Regional and Industry Cycles in Australasia: Implications for a Common Currency

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Abstract

If two countries experience similar cycles, loss in monetary sovereignty following currency union may not be severe. Analysis of cyclical similarity is frequently carried out at the overall industry level, then interpreted with reference to regional industrial structures. By contrast, this paper *explicitly* incorporates regional industry structure into an examination of Australasian cycles. Since 1991, NZ and Australasian cycles have been highly correlated, but there is little evidence that the NZ cycle has been "caused" by Australian regional or industry cycles. We test whether the NZDAUD exchange rate has insulated NZ from Australian shocks, but find it has not played a major buffering role in response to Australian industry shocks (including mining shocks). Instead, the strongest impacts on the NZDAUD stem from the NZ cycle. An important loss of monetary sovereignty under currency union may therefore arise in response to NZ-specific shocks.

JEL Classifications: E32, E52, F36, R11

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1 Introduction

This paper addresses issues that are central to consideration of potential currency union between Australia and New Zealand. The two countries (together termed 'Australasia') currently have separate freely floating exchange rates. They have substantial trade with each other and so there are microeconomic (transactions cost) advantages of their forming a currency union (Grimes et al, 2000).[1] The price signalling mechanism could be enhanced if prices and wages were set in a single currency. In addition, a currency union may deliver capital market advantages arising from greater trading depth of the common currency.

A common currency would, however, mean some loss in monetary sovereignty for the two countries since exchange rate adjustment would be spread over a single currency rather than across two currencies. In most circumstances, the smaller country (New Zealand) would have more to lose in terms of monetary sovereignty since the common currency would most likely react to region-wide developments that would be dominated by the much larger country (Australia). If the two countries experience similar shocks and have similar economic cycles, the loss in monetary sovereignty may not be severe; common exchange rate adjustment could then be as suitable for the smaller country as for the larger country. If, however, the sources of shocks and the resulting cycles are quite different, the loss in monetary sovereignty may have major consequences for the small country. Traditional currency union analysis (Mundell, 1961) suggests that

[1] Australia is New Zealand's largest trading partner while New Zealand is one of Australia's top five trading partners. They have a comprehensive free trade agreement, free labour flows and are harmonizing other aspects of economic regulation (Coleman, 1999; Grimes et al, 2000; Lloyd, 2002; Goddard, 2002).

this is especially the case in the absence of fiscal transfers between countries within the currency union, as is the situation in Australasia.[2]

Analysis of cyclical similarity across regions is frequently carried out at the overall industry level.[3] Regional cyclical differences are then often interpreted, outside of the formal analysis, with reference to industrial structure differences across regions. The main contribution of this paper is to examine regional cyclical issues explicitly incorporating the regional industry structure into the analysis. Examination of shock transmission at this level gives considerably greater insights into the sources of regional shocks. In turn, this examination assists analysis of the costs that are likely to be involved with the loss of an independent currency. Grimes (2004) has examined similarities in trend employment across industries within Australasia, where Australasia is divided into nine regions: New Zealand plus Australia's six states and two territories. On most measures, New Zealand lies between the five large states and Tasmania in terms of structural similarities with other regions; the two territories are outliers. This trend information helps to interpret the cyclical results contained in this paper.

Our methods build on some of those used by Kouparitsas (2001, 2002) who analyses regional business cycle characteristics across US regions, albeit at the overall industry level. He uses both correlation analysis and structural vector autoregression (SVAR) techniques. His correlation approach examines: (a) contemporaneous correlation of business cycles across regions; and (b) 1-period

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[2] For a contrary view, see Kempf and Cooper (2004), who argue that a currency union is welfare-improving no matter what the correlation of shocks even without inter-regional fiscal transfers, provided individual country fiscal policy can be used for stabilization purposes.

