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Consumption Risk-sharing within Australia and with New Zealand

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ABSTRACT

We quantify how output risks are smoothed within Australia, and between Australia and New Zealand. About 85 percent of shocks were smoothed within Australia through credit and capital markets, with fiscal policy a source of dis-smoothing after 1992. Risk-sharing between Australia and New Zealand was greater than within Europe, occurring mostly through credit markets. With fully integrated financial markets between Australia and New Zealand since 1960, the average welfare gain would be 2.7 percent of certainty-equivalent consumption over 50 years, although these gains favour New Zealand. Australia's gains are from the pooling of PPP risks. These potential gains were largely resolved by the deregulations and CER trade agreement of the early1980s.

JEL classification: E32, F33
Key Words: Risk-sharing, horizontal fiscal equalization, common currency, welfare gains from integration.

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1. Introduction

In recent years, there has been much debate on whether or not countries in a region should adopt a common currency. One criterion for assessing the suitability of forming a currency union is whether there is a sufficient risk-sharing mechanism in operation. Although adopting a common currency is expected to improve the amount of risk-sharing and hence welfare gains, identifying the channels and quantifying the amount of risk-sharing should precede any practical debates on the formation of a currency union. A monetary union is broader in scope, involving a common currency as well as integrated financial markets, uniform supervision and regulatory mechanisms etc. In this paper, we will consider the implications for risk-sharing of both currency and monetary unions.

It is widely assumed that the states and territories of a federal system such as in Australia and the United States are close to constituting an optimal currency area (see Mundell, 1961). One would expect then that this would mean a high degree of risk-sharing within such a country, and greater than across countries. However, risk-sharing across national borders seems too low to be consistent with the predictions of standard theory. A major implication of this stylised fact in international data is that market institutions do not appear to provide adequate mechanisms to pool risks faced by different individuals across national borders. In light of this, the formation of a currency union in a region might be seen as a step toward developing market institutions that ultimately diversify income risks and hence improve welfare. Launching a common currency such as the Euro can thus be viewed as a necessary precursor to complete monetary integration in the region.

In the recent international business cycle literature, it has been shown that countries sharing identical preferences and common shocks can benefit from adopting a common currency or, at a minimum, a close policy co-ordination. Backus et al. (1992) demonstrated this in a dynamic general equilibrium model of two artificial economies. Baxter and Crucini (1995) and Stockman and Tesar (1995) further showed that the high degree of risk-sharing shown in theoretical economies is robust to small changes in the utility function, different sources of shocks, and whether or not markets are complete. However, the empirical evidence on the level of risk-sharing seems to be much less than that implied by theory, which is one of the major puzzles of international macroeconomics (for example, see Obstfeld and Rogoff, 2000).

On the empirical side, there have been numerous studies that explore whether and how economic fluctuations are synchronised among a set of countries.[1] This has involved investigating the synchronisation of business cycles and identifying common shocks. However these studies were not designed to address the risk-sharing puzzle. Another important area of research, which emerged to address issues like free trade agreements (FTA), globalization, and optimal exchange rate arrangement, has explored whether markets provide sufficient risk-sharing opportunities among countries believed to be closely related. This literature tries to estimate the potential welfare gains from pooling the identified risks via capital market integration (for example, see Lee et al., 2004).

Coleman (2003) provides an insight that illustrates the importance of this strand of research. Coleman examines Queensland and New Zealand data in relation to Australian aggregate data and shows that a large proportion of shocks to Queensland and New Zealand are region-specific. This implies that a high degree of business cycle synchronization is not necessarily a prerequisite for a successful monetary union. Rather, countries suffering asymmetric shocks but a high degree of consumption risk-sharing can form a successful monetary union. As Coleman notes, a successful monetary union requires smoothing of shocks through (i) factor mobility, (ii) financial markets, or (iii) a fiscal mechanism.

We analyse how risk-sharing takes place within Australia and between Australia and New Zealand. In particular, we quantify the amount risk-sharing among individual states and territories in Australia as well as between Australia and New Zealand. Risk-sharing across countries or states can take several forms. For example, a resident in Melbourne can own an investment property in the Gold Coast while a resident in Melbourne can own shares or bonds issued by a Sydney-based firm (i.e. portfolio diversification of assets that generate income). This cross-ownership of assets is one way of pooling income risks. A well-developed and functioning capital market would help individuals across different regions share risks by diversifying their income profile. In contrast, labour mobility enables aggregate risk-sharing across different regions.

Alternatively, residents in Sydney can borrow from residents in Perth through profit-maximising financial institutions that channel the available funds to those who need them most. This requires credit markets to play a fundamental role in pooling income risks and smoothing consumption (i.e. in facilitating intertemporal trade).

In addition to these market mechanisms that pool income risks across place and time, the government's fiscal system of taxes, transfers and grants can help or hinder the smoothing of income risks. It is well understood at the aggregate level that fiscal policy through taxation can act as an automatic stabiliser in the short-term, which provides some insurance against income risks. The Commonwealth Grants Commission has aimed to achieve horizontal fiscal equalization across states by redistributing GST revenues and other Federal grants. However the design of fiscal subsidies and transfers across states may be such as to make them procyclical, so that they may add to aggregate risks.

Identifying the patterns of risk-sharing and quantifying the amount of smoothing (or dis-smoothing) achieved by each of these mechanisms in the context of Australia and New Zealand is a key objective of this paper. In particular, we seek answers to the following questions. What are the major mechanisms of risk-sharing in Australia? Do the fiscal policies of Australia's federal and state governments offset or amplify idiosyncratic shocks across states? Is the risk-sharing achieved via market mechanisms sufficient? How does the risk-sharing among various states and territories in Australia compare with that between Australia and New Zealand? We can also begin to answer the question of whether Australia and New Zealand constitute less or more of an optimal currency area than Europe and other OECD countries. To answer this, we will focus on the proportion of income risks not smoothed by credit markets, capital markets and fiscal policy. When it is low, there is minimal need for exchange rate insurance, and the case for a common currency increases. When this unsmoothed proportion is high, the insurance role of exchange rate variations becomes particularly beneficial.

However the real exchange rate risk (or PPP risk) could be significantly reduced if the countries could achieve complete financial market integration. Using an approach first developed by van Wincoop (1999) to measure the potential welfare gains from this integration, we can ask how much welfare is being foregone between Australia and New Zealand from incomplete financial market integration. Looking over 40 years since 1960, the welfare foregone appears to be quite large, particularly by New Zealand, with most of Australia's loss due to PPP risks not shared. A crucial question is what proportion of this welfare foregone was resolved after 1983, when financial markets were deregulated, the exchange rates were floated and the Closer Economic Relations (CER) trade agreement was established between the two countries. Interestingly,

[1] A recent study by Otto et al. (2001) explores a rich set of data and concludes that social and legal institutions play an important role in explaining synchronisation of business cycles.

we find that most of the welfare gains from risk-sharing between Australia and New Zealand have already been exploited by these structural changes since 1983.

