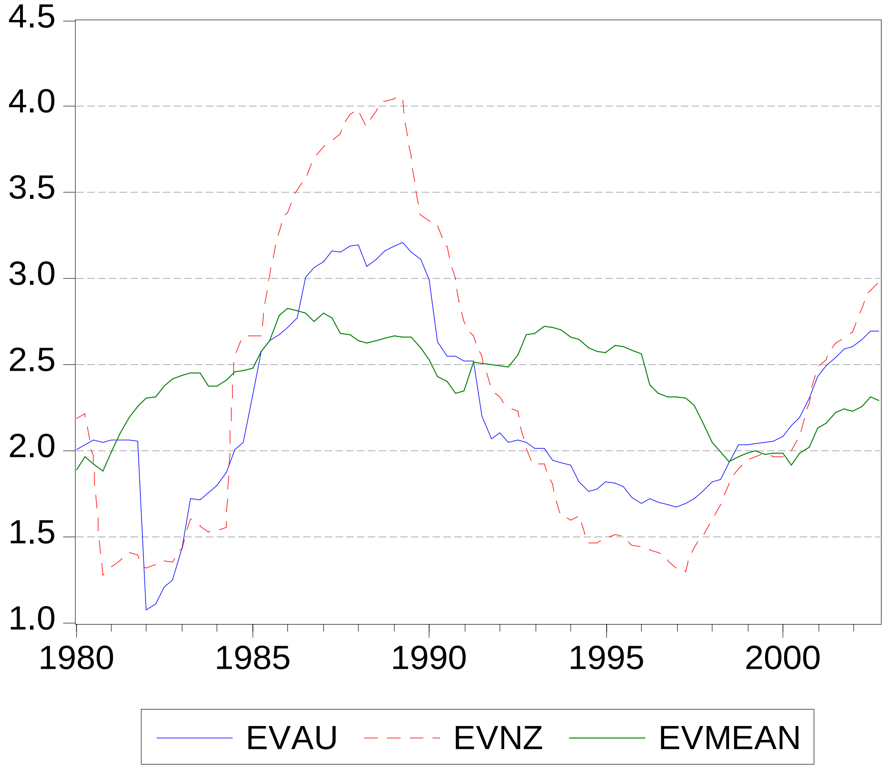


Figure 7: Net private debt of AU and NZ, % of GDP

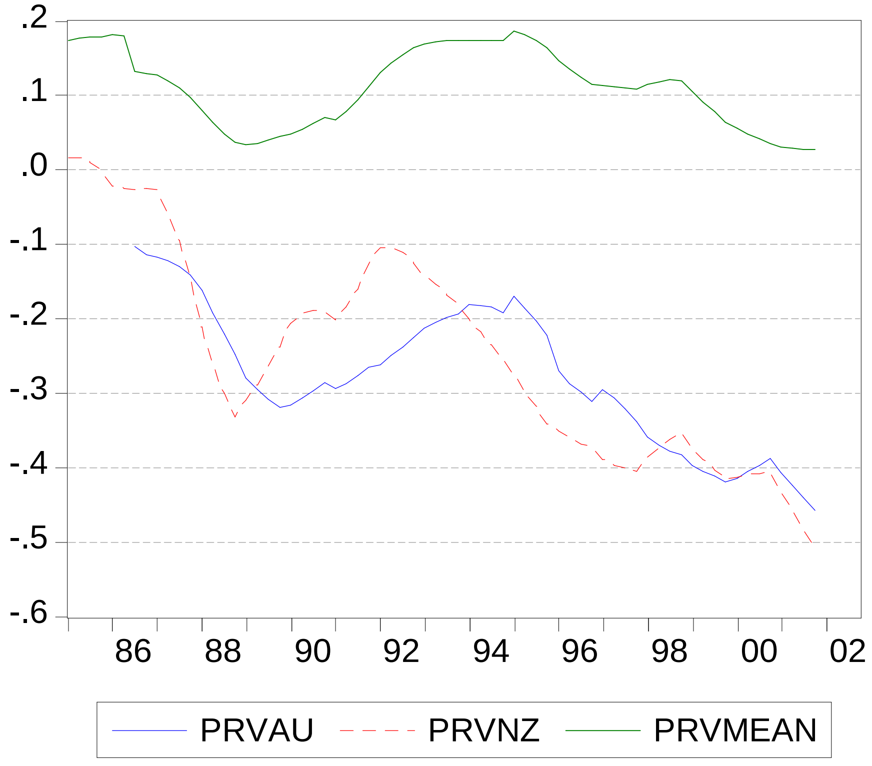