[3] For Australasian examples, see Dixon and Shepherd (2001), Hall et al (1998), Hargreaves and McDermott (1999), Grimes et al (2000), Haug (2001), Bjorksten (2001), Bjorksten et al (2004).

lead/lag correlations of business cycles across regions. If the lead/lag correlations exceed the corresponding contemporaneous correlations, there is *prima facie* evidence of cycle spillovers from one region to another. Kouparitsas interprets the transmission of regional cycles with reference to regional industry characteristics, but he does not use these characteristics to derive the cycles.[4]

Beine and Coulombe (2003), who examine whether individual Canadian provinces should share a common currency with the United States, is another analysis performed at the overall industry level.[5] Nevertheless, it has some features on which we base aspects of our analysis. They choose not to use structural VAR methods, noting that while these methods have strengths, they rely for their interpretation on identification assumptions that are to some extent arbitrary. Instead, the main methodological approach adopted by Beine and Coulombe is to examine the size and significance of quarterly GDP gap correlations between Canadian provinces and the US. They also use quarterly employment data to compare cyclical positions of Canadian provinces and certain US states.

Beine and Coulombe note that the correlation approach does not allow them to distinguish between different types of disturbances. Further, by virtue of their application to Canadian provinces relative to the US, domestic common shocks within Canada (stemming, for instance, from movements in the Canadian

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[4] See also Owyang and Wall (2004) for analysis of US regional responses to monetary policy. Their analysis is also performed at the overall industry level, with ex post reference to industrial structure differences.

[5] We share Beine and Coulombe's aim of comparing cycles in a country that may join a currency union with those in a larger one. We differ in that we treat the small country as one region and the large country as a number of regions that already share a currency union; their analysis treats the large entity as one region and divides the smaller one into a number of regions.

dollar) will tend to be reflected in "high" domestic correlations relative to correlations of the provinces with the US. This could cloud interpretation of the results. Their approach relies on being able to differentiate trend from cycle. They adopt three different measures for doing so: a Hodrick and Prescott (1997) filter with λ=1600 (standard for quarterly data), an HP filter with λ=315, and the Baxter and King (1999) band-pass filter. Their results are robust to use of all three methods.

Our intention is to incorporate information on industrial sectors across regions into the formal analysis of cycle transmission. A brief description of our data, across regions and across industries, is presented in section 2. Section 3 examines the transmission of shocks across regions and across industries using bivariate correlation and Granger-causality approaches. Section 4 extends the analysis to test the impact of regional industry cycles on the New Zealand - Australia cross exchange rate (NZDAUD). Section 5 interprets the results in light of a potential common currency for Australasia.

2 Data

Australia comprises six states and two territories while New Zealand is a unitary state. We refer to each of the states, territories and New Zealand as "regions" of Australasia, denoted as:

ACT	Australian Capital Territory
NSW	New South Wales
NT	Northern Territory
NZ	New Zealand
QLD	Queensland
SA	South Australia
TAS	Tasmania
VIC	Victoria
WA	Western Australia
AUS	Australia (sum of the eight Australian regions)
ANZ	Australasia (sum of all nine regions; i.e. AUS plus NZ)

Table 1: Regional Characteristics*

	ACT	NSW	NT	NZ	QLD	SA	TAS	VIC	WA
2003 (June Year)									
Nominal GDP per capita (A$)	47738	40127	45871	29490	33782	32294	27100	39058	42269
Population (million)	0.317	6.628	0.198	3.942	3.747	1.514	0.472	4.926	1.950
1990-2003 (growth, % p.a.)									
Real GDP	2.57	3.05	2.53	2.85	4.36	1.97	1.46	2.93	3.78
Population	0.98	1.03	1.53	1.21	2.09	0.46	0.23	0.96	1.55
2002									
Industrial Structure Index+	5.44	1.01	4.34	1.53	0.98	1.00	1.93	0.86	1.12

*Data sources: Australian Bureau of Statistics & Statistics New Zealand. In the June 2003 year, 1 Australian$ (A$1) = US$0.59

+The Industrial Structure Index measures the average absolute % deviation of region i's industry shares relative to ANZ; source: Grimes (2004).

Table 1 presents basic data on each region. Consistent with Bjorksten et al (2004) and with Beine and Coulombe (2003), we use quarterly employment data as the basis for calculating the cyclical positions across each region.[6] These data are available on a disaggregated basis for each of nine industries (together comprising overall employment) in each region. We calculate trend employment and employment shares for each industry in each region and derive the cyclical position for each industry in each region.