This paper is organised as follows. Section 2 discusses in detail the analytical approach taken in this paper. Section 3 uses the analytical framework shown in section 2, and examines how risk-sharing takes place within Australia. Section 4 extends the analysis to gain insights about a possible Australia-New Zealand currency union. In section 4, we calculate the potential welfare gains over different time horizons from full integration of financial markets between the two countries. Section 5 summarises the main results and discusses unresolved issues to be dealt by further research.

2. Analytical Framework

In this section, we briefly outline the underlying theory and then discuss the framework that we will use to identify the channels and amount of risk-sharing. The underlying theory is the perfect insurance hypothesis. That is, in a world with full contingent markets, consumption of individuals with identical preferences must co-move across all individuals and regions, and countries.

Under complete financial markets and identical preferences with a single tradable good, this can be written as

$$c_t^i = \theta^i c_t^w \qquad (1)$$

That is, the consumption of a country/region, c^i, co-moves with world consumption c^w, where the constant θ^i is country specific and independent of state of nature.[2]

Full risk-sharing also implies the existence of consumption smoothing, as given by the Euler equation

$$u^i(c_t^i) = \delta(1+r)E_t u^i(c_{t+1}^i) \qquad (2)$$

where u is the utility function, δ is the time preference factor, and r is the riskless real rate of interest. However, even if financial markets are not complete and full risk-sharing cannot be achieved, consumption smoothing can still exist (see Baxter and Crucini, 1995).[3]

[2] One can also add idiosyncratic taste shock, whose distribution is governed fully by the state of nature.

[3] Complete risk-sharing given by equation (1) implies that state contingent assets can insure risks from uncertain future income streams, before shocks are realised. On the other hand, consumption smoothing given by equation (2) arises from the intertemporal optimisation behaviour of economic agents that trade state non-contingent assets such as bonds after a shock is observed, thus, intertemporally diversifying idiosyncratic consumption.

While full risk-sharing is typically rejected by the data, it remains important to quantify the extent of risk-sharing and identify the channels through which (the partial) risk-sharing is achieved. Asdrubali et al. (1996) proposed a method of quantifying the deviations from perfect risk-sharing represented by equation (1). Their method utilises the simple idea that risk-sharing can be written as the sum of incremental sharing via capital markets, the fiscal system and credit markets, leaving a residual unexplained (or undiversified, or unsmoothed) component. Although their method has a number of limitations, it provides a useful and debatable measure of the level and amount of risk-sharing.[4]

The method builds on the simple idea that it is possible to decompose the cross-sectional variance of a variable y, say aggregate output (e.g. GDP for a country, gross state product for a state in a federal system), yielding the following relation:

$$1 = \beta_K + \beta_F + \beta_C + \beta_U \qquad (3)$$

where β_K, β_F and β_C are the fraction of shocks to the variable y smoothed incrementally via capital markets, by the federal fiscal system and via credit markets), and β_U is the fraction not smoothed.[5]

To make this idea operational, consider the decomposition of the period-by-period, cross-sectional variance in the aggregate output per capita in region i, y^i, using the identity[6]

$$y^i = \frac{y^i}{inc^i}\frac{inc^i}{dinc^i}\frac{dinc^i}{c^i}c^i \qquad (4)$$

where i is an index of region, i = 1, …, N. Note that the time index is suppressed to emphasise the cross-sectional nature of this method.

The definitions of the variables and relations are as follows. The income variable *inc* is distinguished from the output variable y in that *inc* is y plus net factor income, analogous to the relation between GNP = GDP + net factor income. The variable *dinc* denotes disposable income and is distinguished from

[4] See discussions in Bayoumi (1999) and Melitz and Zummer (1999) for limitations of this method.

[5] This decomposition presupposes that risk-sharing is incomplete. If risk-sharing is close to being perfect, the size of the last coefficient β_U would be close to zero.

[6] Given that it is an identity composed of chains of ratios, there is no unique way of writing such an identity.

the income variable in that the difference reflects the presence of fiscal policy. The last variable c denotes consumption. Conceptually, one can write the relations as follows: *inc* = y + net factor income; *dinc* = *inc* + transfers – taxes; and *dinc* – c = savings.

Take logs and first differences of (4), and then multiply both sides of the equation by $\Delta\log y^i$, subtract the means of the term on the left and the four terms on the right and take expectations to write:

$$\begin{aligned}\mathrm{var}\{\Delta\log y\} &= \mathrm{cov}\{\Delta\log y,\ \Delta\log y - \Delta\log inc\}\\ &+ \mathrm{cov}\{\Delta\log y,\ \Delta\log inc - \Delta\log dinc\}\\ &+ \mathrm{cov}\{\Delta\log y,\ \Delta\log dinc - \Delta\log c\}\\ &+ \mathrm{cov}\{\Delta\log y,\ \Delta\log c\}\end{aligned}$$

Dividing by the variance of $\Delta\log y$, we can derive the expression (3) and write the vector of coefficients $\boldsymbol{\beta}$ in (3)

$$\boldsymbol{\beta} = \begin{bmatrix}\beta_K\\ \beta_F\\ \beta_C\\ \beta_U\end{bmatrix} = \mathrm{var}(\Delta\log y)^{-1}\begin{bmatrix}\mathrm{cov}(\Delta\log y, \Delta\log y - \Delta\log inc)\\ \mathrm{cov}(\Delta\log y, \Delta\log inc - \Delta\log dinc)\\ \mathrm{cov}(\Delta\log y, \Delta\log dinc - \Delta\log c)\\ \mathrm{cov}(\Delta\log y, \Delta\log c)\end{bmatrix} \tag{5}$$

Using a panel of data for the variables defined above, the vector of parameters, $\boldsymbol{\beta}$, can be obtained as OLS estimates from the following regressions[7]:

$$\begin{aligned}\Delta\log y_t^i - \Delta\log inc_t^i &= \alpha_{K,t} + \beta_K\Delta\log y_t^i + u_{K,t}^i\\ \Delta\log inc_t^i - \Delta\log dinc_t^i &= \alpha_{F,t} + \beta_F\Delta\log y_t^i + u_{F,t}^i\\ \Delta\log dinc_t^i - \Delta\log c_t^i &= \alpha_{C,t} + \beta_C\Delta\log y_t^i + u_{C,t}^i\\ \Delta\log c_t^i &= \alpha_{U,t} + \beta_U\Delta\log y_t^i + u_{U,t}^i\end{aligned} \tag{6}$$

where α's denote time fixed effects and the coefficients β's can then be interpreted as weighted averages of year-by-year cross-sectional regressions.[8]

Asdrubali et al. (1996) provide interpretations of the slope coefficients that conform with the idea shown in equation (3). The coefficient in the first equation, β_K, is a measure of the smoothing (or diversification) of regional shocks to per capita output resulting from cross-sectional ownership of claims to output. The coefficient in the second equation, β_F, measures the smoothing coming from the fiscal tax and transfer system. The third coefficient, β_C, is a measure of the smoothing achieved by interregional lending and borrowing. Finally, the coefficient β_U is the unsmoothed component of the risks after the smoothing achieved by the first three mechanisms.