Figure 8: Net government debt of AU and NZ, % of GDP

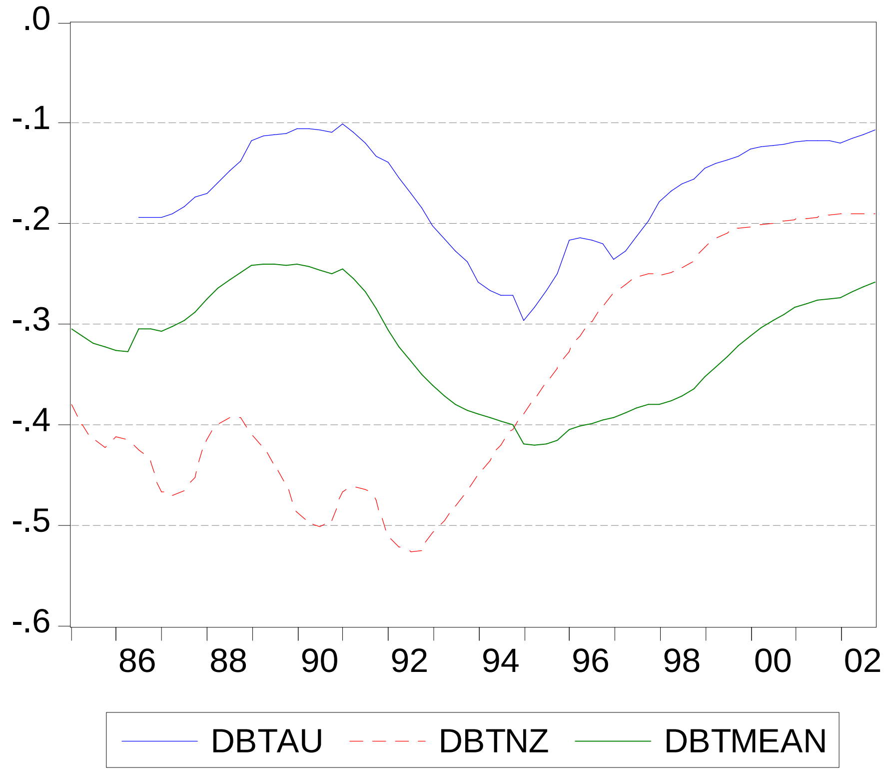


Figure 9: NFA positions of AU and NZ, % of GDP