In Table 1, the 'Industrial Structure Index' provides a measure of the similarity of the industrial structure in a region relative to ANZ; a figure of 0.00 indicates perfect alignment of sectoral shares, a figure of 1.00 indicates an average absolute deviation of sectoral shares of 1 percentage point, etc. From this measure, the two territories are clear structural outliers relative to ANZ.

The industry decomposition used in this study is:

AFF	Agriculture, Forestry, Fishing
BFS	Business and Financial Services
CON	Construction
EGW	Electricity, Gas, Water
MAN	Manufacturing
MIN	Mining
OTS	Other Services[7]
TSC	Transport, Storage and Communications
WRT	Wholesale and Retail Trade[8]
TOT	Total (sum of all nine industries)

To separate trend from cyclical employment, we filter each regional industry employment series using an HP filter (with λ=1600). The "employment gap" or cycle series for each regional industry is calculated as seasonally adjusted

[6] Australian and New Zealand employment data are obtained from Australian Bureau of Statistics and Statistics New Zealand respectively. The data are described in more detail in Grimes (2004).
[7] I.e. Community/Social/Personal Services; many of which are provided or funded by government.
[8] Including Accommodation, Cafes, Restaurants

employment as a ratio of trend employment. The mean of the employment gap for each series is almost exactly unity.[9]

We denote employment gap series as $G_{i,j}$ where the prefix, G, represents the employment gap (i.e. the cycle), i is the region identifier, and j indicates the industry; for instance, $G_{TAS,AFF}$ is Tasmania's employment gap in the agriculture sector. For each region, the overall employment gap, $G_{i,TOT}$, is derived from the sum of trend employment and the sum of actual employment across the nine industries. For each industry, the Australasian employment gap, $G_{ANZ,j}$, is derived from the sum of actual employment and the sum of trend employment across the nine regions.

Aggregate employment gaps for each region other than NT[10] are shown in Figure 1. The NZ employment gap is highlighted; the remaining lines represent the other eight regions. We present the information in this manner since the primary question driving our analysis is whether NZ is an appropriate candidate to join a currency union to which the other regions already belong. As regions become larger, they tend to become more diversified and so cycles have smaller amplitude. The ANZ employment gap has a standard deviation of 1.2%. Apart from VIC, all the larger regions' cycles (including NZ) have standard deviations of 1.4%-1.5%; TAS and ACT are at 1.7%-1.8%, and NT is at 4.0%. VIC is unusual in having a cycle amplitude (1.9%) akin to that of TAS and ACT.

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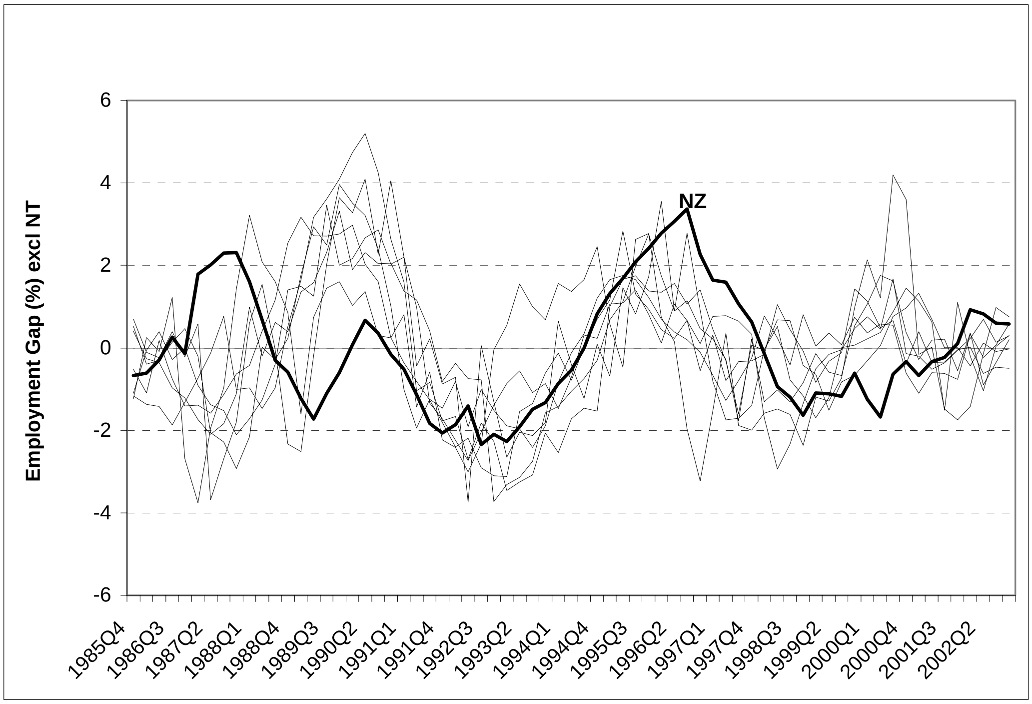
[9] We also computed a Baxter-King (BK) band-pass filtered gap (assuming a cycle length of between 1.5 and 8 years) and compared it to the HP filtered gap on the overall Australasian series. The correlation coefficient between the two cycle measures is 0.990. Given these almost identical measures, we restrict ourselves solely to consideration of the HP filtered series.