For risk-sharing across countries (say, between Australia and New Zealand), we use the cross-country analogue of the identity (4) defined above. In the typical case of the absence of an international fiscal mechanism, it can be written as

$$GDP^i = \frac{GDP^i}{GNP^i}\frac{GNP^i}{C^i}C^i \tag{7}$$

Therefore, the set of panel data equations to be estimated is

$$\begin{aligned}\Delta\log GDP_t^i - \Delta\log GNP_t^i &= \alpha_{K,t} + \beta_K\Delta\log GDP_t^i + \varepsilon_{K,t}^i\\ \Delta\log GNP_t^i - \Delta\log C_t^i &= \alpha_{C,t} + \beta_C\Delta\log GDP_t^i + \varepsilon_{C,t}^i\\ \Delta\log C_t^i &= \alpha_{U,t} + \beta_U\Delta\log GDP_t^i + \varepsilon_{U,t}^i\end{aligned} \tag{8}$$

[7] A crucial assumption for using OLS estimator is that the regressor, $\Delta\log y$, is uncorrelated with the error terms.

[8] The slope coefficient of a typical time fixed effect regression is given by $\hat{\beta} = \sum_{t=1}^{T}\sum_{i=1}^{N}(x_t^i - \bar{x}_t)(y_t^i - \bar{y}_t) / \sum_{t=1}^{T}\sum_{i=1}^{N}(x_t^i - \bar{x}_t)^2$, where $\bar{x}_t = (1/N)\sum_{i=1}^{N} x_t^i$, the average of the regressors across N regions in period t. Note that y is a left-hand-side variable and x is the regressor, Thus, $\hat{\beta}$ is a weighted average of the period-by-period cross sectional coefficients $\hat{\beta}_t$ with weights determined by the different cross sectional variance in different periods.

where α's are time fixed effects, β's are the coefficients of interest and the variables are logarithms of gross domestic product (*GDP*), gross national product (*GNP*), and total private consumption (*C*) all in per capita magnitudes, and *i* indexes countries.[9]

By the same logic used to obtain (3), the β's are assumed to satisfy the relation

$$1 = \beta_K + \beta_C + \beta_U \qquad (9)$$

The individual coefficients β can be interpreted in an analogous manner. β_K measures the extent of smoothing (or diversification) achieved by international factor income flows and β_C measures the extent of smoothing achieved by national saving, reflecting the intertemporal aspect of consumption smoothing through lending and borrowing. β_U measures the unsmoothed component of consumption to a GDP shock. That is, we decompose the variance of shocks to GDP that are smoothed through international factor income flows (as reflected in the National Accounts as the difference between GDP and GNP), through saving (reflecting intertemporal trade), and the fraction of shocks unsmoothed. Note that, as there is no fiscal smoothing mechanism in risk-sharing between Australia and New Zealand, we exclude β_F, the fraction of shocks smoothed by the fiscal system. The unsmoothed fraction of shocks would typically include permanent shocks that cannot be smoothed via capital markets and are not diversifiable through the intertemporal reallocation of assets. The optimal response of individuals to permanent shocks would be to do little, except possibly for migration.

The systems of equations given by (6) and (8) can be estimated by a pooled OLS or SUR (Seemingly Unrelated Regression) estimator since the regressors are the same across equations. However, we allow for heterogeneity taking the form of different variances across the regions and correct for heteroskedasticity arising from the cross-sectional nature of the regression. Therefore, we estimate the entire equation set using weighted generalised least squares (GLS).[10]

[9] We ignore government consumption in our analysis.

[10] While we did not consider potential issues arising from autocorrelation, the DW statistics under the null of first order autocorrelation indicated no evidence of autocorrelation.

3. Risk Sharing in Australia

This section examines the patterns of risk-sharing among various states and territories in Australia and quantifies the extent to which income risks are smoothed via market and fiscal mechanisms. Some preliminary data analysis is useful at this point.

Figure 1 shows the shares of Australia's GDP by states and territories. It reveals the relative importance of each state and territory in total output produced in Australia. Figure 2 shows how real consumption per capita has grown across states and territories of Australia for the period 1983-2003. In 2003, ACT showed the highest level of consumption per capita (exceeding $26,000) in Australia, followed by NSW and Victoria. Consumption growth was also much higher in ACT, NSW and Victoria among all regions. In contrast, the Northern Territory and Tasmania showed the lowest level of per capita consumption (barely exceeding $20,000) and growth, with little difference between the two.

We also report in Table 1 per capita output and consumption correlations across the states and territories of Australia for the period 1983 – 2003. Our choice of the sample period was guided by two issues. First, since 1983 a sequence of economic reform measures have been implemented in Australia including financial deregulation and labour market reforms. Second, in this period one can obtain chain volume measures of price deflators at the state level.