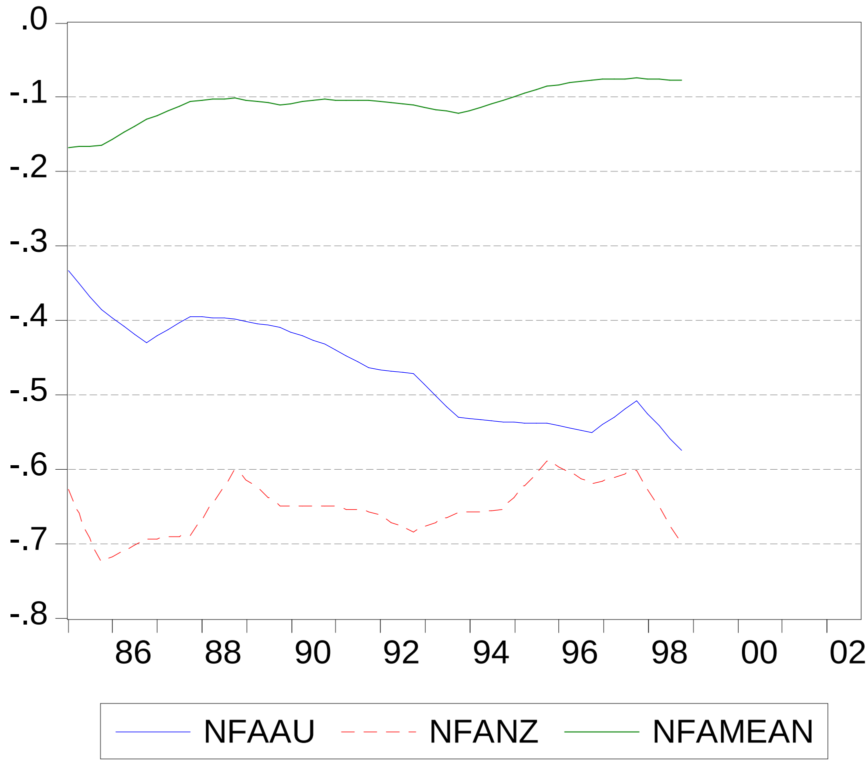


Figure 10: Real long rate vs. NFA/GDP ratio, 1998q1

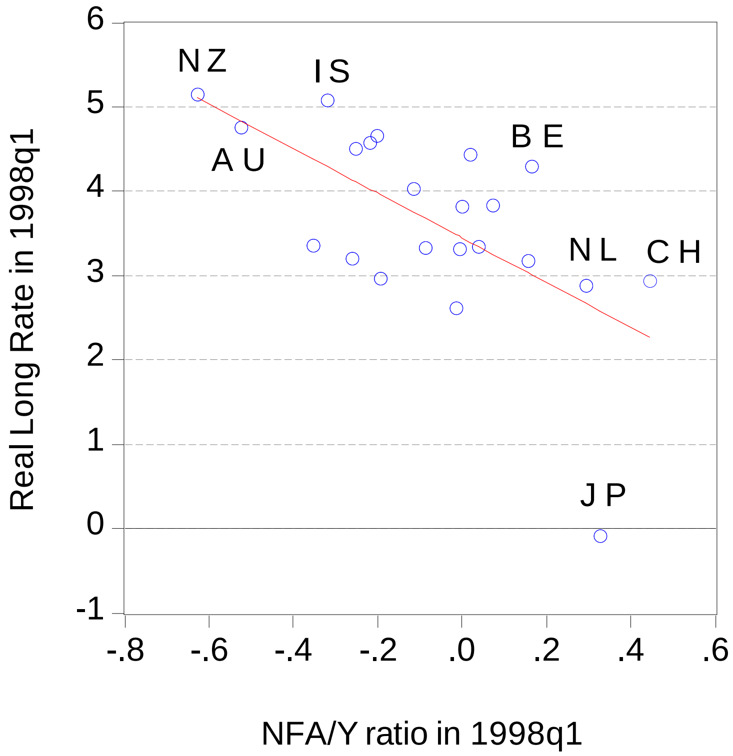