[10] NT is omitted since the amplitude of its cycle is much larger than for the other regions. For clarity, the employment gaps are presented as $(G_{i,j} -1)*100$ rather than $G_{i,j}$.

Figure 1: Regional Employment Gaps (%) excl NT: Total Industry*



*Employment gaps expressed as ($G_{i,TOT}$ -1)*100

While the NZ cycle's standard deviation is similar to those of NSW, QLD, SA and WA, its pattern over 1985-1991 differs from that in any other region.[11] This period coincided with the major microeconomic and macroeconomic reforms undertaken within New Zealand beginning in 1984 and culminating in 1991 (Evans et al, 1996). The reforms initially had a positive economic impact as the financial sector was deregulated. However, negative balance sheet effects following the October 1987 sharemarket fall, and the effects of fiscal tightening and a labour-market "shake-out" after privatization and commercialization of government enterprises, led to a sharp fall in employment in the late-1980s. After 1991, the NZ employment gap mirrors that of most other regions, other than a greater fall following the Asian financial crisis, coinciding with a major drought in NZ (Buckle et al, 2003). For these reasons, where our

[11] Bjorksten et al (2004) noted strong similarities between the NZ and Australian regional cycles across their sample, but that sample only started in 1992.

descriptive statistics apply to NZ, we report results both for the full sample, 1985(4)-2002(4), and for a shortened sample, 1991(4)-2002(4).

Prior to examining the correlation and transmission of cycles, we examine the mean absolute gap and standard deviation of the gap between the cycle positions of each region and ANZ. Table 2 presents this information for both the full sample period and the 1991(4)-2002(4) sub-sample. Over the full sample, these measures indicate a core of five regions (NSW, VIC, QLD, SA, WA) with TAS moderately close to the aggregate cycle and NZ further distant. ACT and NT are outliers. After 1991, NZ and TAS move to the fringes of the core, having similar gaps between their respective cycles and that of ANZ as does SA; ACT and NT remain outliers.

Table 2: Cyclical Differences Between Region & ANZ*

	Mean Absolute Deviation (%)	**Standard Deviation (%)**		**Mean Absolute Deviation (%)**	**Standard Deviation (%)**
	1985(4) - 2002(4)			**1991(4) - 2002(4)**	
ACT	1.5	1.8		1.6	1.9
NSW	0.5	0.6		0.4	0.6
NT	3.0	3.9		2.9	3.8
NZ	1.1	1.4		0.8	0.9
QLD	0.7	0.8		0.6	0.7
SA	0.7	0.9		0.7	0.9
TAS	0.9	1.2		0.8	1.0
VIC	0.7	0.9		0.5	0.6
WA	0.7	0.8		0.6	0.8

*Mean absolute deviation for region i calculated as the mean of $|G_{i, TOT} - G_{ANZ,TOT}|$.
Standard deviation for each region calculated as standard deviation of $(G_{i,TOT} - G_{ANZ,TOT})$.