As shown in Figure 1, the two states, NSW and Victoria accounted for almost 60 percent of Australia's total output. The per capita output and consumption correlations within Australia show some interesting features. First, the consumption correlation was higher than the output correlation for most pairs, and in particular on average between the three largest states, NSW, VIC and Queensland. Hess and Shin (1998) examined intranational business cycle in the US and found evidence that a 'quantity anomaly' existed in intranational data.[11] Contrary to their results, we find that the quantity anomaly was largely absent in intranational data for Australia. The average pair-wise correlation of output was 0.417 while the average consumption correlation was 0.513. Only

[11] This term was coined by Backus et al. (1992) and refers to the fact that in theory consumption correlation is much higher than output correlation while the opposite is found in international data.

for the ACT was the average bilateral output correlation with other states less than the average consumption correlation. Between NSW and Victoria, output and consumption correlations were 0.614 and 0.875, respectively, implying that a significant consumption risk-sharing has taken place between the two states. ACT's output was more highly correlated with output in NSW and Victoria with values around 0.56-0.60 while its consumption correlation with each of these states was significantly lower at 0.389 and 0.211, respectively. Output in South Australia was most highly correlated with Victoria at 0.71. Two further features emerge from Table 1. First, there was a border effect in the correlation of output. Regions with high output correlations tended to be characterised by geographic proximity. Second, regions well connected via communication, transportation and financial institutions, such as between NSW and Victoria, in which the two major Australian cities are located, tended to show high correlations. It is also worth noting that consumption among NSW, Victoria and Queensland were all highly correlated with each other in the range of 0.80-0.875. In contrast to other states and territories, Queensland had significantly higher consumption correlations with other states and territories relative to output correlations, except for ACT. The lower output correlation indicates that Queensland was subject to different kinds of income shocks, (for example, Queensland would be more subject to tourism shocks) but that through labour mobility, cross-ownership of assets, and possibly the fiscal mechanism, residents in Queensland had more incentives to smooth out their consumption profile relative to residents elsewhere.

To implement the system of equations (6), we need measures for gross state product, state income, state disposable income and state consumption. This requires constructing data using the various sub-components of output—factor income, transfers, taxes etc at the state level. However, gross state income data available in Australia does not reflect interstate income flows, unlike the US data used by Asdrubali et al. (1996).[12] Moreover, Asdrubali et al. did not distinguish between the citizens of a state and the government of the state. In their study, it cannot be identified whether it is the individuals or the government sectors that engage in the risk-sharing. In contrast, the focus of our study is consumption risk-sharing by the citizens across states and territories in the face of fluctuations in output produced in each region.

[12] The gross state income data available from the ABS rather measures how residents in a state conduct transactions with the rest of the world. The data only reflects disaggregated GNP, divided into 8 states and territories.

The data used to estimate the equations in (6) is obtained from the ABS catalogues 5220.0. The series are gross state product, gross household income, disposable household income and final household consumption expenditure, all at the state level. All series are annual for the period 1983/84 – 2002/03, and chained volume measures in per capita terms.[13]

Table 2 reports the estimates of consumption and income smoothing among six states and two territories of Australia. For 1983/84-2002/03 at an annual frequency, approximately 85 percent of shocks to gross state product were smoothed and only 15 percent of shocks remain unsmoothed. Capital markets played the most important role in risk-sharing within Australia, smoothing 53 percent shocks to gross state product. An additional 32 percent of output shocks were absorbed by credit markets. Surprisingly, the tax-transfer mechanism appeared to dis-smooth 5 percent of shocks to gross state output.[14] Our interpretation of this result is as follows. Despite (or because of) the fiscal equalization mechanism[15] in Australia that aims to equalize fiscal capacities across states, fiscal mechanisms have exacerbated cross-sectional risk. The growth of taxes net of subsidies to households has been negatively correlated with the growth of state product. Due to the complexity of the tax and subsidy system, it is not easy to determine the main cause of this negative correlation, but we can conclude that the fiscal design is sub-optimal from the point of view of risk smoothing across states.

We also split the sample into two sub-periods: 1983/84 – 1991/92 and 1992/93 – 2002/03. The most noticeable change in the estimates is that credit market smoothing became as important as capital market smoothing since 1992/93. This could be a positive result of the financial market deregulations that began in the mid 1980s. Credit markets absorbed almost 48 percent of shocks to state output in the later period, but only 15 percent of shocks in the earlier one. This implies that intertemporal smoothing via credit markets became a more important channel to smooth output shocks since 1992. The role of fiscal policy in dis-smoothing worsened after 1992 (from an insignificant

[13] Data before 1989/90 is only available from print sources.

[14] Note that unlike Asdrubali et al. (1996), our data includes all forms of taxes, subsidies and transfers at both state and federal levels.

[15] The Commonwealth Grants Commission, set up in 1933, distributes grants to states according to a fiscal formula. Most of the revenue comes now from the GST. The goal of the redistribution is horizontal fiscal equalization so that "State governments should receive funding from the Commonwealth such that if each made the same effort to raise revenue from its own sources and operated at the same level of efficiency, each would have the capacity to provide services at the same standard".

-2.57 to a significant -6.71 percent). It is possible that GST revenues going to state governments after 2000 have contributed to the worsening. The total fraction of output risks remaining unsmoothed was smaller (by about 5 percentage points) after 1992/93.

For the United States, Asdrubali et al. (1996) found that 63 percent of shocks to per capita gross product of individual states were smoothed through transactions on markets, 13 percent by the federal tax-transfer and grant system, and 25 percent remained unsmoothed. In the US, the capital market was found to be most important as a market mechanism for sharing risks. Although the data used for Australia differ in definition and emphasis to some extent from that used by Adrubali et al. (1996) for the US, one should be cautious in making comparisons.

4. Risk Sharing between Australia and New Zealand

Recently, the possibility of a monetary union between Australia and New Zealand has received growing media attention with the leaders of the two countries expressing interest in developing even closer economic relations, which could potentially lead to a realization of a monetary union. There are a number of studies that have sought to answer whether Australia and New Zealand would be better off forming a currency union.

Grimes (2000) presented a case for forming a single currency across the Tasman Sea, which he dubbed an "ANZAC" dollar.[16] Crosby and Otto (2002) and Hall et al. (1998) examined the extent of business cycle synchronisation between the two countries (and also with the US). Their evidence indicates that the two economies were not synchronised enough to warrant a transition to a currency union. This section takes an alternative approach to examining this issue in the framework of risk-sharing. Using the same analytical framework used to quantify the patterns of risk-sharing within Australia, we evaluate whether the amount of risk-sharing taking place between the two countries was comparable to that taking place within Australia and within Europe. As the economic size of New Zealand is about one seventh of Australia, it would be the fifth largest state, pushing South Australia to the sixth position in Australia under a common currency.

There are similar studies for the European monetary integration in recent years. Sørensen and Yosha (1998) examined the EU countries for the period 1966-90 and found that only 40 percent of the shocks to GDP were smoothed and factor income flows did not smooth income across countries. The bulk of income and consumption smoothing among the EU and OECD countries was achieved through the intertemporal channel, via credit markets. Their finding implies that capital income smoothing across countries, reflected in factor income flows, was negligible, and suggest that further integration of capital markets should be a high priority in the process of monetary unification. Melitz and Zummer (1999) also examined the extent of risk-sharing in Europe and found similar results. The common conclusion from this research is that financial integration is far from complete with about 60 percent of the total income risks remaining unsmoothed.