Figure 11: Decomposition of gap between NZ and world real rate

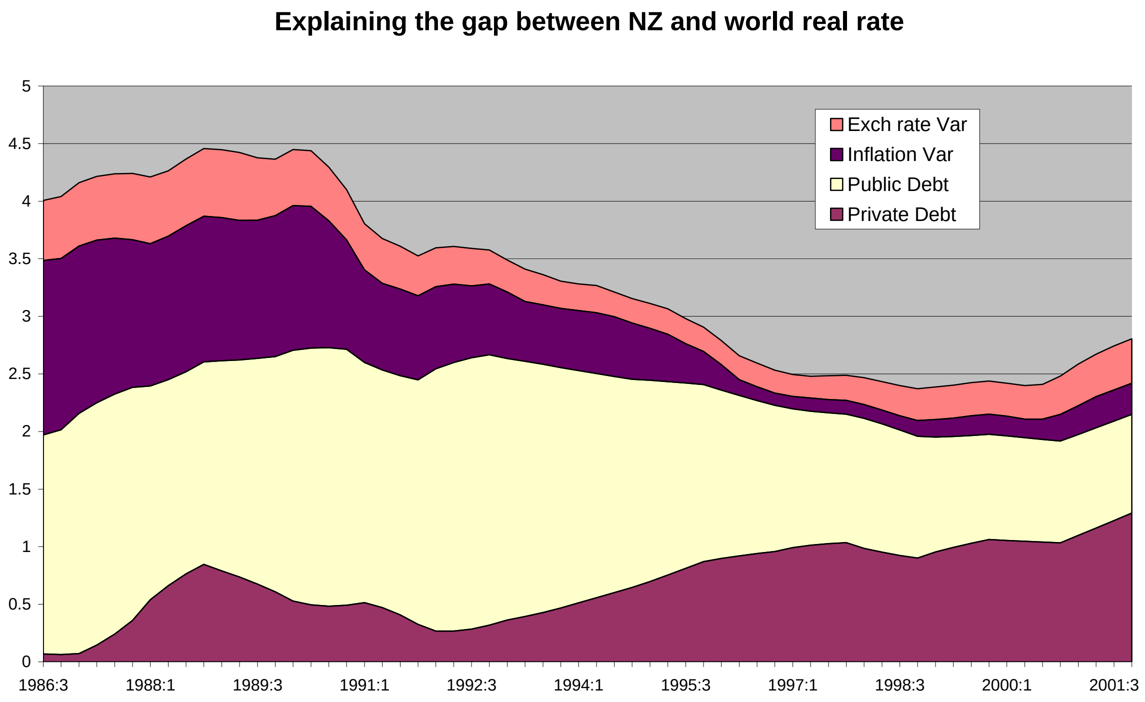
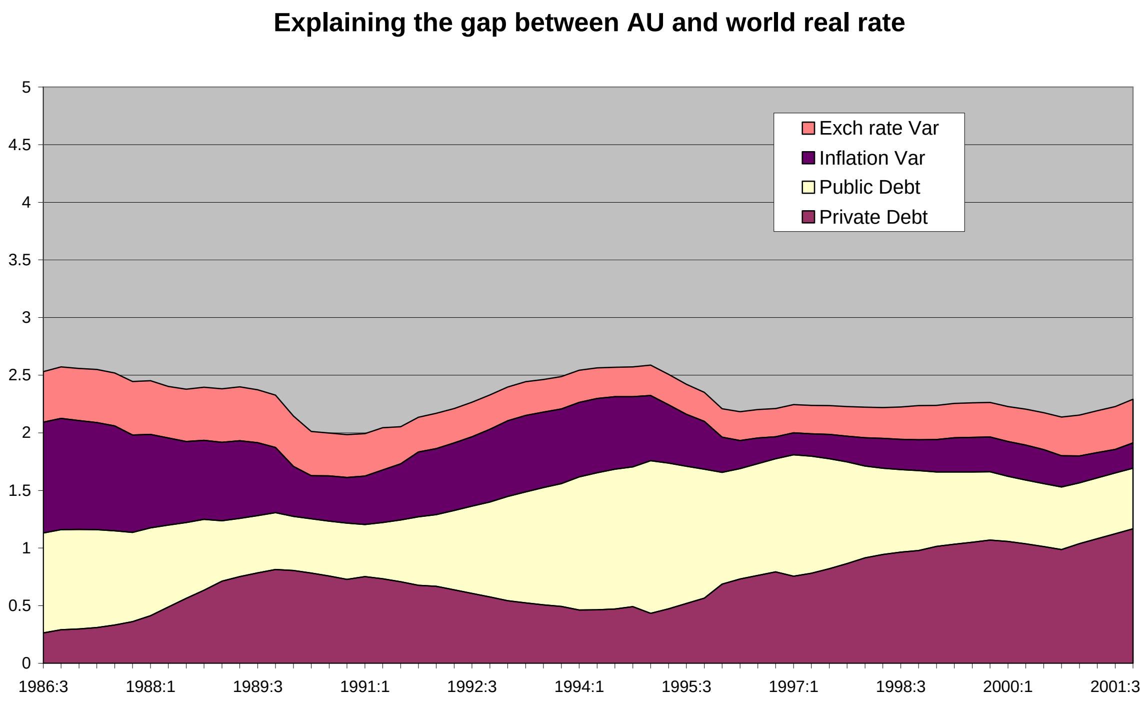