The cyclical measures indicate that NSW and VIC can be considered the core regions of Australasia in cyclical terms, and on most measures so can QLD, SA and WA. NZ and TAS are closely related to the core for the post-1991 period. ACT and NT cannot be considered as core regions in cyclical terms.

3 Correlation & Transmission of Regional & Industry Cycles

In examining the transmission of cycles across regions and across industries, we initially follow Kouparitsas's (2002) approach examining contemporaneous and lead/lag correlations between regional employment gaps at the overall industry level ($G_{i,TOT}$). Table 3 presents contemporaneous correlation coefficients for the full sample [1985(4)-2002(4)].

Table 3: Contemporaneous Correlation; 1985(4)-2002(4)

	$G_{i,TOT,\,t}$ (Region i Employment Gap, Total All Industries, Time t)									
$G_{i,TOT,\,t}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT	1.00	0.32	-0.46	0.05	0.20	0.35	0.31	0.15	0.34	0.28
NSW	0.32	1.00	0.21	0.25	0.69	0.69	0.68	0.77	0.72	0.90
NT	-0.46	0.21	1.00	0.01	0.40	0.20	0.01	0.31	0.17	0.29
NZ	0.05	0.25	0.01	1.00	0.09	0.22	0.24	0.32	0.20	0.44
QLD	0.20	0.69	0.40	0.09	1.00	0.67	0.61	0.74	0.78	0.81
SA	0.35	0.69	0.20	0.22	0.67	1.00	0.50	0.69	0.66	0.78
TAS	0.31	0.68	0.01	0.24	0.61	0.50	1.00	0.65	0.47	0.71
VIC	0.15	0.77	0.31	0.32	0.74	0.69	0.65	1.00	0.74	0.92
WA	0.34	0.72	0.17	0.20	0.78	0.66	0.47	0.74	1.00	0.82
ANZ	0.28	0.90	0.29	0.44	0.81	0.78	0.71	0.92	0.82	1.00

Table 4: Lead/Lag Correlation; 1985(4)-2002(4)

	$G_{i,TOT,\,t+1}$ (Region i Employment Gap, Total All Industries, Time t+1)									
$G_{i,TOT,\,t}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT	0.66	**0.38**	**-0.34**	**0.06**	**0.27**	**0.38**	**0.42**	**0.20**	**0.42**	**0.34**
NSW	0.20	0.83	**0.23**	0.22	0.62	0.65	**0.72**	0.74	0.56	0.80
NT	**-0.41**	0.09	0.59	**0.04**	0.30	0.18	**0.06**	**0.35**	0.10	0.24
NZ	-0.03	**0.26**	-0.04	0.92	0.03	0.15	0.21	0.30	0.19	0.41
QLD	0.17	0.68	**0.43**	**0.18**	0.85	**0.73**	**0.62**	**0.82**	0.67	**0.82**
SA	0.24	0.69	**0.28**	**0.25**	0.60	0.83	**0.60**	0.69	0.56	0.75
TAS	0.12	0.54	**0.03**	**0.26**	0.40	**0.51**	0.61	0.56	0.31	0.57
VIC	0.10	0.73	0.23	0.32	0.59	0.64	**0.66**	0.90	0.59	0.83
WA	0.32	**0.83**	**0.23**	0.20	**0.82**	**0.71**	**0.59**	**0.85**	0.87	**0.90**
ANZ	0.18	0.84	0.26	0.43	0.69	0.73	**0.74**	0.90	0.67	0.93

Bold indicates lead/lag correlation exceeds corresponding contemporaneous correlation

Two features stand out from Table 3. First is the generally "low" correlation coefficients compared with Kouparitsas's findings for 8 regions in the US. Only 5 of the 36 regional correlations within Australasia exceed 0.70 (R^2=0.49) and none exceeds 0.78 (R^2=0.61). The median regional correlation in the US is 0.77 with a mean of 0.75 (Kouparitsas, 2002). In Australasia, the median is 0.33 with a mean of 0.39. The Australasian correlations are, however, similar to those in Canada where the median is 0.37 and the mean is 0.33 (Beine and Coulombe, 2003). Australasia and Canada each comprise diverse regions that may have an agricultural base (e.g. Manitoba, Tasmania) or a minerals base (Alberta, Western Australia) or are primarily financial and industrial (Ontario, NSW).