The data we use are taken from the *ABS National Accounts* for Australia and *International Financial Statistics* for New Zealand. All data are annual, real and in per capita terms. While Sørensen and Yosha (1998) also used annual data to examine risk-sharing among the European countries, Kim et al (2005) used the data taken from the Penn World Tables to examine risk-sharing in East Asia. Our dataset is consistent with that used by Sørensen and Yosha in source and definition. However, we have also considered how using a dataset that adjusts for purchasing power parities, such as the PWT data, leads to different results.[17] In the next section, where we estimate the potential gains from complete

[16] Crosby and Otto (2002) proposed an alternative name for a single currency, 'Kemu', Kiwi plus Emu.

[17] We show that when the data used are in local currency units, the role of factor income transfers is negligible at less than 1% in all cases with large standard errors. Moreover, about 50% of the shocks still remain unsmoothed between Australia and New Zealand. On the other hand, when we use data adjusted for purchasing power parities, we get a significant estimate of capital market smoothing of more than 10% of the shocks, though the smoothing achieved by credit markets is lowered substantially to about 10%. Moreover, the percentage of shocks that still remains unsmoothed rises to approximately 80%.

We interpret this difference as follows. Since the PWT dataset accounts for the volatility of exchange rates and relative prices, it reduces the proportional need for smoothing through the capital and credit market channels. Thus β_u increases in size. The difference in the amount of risk-sharing due to the use of this alternative dataset potentially highlights one source by which risk-sharing can be improved. That is, eliminating risks due to real exchange rate uncertainty among member countries could lead to an improvement in risk-sharing by as much as 30% of total income shocks.

consumption risk-sharing between Australia and New Zealand, we do need to use the PWT data.

Table 3 reports estimation results for the slope coefficients. More than 60 percent of income shocks remained unsmoothed for the whole sample period, 1960-2002. This amount of unsmoothed risks at the annual frequency was comparable to that among European Community (EC) countries considered by Sørensen and Yosha (1998), who found that 60 percent of shocks remained unsmoothed during the period 1966-1990. For a better comparison with the results of Sørensen and Yosha and to examine if there is any change in the historical pattern, we consider two sub-samples: 1960-1980 and 1981-2002. The amount of risks left unsmoothed was about 75 percent in the first sub-sample, but only 52% in the second.

Also, the degree of risk-sharing across the Tasman Sea was significantly larger than risk-sharing found among East Asian countries and the ASEAN group. Kim et al. (2005) found that only 20 percent of shocks were smoothed in East Asia. It is to noteworthy that risk-sharing between the two countries has improved to a noticeable degree during the later period, 1981-2002, a result consistent with what we shall obtain in the next section. However the amount of risk-sharing is still far less than that achieved within a country with a federal system such as the US and Australia.

Consistent with the studies for European and East Asian countries, capital markets played at best a small role in smoothing shocks. For the entire sample period, about 6 percent of shocks were smoothed via capital markets, and the role of capital markets in smoothing output shocks did improve in the later period. Factor income transfers across national borders seem to have played only a minor role in smoothing income risks.

The bulk of income risk smoothing between Australia and New Zealand was achieved via credit markets. Intertemporal trades in the region smoothed about one third of total income risks. During 1981-2002, an even larger fraction of output shocks was smoothed by credit markets (about 36 percent). Given the integration of the banking system across the countries, this result is not surprising. That credit markets were most important in smoothing income risks is consistent with the results obtained in the previous studies mentioned above.

Given that previous studies (for example, Crosby and Otto, 2002) find that Australia's business cycles are more synchronised with the US business cycles rather than with New Zealand business cycles, we also consider risk-sharing between Australia and the US. Our results from estimation of the system of equations (8) indicate that the amount of income risks unsmoothed at the annual frequency over 1960-2002 is much higher between Australia and the US (about 74%) than between Australia and New Zealand (61%).[18] One interesting result is that capital market smoothing with the US was quite negligible prior to 1980 but became quite important (at 18%) during 1981-2002. This is at stark contrast with our results for Australia and New Zealand as well as previous studies on Europe and East Asia, all of which do not find such a sizable estimate of capital market smoothing across countries. In terms of the total fraction of income shocks left unsmoothed, the degree of risk-sharing between Australia and the US was even less than Europe.

While the degree of business cycle synchronisation between Australia and the US seems to have been larger than that between Australia and New Zealand, our estimates show that the risk-sharing between Australia and New Zealand was far greater than that between Australia and the US. Contrary to the findings from previous studies that examined the extent of business cycle synchronisation and concluded that there is no strong case for a currency union between Australia and New Zealand, our results show that in terms of the risk-sharing criterion, Australia and New Zealand are more suited to forming a currency union than even among the members of the Euro zone.

5. Potential Welfare Gains from Risk-sharing between Australia and New Zealand

Although Asdrubali et al.'s procedure allows joint identification of risk-sharing through credit, private insurance (via capital markets), and public transfers as smoothing mechanisms, it cannot answer the following question: what are the potential welfare gains from perfect risk-sharing over time achieved by complete financial market integration? In this section, we now turn to this question under the assumption that country-specific income shocks are perfectly diversified and consumption streams are smoothed out across countries. We quantify the amount of potential welfare gains due to perfect smoothing of income risks achieved through financial market integration at different time horizons.[19]

We follow van Wincoop (1999) and compute the potential welfare gain when Australia and New Zealand perfectly pool their income risks with each

[18] The US data were also taken from the *International Financial Statistics*. Our estimation results for Australia- US risk-sharing are not reported in detail but are available upon request.

[19] That is, we ignore the income smoothing across regions/countries via credit markets and government transfers.

other. van Wincoop provides a technique for computing the potential welfare gains from risk-sharing across countries in a region when there is full integration of financial markets. The results obtained are quite consistent with those using a technique developed in the presence of growth uncertainty by Athanasoulis and van Wincoop (2000). While their technique requires estimating a growth regression with a set of informational variables, our computation can be implemented if we assume the endowment process is a random walk with drift.[20]

The theoretical framework outlined in this section follows van Wincoop (1994, 1999). We assume that there are 2 countries with identical preferences, complete financial markets, and residents in each country i maximize the following utility function

$$U_i = E\int_0^T e^{-\beta t}\frac{c_{it}^{1-\gamma}}{1-\gamma}dt \qquad (10)$$

where T is the time horizon, γ is the risk aversion parameter and c_i is aggregate consumption per capita. The per capita endowment y_i follows a random walk with drift

$$dy_{it} = \mu_i y_{it}dt + \sigma_i y_{it}d\eta_i \qquad (11)$$

where η is a standard Brownian motion and $\rho = d\eta_i\eta_k$ $(i \neq k)$ is the correlation between innovations of endowment growth rates of the two countries.