Figure 12: Decomposition of gap between AU and world real rate



Panel Regression Tables

Table 1a: Base model with constant world rate and lagged NFA

Dependent Variable	**Real long (RL)**	**Real long (RL)**	**RL – US RL**
Sample Period	1990:1 2001:4	1990:1 2001:4	1990:1 2001:4
Countries	22	22	21
Excluded	GR	GR	GR, US
	Panel 1	Panel 1	Panel 4
Constant World Rate	**2.960** **(0.085)**	**3.482** **(0.445)**	-0.329 (0.519)
NFA position of country, *lagged 12 qrts **	**-2.876** **(0.132)**	**-2.719** **(0.696)**	**-2.533** **(0.523)**
% Change in Exch Rate[18]	**0.051** **(0.004)**	**0.020** **(0.003)**	**0.033** **(0.003)**
Inflation Variability	**0.223** **(0.094)**	0.059 (0.259)	-0.086 (0.273)
Exch Rate Variability	**0.454** **(0.034)**	0.029 (0.179)	0.183 (0.203)
Common AR (1)		**0.922** **(0.012)**	**0.893** **(0.016)**
R-squared	0.602	0.920	0.856
Adjusted R-squared	0.600	0.920	0.855

Bolded numbers indicate significance at 5 per cent or better.

* NFA position of country is expressed as a percentage of GDP and equals NFA lagged 12 quarters (3 years) to extend dataset

[18] As noted by Lane and Milesi-Ferretti (2002), the change in the real exchange rate is included so as "to proxy for expected changes in the real exchange rate." Given the high correlation between nominal and real exchange rate movements, the current annual rate of change in the nominal rate is used as a proxy for the expected change, and the equation above is essentially an augmented UIP condition.

Table 1b: Base model with constant world rate and current NFA

Dependent Variable	Real long (RL)	Real long (RL)	RL – US RL
Sample Period	1990:1 1998:4	1990:1 1998:4	1990:1 1998:4
Countries	22	22	21
Excluded	GR	GR	GR, US
	Panel 1	Panel 1	Panel 4
Constant World Rate	**3.353** **(0.076)**	**3.146** **(0.435)**	**-1.397** **(0.535)**
NFA position of country, *contemporaneous* **	**-2.875** **(0.134)**	**-2.22** **(0.641)**	**-2.587** **(0.562)**
% Change in Exch Rate	**0.047** **(0.003)**	**0.023** **(0.003)**	**0.041** **(0.003)**
Inflation Variability	-0.004 (0.090)	0.304 (0.262)	0.038 (0.273)
Exch Rate Variability	**0.590** **(0.0260)**	0.366 (0.179)	**0.649** **(0.213)**
Common AR (1)		**0.890** **(0.019)**	**0.883** **(0.020)**
R-squared	0.763	0.921	0.860
Adjusted R-squared	0.761	0.920	0.860

Bolded numbers indicate significance at 5 per cent or better.