Second, each of the Australian states (i.e. each region apart from NZ and the two territories) is reasonably highly correlated with ANZ as a whole; TAS is lowest at 0.71. The small size and idiosyncratic industrial structures of the two territories make their low correlation with ANZ expected. The low correlation of NZ with ANZ indicates the possibility of different cyclical forces at work in NZ relative to the Australian regions. Table 5, which presents the correlations just for 1991(4)-2002(4), indicates that the low correlations for NZ are due to idiosyncratic outcomes during its reform period through to 1991. Its contemporaneous correlation coefficient with each of the Australian regions over the post-1991 period ranges from 0.52 to 0.68; its correlation with ANZ is 0.80, the same as QLD and WA and above each of SA, TAS and the two territories. In the latter part of the sample, NZ was therefore as integrated with the ANZ cycle as most Australian regions.

Table 4 presents the full-sample correlations relating the employment gap in period t with that in period t+1. Table 6 provides the same information for the shortened period. The figures on the leading diagonal provide a measure of the degree of persistence in each region's cycle.[12] More interesting for the inter-regional transmission of shocks are the magnitudes of each non-diagonal cell. Each figure is compared with the corresponding figure in Table 3 (or 5). Where the figure exceeds the relevant figure in Table 3 (or 5), the implication is that the cycle of the region listed vertically leads the cycle of the region listed horizontally. For instance, the full sample contemporaneous correlation of ACT and TAS is 0.31 whereas the correlation of ACT in time t with TAS in time t+1 is 0.42. The implication is that ACT's cycle leads that of TAS. In Table 4 (and 6), we note in bold any figure that exceeds its corresponding entry in Table 3 (and 5).

[12] The figure is the square root of the R^2 in an equation regressing a region's employment gap on its own lag plus a constant (note that it is not the coefficient on the lag).

Table 5: Contemporaneous Correlation; 1991(4)-2002(4)

	$\mathbf{G_{i,TOT,\,t}}$ (Region i Employment Gap, Total All Industries, Time t)									
$\mathbf{G_{i,TOT,\,t}}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT	1.00	0.22	-0.49	0.07	0.23	0.47	0.25	0.07	0.29	0.23
NSW	0.22	1.00	0.19	0.61	0.71	0.59	0.65	0.78	0.67	0.92
NT	-0.49	0.19	1.00	0.21	0.22	-0.04	-0.12	0.18	0.02	0.20
NZ	0.07	0.61	0.21	1.00	0.52	0.66	0.54	0.68	0.55	0.80
QLD	0.23	0.71	0.22	0.52	1.00	0.51	0.56	0.66	0.76	0.80
SA	0.47	0.59	-0.04	0.66	0.51	1.00	0.36	0.50	0.56	0.69
TAS	0.25	0.65	-0.12	0.54	0.56	0.36	1.00	0.71	0.57	0.72
VIC	0.07	0.78	0.18	0.68	0.66	0.50	0.71	1.00	0.71	0.90
WA	0.29	0.67	0.02	0.55	0.76	0.56	0.57	0.71	1.00	0.80
ANZ	0.23	0.92	0.20	0.80	0.80	0.69	0.72	0.90	0.80	1.00

Table 6: Lead/Lag Correlation; 1991(4)-2002(4)