Under autarky, domestic consumption is equal to the domestic endowment and expected utility can be written as

$$U_i = \frac{1-e^{-\nu T}}{\nu}\frac{c_{i0}^{1-\gamma}}{1-\gamma} \qquad (12)$$

where $\nu = \beta + (\gamma-1)(\mu_i - 0.5\gamma\sigma_i^2)$.

Under complete financial markets, country-specific risks are maximally diversified and consumption in each country is proportional to the global endowment (with real variables from both countries adjusted for PPP variations)

$$c_i = \alpha_i y^w = \alpha_i \sum_{j=1}^{2} y_j \qquad (13)$$

[20] Standard unit-root tests cannot reject that GDP and consumption are both $I(1)$ processes with a drift component.

where α_i is the ith country's share of the global endowment. With complete financial markets and the endowment processes in (11), consumption growth in either country follows approximately a random walk with variance

$$\sigma_W^2 = \alpha_1^2\sigma_1^2 + \alpha_2^2\sigma_2^2 + 2\alpha_1\alpha_2\rho\sigma_1\sigma_2 \qquad (14)$$

As a benchmark, consider the symmetric case studied by van Wincoop (1999) and Kim et al (2005), where $\sigma_1=\sigma_2=\sigma$ and $\alpha_1=\alpha_2=0.5$. In this case, consumption growth risk for each country becomes

$$\sigma_W^2 = \frac{\sigma^2}{2}(1+\rho)$$

and so when $\rho=1$, there are no risk-sharing gains from financial integration for either country, and when $\rho=-1$, there is complete diversification with no risk. However, in the more realistic case where $\sigma_1>\sigma_2$, the country with the lower consumption growth risk may incur a risk-sharing loss when $\rho<1$ i.e. $\sigma^2_W>\sigma^2_2$, and even when $\rho=-1$.[21] If $\alpha_1\neq\alpha_2$, consumption growth risk remains after financial integration even when $\rho=-1$. Our calculations are based on the more realistic specification given by (14).

The welfare gain/loss to the ith country from complete financial integration can be measured by changes in certainty-equivalent consumption per year, which van Wincoop (1999) shows as

$$Gain_i \approx -\frac{0.5\gamma d\sigma_i^2}{r_i - \bar{\mu}_i}\left[1 - T(r_i-\bar{\mu}_i)\frac{e^{-T(r_i-\bar{\mu}_i)}}{1-e^{-T(r_i-\bar{\mu}_i)}}\right] \qquad (15)$$

where $\bar{\mu}_i = \mu_i - 0.5\gamma\sigma_i^2$ is the risk-adjusted growth rate and $d\sigma_i^2 = \sigma_W^2 - \sigma_i^2$ is the change in the variance of consumption growth rate when moving from autarky to the complete markets economy. The horizon, T, matters for the calculation of the gains because the stochastic process for consumption in (11) is assumed to be a random walk with drift.

Estimating potential welfare gains from complete risk-sharing requires the following parameter values: the risk-free interest rate, the rate of relative risk aversion, and the standard deviation of country endowment growth, and the correlation between endowment growth rates. Consistent with van Wincoop's (1999) calculation, we use consumption rather than output data to measure the endowments. This implies that risk-sharing already occurs to a certain extent,

[21] For a more general case where $a_1 \neq a_2$ and $\sigma_1>\sigma_2$, the country with a lower variance may incur a risk-sharing loss if $(\alpha_1\sigma_1 + \alpha_2\sigma_2)^2 < 2\alpha_1\alpha_2\sigma_1\sigma_2(1-\rho) + \sigma_2^2$.

rather than moving from financial autarky to complete risk-sharing. Hence, what we measure is the welfare gains that arise when countries move from the current state to complete markets.

While the consumption used in the theory is tradable consumption, we use total private consumption as it is hard to accurately separate tradable and non-tradable consumption. Further, for an analysis of the real consumption risk shared across countries, we need PPP-adjusted measures of real consumption for each country. Using annual data from the Penn World Tables for the period 1960–2002, the average rate of growth of PPP-adjusted consumption per capita is 5.9 percent in Australia and 5.4 percent in New Zealand. This is considerably higher than the average real consumption growth rates per capita in local currency (2.0 and 1.5 percent respectively), which reflects the gains from PPP improvements. The standard deviations of the PPP-adjusted growth rates are 2.9 and 4.2 percent respectively, again much higher than the local currency counterparts (1.5 and 3.7). The correlation between the two countries' consumption growth rates was 0.15. The risk-free interest rate we use is the average computed from CPI based inflation rates and long-term bond rates from 1960-2000. For Australia, it is 3.1 percent annually, and for New Zealand it is 1.5 percent. The risk aversion parameter used by van Wincoop (1999) was 3 and so we used this value. The average shares of regional consumption over the forty years were close to 50 percent with the PPP-adjusted data.

Table 4 reports implied potential welfare gains from complete risk-sharing over a horizon of 10 to 50 years. The gains are quite significant on average, but much more so for New Zealand. Using PPP-adjusted data, the gain in permanent consumption to New Zealand after 10 years is 0.8 percent, rising to 4.9 percent after 50 years. The welfare gains to Australia from complete integration of financial markets with New Zealand are one tenth those of New Zealand, measured as a 0.1 percent increase in permanent consumption over 10 years, but rising to 0.5 percent after 50 years.

A significant proportion of the gains we detect appear to come from the sharing of PPP risks. This becomes apparent when the welfare analysis is repeated using real consumption per capita data from the OECD's Main Economic Indicators. With this data, real exchange rate risk is ignored, and so the measured welfare gains must come from sources other than the pooling of PPP risk. Table 4(b) reports these gains, which are much smaller than the results we obtained with PPP-adjusted consumption, and indeed negative in the case of Australia. From the average welfare effects, it would appear to be zero-sum game. This suggests that the Australian benefits from complete financial market integration with New Zealand would arise largely from the pooling of PPP risks.

Finally we compared the measured welfare gains during the fixed exchange rate period from 1960 to 1983, and the flexible exchange rate period from 1984 to 2000. This latter period was associated with considerable financial market deregulation and the introduction of the CER trade agreement, which led to a 500% expansion of two-way trade in goods and services between the countries, as well as substantial increases in two-way investments. These structural changes would be expected to have yielded considerable welfare gains. Table 4(c) reports the gains for the two periods. The results suggest that most of the gains we identified over the whole sample arose from the more regulated fixed exchange rate period. For both countries, only minor potential welfare gains of 0.5 percent on average remain unexploited.