** NFA position of country is expressed as a percentage of GDP and is contemporaneous

Table 2a: Model with time-varying world rate and lagged NFA

Dependent Variable	**Real long (RL)**	**Real long (RL)**	**RL – US RL**
Sample Period	1990:1 2001:4	1990:1 2001:4	1990:1 2001:4
Countries	22	21	20
Excluded	GR	GR, JP	GR, JP, US
	Panel 1	Panel 5	Panel 5
NFA position of country, *lagged 12 qrts* *	**-2.705** **(0.461)**	**-2.715** **(0.457)**	**-2.447** **(0.427)**
% Change in Exch Rate	**0.020** **(0.003)**	**0.022** **(0.003)**	**0.032** **(0.003)**
Inflation Variability	0.004 (0.246)	-0.013 (0.251)	-0.222 (0.265)
Exch Rate Variability	0.164 (0.140)	0.173 (0.194)	0.104 (0.193)
Common AR (1)	**0.877** **(0.017)**	**0.876** **(0.018)**	**0.870** **(0.019)**
1990 Time Dummy	**4.936**	**5.129**	**2.111**
1991 Time Dummy	**4.864**	**5.046**	**1.503**
1992 Time Dummy	**4.679**	**4.794**	1.009
1993 Time Dummy	**3.918**	**4.040**	0.955
1994 Time Dummy	**4.258**	**4.349**	0.558
1995 Time Dummy	**3.920**	**4.018**	0.862
1996 Time Dummy	**3.852**	**3.946**	0.730
1997 Time Dummy	**3.806**	**3.873**	0.167
1998 Time Dummy	**3.484**	**3.505**	-0.406
1999 Time Dummy	**3.316**	**3.264**	-0.739
2000 Time Dummy	**2.973**	**2.962**	-0.203
2001 Time Dummy	**2.543**	**2.499**	-0.481
R-squared	0.929	0.932	0.871
Adjusted R-squared	0.927	0.931	0.869

Bolded numbers indicate significance at 5 per cent or better.

* NFA position of country is expressed as a percentage of GDP and equals NFA lagged 12 quarters (3 years) to extend dataset

Table 2b: Model with time-varying world rate and current NFA

Dependent Variable	Real long (RL)	Real long (RL)	RL – US RL
Sample Period	1990:1 1998:4	1990:1 1998:4	1990:1 1998:4
Countries	22	21	20
Excluded	GR	GR, JP	GR, JP, US
	Panel 1	Panel 5	Panel 5
NFA position of country, *contemporaneous* **	**-2.388 (0.635)**	**-2.201 (0.524)**	**-2.443 (0.444)**
% Change in Exch Rate	**0.020 (0.003)**	**0.022 (0.003)**	**0.039 (0.003)**
Inflation Variability	0.206 (0.253)	0.215 (0.259)	-0.039 (0.269)
Exch Rate Variability	0.289 (0.157)	0.377 (0.201)	**0.444 (0.195)**
Common AR (1)	**0.872 (0.020)**	**0.871 (0.022)**	**0.859 (0.023)**
1990 Time Dummy	**4.503**	**4.430**	0.946
1991 Time Dummy	**4.436**	**4.356**	0.417
1992 Time Dummy	**4.222**	**4.076**	-0.115
1993 Time Dummy	**3.461**	**3.323**	-0.161
1994 Time Dummy	**3.806**	**3.645**	-0.573
1995 Time Dummy	**3.525**	**3.380**	-0.224
1996 Time Dummy	**3.471**	**3.326**	-0.305
1997 Time Dummy	**3.442**	**3.279**	-0.822
1998 Time Dummy	**3.123**	**2.930**	**-1.390**
R-squared	0.930	0.932	0.873
Adjusted R-squared	0.929	0.931	0.870

Bolded numbers indicate significance at 5 per cent or better.