	$\mathbf{G_{i,TOT,\,t+1}}$ (Region i Employment Gap, Total All Industries, Time t+1)									
$\mathbf{G_{i,TOT,\,t}}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT	0.71	**0.28**	**-0.41**	**0.18**	0.18	0.38	**0.39**	**0.19**	**0.36**	**0.29**
NSW	0.13	0.80	0.14	**0.62**	0.55	0.50	**0.69**	0.78	0.48	0.82
NT	-0.49	0.07	0.63	0.11	0.22	**-0.03**	**0.00**	0.17	0.02	0.13
NZ	-0.12	0.55	**0.22**	0.95	0.46	0.55	0.51	**0.70**	0.48	0.75
QLD	**0.25**	**0.73**	**0.30**	**0.56**	0.82	0.51	0.55	**0.77**	0.71	**0.83**
SA	0.41	**0.61**	-0.05	**0.70**	0.45	0.81	**0.52**	**0.56**	0.56	**0.71**
TAS	0.12	0.56	**-0.11**	**0.58**	0.37	**0.37**	0.50	0.70	0.39	0.63
VIC	-0.06	0.67	0.18	0.66	0.50	0.40	0.60	0.87	0.56	0.78
WA	0.27	**0.80**	**0.05**	**0.58**	0.75	0.53	**0.61**	**0.82**	0.81	**0.86**
ANZ	0.09	0.82	0.19	0.80	0.66	0.59	0.71	**0.91**	0.65	0.93

Bold indicates lead/lag correlation exceeds corresponding contemporaneous correlation.

Three regions stand out as leading the cycle of other regions. For each sample, ACT, QLD and WA each lead at least 5 of the other 8 regions, and each also leads ANZ. For the full period, NT leads the cycle of 4 other regions. A common feature shared by WA, QLD and NT is that they are all heavily involved in mining compared with other regions. Over the full sample, each of WA and NT had an average mining share of 3.7% (WA's share stayed at around this level throughout the sample, while NT's dropped sharply from 5.8% to 1.5%); QLD had the next largest mining share, averaging 1.4%. In terms of numbers employed in mining, each of the three regions averaged between 20,000 and 30,000 mining employees over the sample (as did NSW, although this is largely due to its overall size; its mining share was lower than the ANZ average). The next largest mining region averaged fewer than 6,000 employees. This evidence indicates a *prima facie* case for investigating the importance of mining shocks in determining the cycles of these particular regions and thence influencing other regions.

The key distinguishing feature of ACT is that it contains Australia's capital city (Canberra) and little else. Its average employment share involved in OTS (largely government-related services) was 50% compared with 26% for ANZ. The leading nature of ACT relative to other regions may represent a fiscal shock that registers first in ACT and then spreads outwards to other regions.

Table 7: Granger Causality Tests (1 lag) H_0: $G_{i,TOT}$ does not Granger-cause $G_{k,TOT}$

	$G_{k,TOT}$									
$G_{i,TOT}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT		*		**			**		**	*
NSW							***			*
NT				*						
NZ							**	**		
QLD		**	**	*		***	***	***		***
SA		**	*	**			***			
TAS					**					***
VIC		**					***			
WA		***			***	***	***	***		***
ANZ		***				**	***	***		

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4) except NZ tests (both directions) are 1991(4)-2002(4)

Table 8: Granger Causality Tests (2 lags) H_0: $G_{i,TOT}$ does not Granger-cause $G_{k,TOT}$

	$G_{k,TOT}$									
$G_{i,TOT}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
ACT				*			**	**		*
NSW							***		*	
NT		*								
NZ							*	*		
QLD		*	*			***	***	***		
SA		*	**	*	**		***	**		
TAS			**			***				*
VIC							***		***	
WA	**	***			***	***	***	***		***
ANZ		***			*	**	***	***	**	

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4) except NZ tests (both directions) are 1991(4)-2002(4)

We test leads and lags in aggregate cycles more formally with Granger causality tests. Each region's aggregate employment gap can be characterized either as an AR(1) process [6 regions] or as an AR(2) process [3 regions plus ANZ]. We therefore report (in Tables 7 and 8) Granger causality tests using one and two lags respectively. All tests are run over the full sample, except in cases involving NZ where the tests are run over the "post-reform" period starting in 1991(4).[13]

The aggregate cycles in each of WST and QLD again show out as major precursors of cycles in other regions and for ANZ.[14] ACT Granger-causes ANZ in each case, consistent with the prior results. Perhaps surprisingly, TAS also Granger-causes ANZ in each case, possibly reflecting the influence of a more generalized agriculture shock (TAS is second only to NZ in its agriculture share throughout the period). The two largest regions, NSW and VIC, have very little in the way of lead or lag relationships with other regions.