6. Conclusion and Further Research

This paper examined how risk-sharing has taken place within Australia and between Australia and New Zealand. Using the framework developed under the hypothesis of perfect insurance, we decomposed the cross sectional variance of output into components smoothed by market mechanisms, the fiscal mechanism and unsmoothed components. Our key findings are as follows.

First, the share of income risks smoothed within Australia is quite consistent with results for the US, in the sense that almost 85 percent of shocks are smoothed. Since 1992, credit and capital markets have contributed equally to risk-sharing in Australia , while capital markets play a more important role in the US. We find that fiscal mechanism has been counterproductive to risk-sharing in Australia, particularly since 1993. This suggests that the Commonwealth's fiscal equalization mechanism across states needs to be reconsidered in the context of its implications for inter-state risks.

Second, we find that, unlike previous studies that explored business cycle synchronisation as the criteria for assessing the suitability of a currency union between Australia and New Zealand, our results show that Australia and New Zealand would constitute more of an optimum currency area than even the EU countries when the degree of risk-sharing is used as the main criterion.

Third, we find that should financial markets become fully integrated between Australia and New Zealand, the welfare gains appear to be asymmetric with New Zealand standing to gain much more than Australia. Most of the gains to Australia seem to arise from the pooling of PPP risks. However most of

these potential gains appear to have been successfully resolved after the floating of the exchange rates, the deregulation of financial markets and the CER trade agreement in the early 1980s.

Our assessment of the current state of intranational and international risk-sharing is as follows. First, there remains uninsurable idiosyncratic country/region specific risk in non-traded sectors, and in wage and labour markets. Second, the integration of capital markets is still incomplete even among developed countries. An alternative interpretation is that home bias remains a robust feature even when financial markets are fully developed and transactions costs are negligible. Third fiscal mechanisms in Australia need to be redesigned to correct their risk-worsening features. Our framework can be extended to a deeper investigation of the horizontal fiscal equalisation between states. Currently, the Commonwealth Grants Commission's pursuit of cross subsidisation in the allocation of GST revenues across states and territories is a major political and economic issue that has received intense political and media scrutiny. While Harding et al. (2002) examined this issue using micro-level simulations, a macro approach is needed to explore how risk-sharing and welfare gains could be improved. Fourth, our results indicate that there is scope for creating new market mechanisms for sharing income and consumption risks. In this regard, policymakers could give serious consideration to Robert Shiller's (1993) proposal for establishing a new class of markets that trade claims on aggregate income and service flows.

Further research may include extending the analytical framework used in this paper to incorporate the openness in physical and financial trades, as well as labour mobility both interstate and across countries (immigration). An exciting area to pursue would be to consider the effects of risk-sharing across generations, i.e. intergenerational risk-sharing, to examine the effects of social security and institutions (see Shiller, 1999).

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Figure 1: Share of GDP by States and Territories, 1983/84 – 2002/03