** NFA position of country is expressed as a percentage of GDP and is contemporaneous

Table 3a: Six country panel estimates, Conway & Orr comparison

Dependent Variable	Real long	Real long	Real long
Sample Period	1986:3 2001:4	1986:3 2001:4	1986:3 2001:4
Countries	6	6	6
	Panel 3	Panel 3	Panel 3
Constant World Rate		**2.481 (0.958)**	
Net Private Debt*	**-2.240 (0.226)**	**-2.473 (0.679)**	**-2.552 (0.605)**
Net Gov Debt	**-3.647 (0.630)**	**-4.441 (1.545)**	**-4.470 (1.427)**
% Change in Exch Rate	0.011 (0.008)	**0.020 (0.008)**	**0.015 (0.008)**
Inflation Variability	0.178 (0.165)	**0.536 (0.281)**	0.335 (0.275)
Exch Rate Variability	0.177 (0.167)	0.171 (0.335)	0.146 (0.315)
Common AR (1)		**0.819 (0.034)**	**0.788 (0.039)**
1986 Time Dummy	**3.596**		**3.919**
1987 Time Dummy	**3.820**		**3.801**
1988 Time Dummy	**3.758**		**3.386**
1989 Time Dummy	**3.871**		**3.425**
1990 Time Dummy	**4.118**		**3.726**
1991 Time Dummy	**3.588**		**3.132**
1992 Time Dummy	**4.115**		**3.554**
1993 Time Dummy	**2.795**		**2.532**
1994 Time Dummy	**4.270**		**3.362**
1995 Time Dummy	**3.595**		**2.784**
1996 Time Dummy	**3.672**		**2.982**
1997 Time Dummy	**3.093**		**2.734**
1998 Time Dummy	**2.510**		**2.598**
1999 Time Dummy	**2.786**		**2.583**
2000 Time Dummy	**2.056**		**2.074**
2001 Time Dummy	**1.446**		1.661
R-squared	0.761	0.824	0.844
Adjusted R-squared	0.747	0.821	0.835

Bolded numbers indicate significance at 5 per cent or better.

* NFA position of country is expressed as a percentage of GDP and equals NFA lagged 12 quarters (3 years) to extend dataset
Net Gov Debt is the current level of net government indebtedness as a percentage of GDP

Table 3b: Six country panel estimates, Conway & Orr comparison

Dependent Variable	Real long	Real long	Real long
Sample Period	1986:3 1998:4	1986:3 1998:4	1986:3 1998:4
Countries	6	6	6
	Panel 3	Panel 3	Panel 3
Constant World Rate		**2.610** **(1.050)**	
Net Private Debt**	**-1.885** **(0.267)**	**-2.245** **(0.736)**	**-2.253** **(0.745)**
Net Gov Debt	**-3.499** **(0.712)**	**-4.301** **(1.591)**	**-4.497** **(1.621)**
% Change in Exch Rate	0.006 (0.010)	**0.017** **(0.009)**	0.011 (0.008)
Inflation Variability	0.220 (0.188)	0.350 (0.293)	0.311 (0.297)
Exch Rate Variability	0.122 (0.190)	0.325 (0.371)	0.207 (0.365)
Common AR (1)		**0.805** **(0.040)**	**0.800** **(0.040)**
1986 Time Dummy	**3.322**		**3.822**
1987 Time Dummy	**3.801**		**3.718**
1988 Time Dummy	**3.956**		**3.296**
1989 Time Dummy	**4.067**		**3.293**
1990 Time Dummy	**4.239**		**3.577**
1991 Time Dummy	**3.562**		**2.899**
1992 Time Dummy	**4.133**		**3.301**
1993 Time Dummy	**2.768**		**2.292**
1994 Time Dummy	**4.314**		**3.139**
1995 Time Dummy	**3.637**		**2.567**
1996 Time Dummy	**3.783**		**2.787**
1997 Time Dummy	**3.237**		**2.563**
1998 Time Dummy	**2.593**		**2.438**
R-squared	0.780	0.804	0.822
Adjusted R-squared	0.767	0.800	0.810

Bolded numbers indicate significance at 5 per cent or better.

** NFA position of country is expressed as a percentage of GDP and is contemporaneous
Net Gov Debt is the current level of net government indebtedness as a percentage of GDP