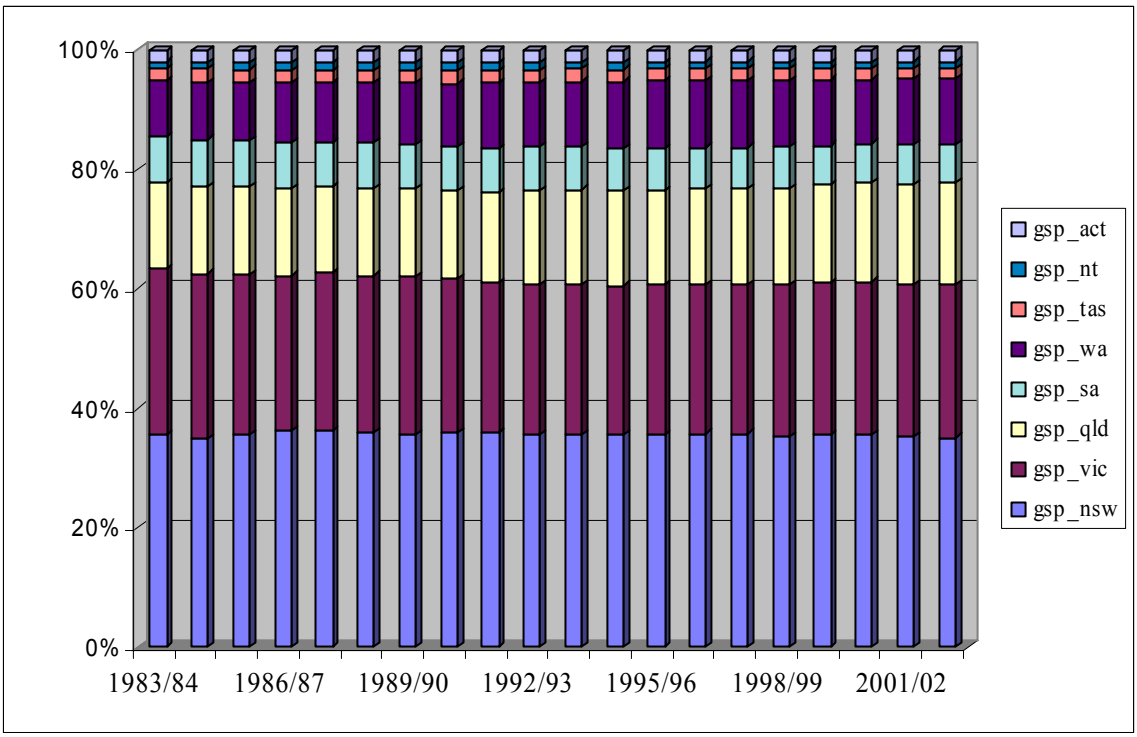

Figure 2: Growth of per capita Consumption across Australia, 1983/84 – 2002/03

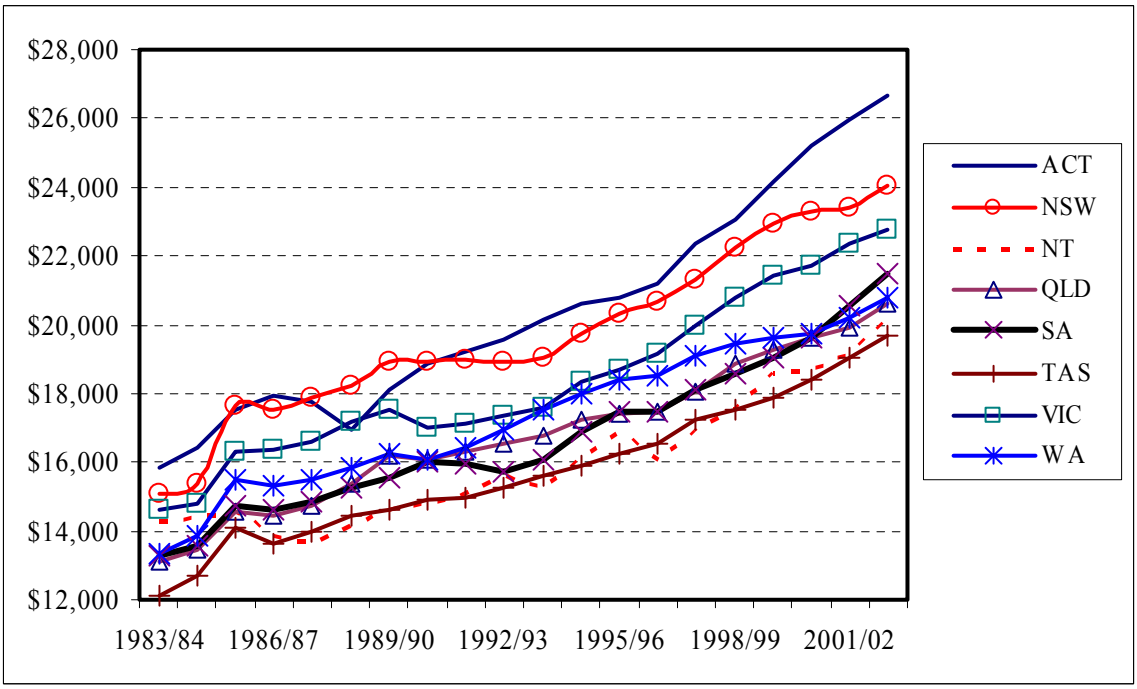

Table 1: Output and Consumption Correlations Across States and Territories in Australia, 1983/84 – 2002/03

Output							
	ACT	NSW	VIC	QLD	SA	WA	TAS
NSW	0.561	1.000					
VIC	0.599	0.614	1.000				
QLD	0.455	0.498	0.557	1.000			
SA	0.605	0.514	0.706	0.329	1.000		
WA	0.404	0.313	0.420	0.319	0.480	1.000	
TAS	0.566	0.422	0.514	0.494	0.625	0.697	1.000
NT	0.450	0.432	0.149	0.190	0.279	-0.107	0.372
Pair-wise Average: 0.417							
Consumption							
	ACT	NSW	VIC	QLD	SA	WA	TAS
NSW	0.389	1.000					
VIC	0.211	0.875	1.000				
QLD	0.256	0.841	0.800	1.000			
SA	0.296	0.727	0.631	0.605	1.000		
WA	0.309	0.826	0.792	0.792	0.613	1.000	
TAS	0.243	0.767	0.675	0.701	0.748	0.847	1.000
NT	0.094	0.207	0.268	0.402	0.420	0.213	0.243
Pair-wise Average: 0.513							

N.B. The statistics are computed using the growth rates of per capita variables.

Table 2: Household income and consumption smoothing within Australia (%)

	1983/84 – 2002/03	1983/84 – 1991/92	1992/93 – 2002/03
Capital markets (β_K)	52.96* (6.60)	59.12* (11.31)	48.30* (7.97)
Fiscal system (β_G)	-4.93* (1.65)	-2.57 (2.76)	-6.71* (1.97)
Credit market (β_C)	32.44* (9.97)	14.82 (14.25)	47.79* (13.21)
Not smoothed (β_U)	14.53* (6.10)	16.61* (7.62)	11.35 (9.47)

Note: The numbers in parentheses are White's heteroskedasticity consistent standard errors. The point estimates with an asterisk are statistically significant at the level of 5% or less.

Table 3: Income and consumption smoothing between Australia and New Zealand (%)

	1960- 2002	1960-1980	1981-2002
Factor income flows (β_K)	5.99* (0.75)	4.14 (2.62)	8.91* (1.11)
National borrowing-lending (β_C)	30.70* (3.29)	25.49* (9.21)	35.68* (6.82)
Not smoothed (β_U)	61.26* (5.98)	74.38* (12.50)	51.67* (2.87)

Note: The numbers in parentheses are White's heteroskedasticity consistent standard errors. The point estimates with an asterisk are statistically significant at the level of 5% or less.

Table 4: Potential Gains from Risk Sharing between Australia and New Zealand

(a) Using PPP-adjusted consumption (PWT; 1960-2000)

Parameters	r	μ	σ	γ	σ_w	ρ	*Shares: α,1–α*
Australia	3.1%	5.9%	2.9%	3	2.7%	0.15	50.5%
New Zealand	1.5%	5.4%	4.2%	3			49.5%

Welfare Gains	T=10	T=20	T=30	T=40	T=50
Australia	0.1%	0.2%	0.3%	0.4%	0.5%
New Zealand	0.8%	1.7%	2.7%	3.7%	4.9%
Average	*0.4%*	*0.9%*	*1.5%*	*2.1%*	*2.7%*

Note: In the PWT6.1 table for Australia, real consumption growth per capita jumps inexplicably to 24% in 1989, which distorts the results. We substituted the average growth of 5.9% for this year.

(b) Using real consumption (MEI; 1960-2000)

Parameters	r	μ	σ	γ	σ_w	ρ	*Shares: α,1–α*
Australia	3.1%	2.0%	1.5%	3	2.9%	0.15	53%
New Zealand	1.5%	1.5%	3.7%	3			47%

Welfare Gains	T=10	T=20	T=30	T=40	T=50
Australia	-0.4%	-0.8%	-1.2%	-1.6%	-2.0%
New Zealand	0.4%	0.9%	1.3%	1.7%	2.1%
Average	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.1%*

(c) Fixed versus Flexible Exchange Rate Periods (PWT; 1960-1983 and 1984-2000)

Fixed

Welfare Gains	T=10	T=20	T=30	T=40	T=50
Australia	0.1%	0.2%	0.4%	0.5%	0.7%
New Zealand	1.3%	2.8%	4.6%	6.5%	8.6%
Average	*0.7%*	*1.5%*	*2.5%*	*3.5%*	*4.7%*

Flexible

Welfare Gains	T=10	T=20	T=30	T=40	T=50
Australia	0.0%	0.1%	0.1%	0.2%	0.2%
New Zealand	0.2%	0.3%	0.5%	0.6%	0.7%
Average	*0.1%*	*0.2%*	*0.3%*	*0.4%*	*0.5%*