The regional results lead to some hypotheses regarding the effects of sectoral shocks on regional and ANZ cyclical outcomes. In particular, we hypothesize that shocks to MIN, OTS and possibly AFF cause regional and ANZ-wide cycles. We can test whether this is the case using Granger causality tests for the impact of Australasian industry cycles on each of the regional cycles. Tables 9 and 10 present the test results, using one and two lags respectively.[15]

[13] When the NZ tests are run over the full sample, the only significant test result with one lag is QLD causing NZ (at 5%); the only significant result with two lags is VIC causing NZ (at 10%). In no case does NZ cause any other region or ANZ.
[14] The exception in the latter case is that QLD does not Granger-cause ANZ with two lags.
[15] The tests for NZ are again run over 1991(4)-2002(4); other samples begin in 1985(4).

Table 9: Granger Causality Tests (1 lag) H_0: $G_{ANZ,j}$ does not Granger-cause $G_{k,TOT}$

	$G_{k,TOT}$									
$G_{ANZ,j}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
AFF		*								*
BFS			*				*		*	
CON	*	***		**		***	***	***		***
EGW				***						
MAN		***		*	*	**	***	***		***
MIN										
OTS					**			**	**	***
TSC	**						**			
WRT							***			

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4) except NZ tests are 1991(4)-2002(4)

Table 10: Granger Causality Tests (2 lags) H_0: $G_{ANZ,j}$ does not Granger-cause $G_{k,TOT}$

	$G_{k,TOT}$									
$G_{ANZ,j}$	**ACT**	**NSW**	**NT**	**NZ**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**ANZ**
AFF		*	**							
BFS								*	**	
CON	*	***			*	***	***	***		***
EGW				*						
MAN	***	***			*	**	**	**		**
MIN										
OTS					**					**
TSC				**	**		*			
WRT		**				***	***			

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4) except NZ tests are 1991(4)-2002(4)

Two sectors are shown to Granger-cause most regions. CON and MAN each Granger-cause six of the nine regions, plus ANZ, under both lag structures. The only other sector to Granger-cause ANZ under both lag structures is OTS (possibly reflecting a fiscal shock). MIN does not Granger-cause any region or ANZ under either lag structure. We return to this paradoxical result below.

We gain more insight into the role of certain industries in causing regional cycles using Granger causality tests between industries. Tables 11 and 12 present the industry analogues of Tables 7 and 8. Three industries - CON, MAN and OTS - are found to Granger-cause the total economy at the 5% level (with both 1 and 2 lags). CON and MAN each lead several sectors. OTS is not found to lead any specific sector; its effect is discernable in the aggregate only, consistent with the effects of a pervasive fiscal shock. The primary industries - AFF and MIN - are notable for their lack of influence on other sectors.

Table 11: Granger Causality Tests (1 lag) H_0: $G_{ANZ,j}$ does not Granger-cause $G_{ANZ,k}$

	$G_{ANZ,k}$									
$G_{ANZ,j}$	**AFF**	**BFS**	**CON**	**EGW**	**MAN**	**MIN**	**OTS**	**TSC**	**WRT**	**TOT**
AFF										*
BFS							*			
CON		***			**	***		***	***	***
EGW										
MAN		***				**		***	***	***
MIN		***	*	*						
OTS										***
TSC	*	**	*		*	**				
WRT		***						*		
TOT		***				**	***	**		

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4)

Table 12: Granger Causality Tests (2 lags) H_0: $G_{ANZ,j}$ does not Granger-cause $G_{ANZ,k}$

	$G_{ANZ,k}$									
$G_{ANZ,j}$	**AFF**	**BFS**	**CON**	**EGW**	**MAN**	**MIN**	**OTS**	**TSC**	**WRT**	**TOT**
AFF										
BFS					*			**		
CON		***			**	***		***	**	***
EGW										
MAN		***	*			*		***	**	**
MIN										
OTS										**
TSC		**								
WRT	*	***						**		
TOT	*	***	***		**	*		***	**	

*** significant at 1%; ** significant at 5%; * significant at 10%; all tests over 1985(4)-2002(4)

Overall, the regional and industry results appear to be at odds with one another. The regions that are most heavily represented in mining have strong causal impacts on other regions, while mining itself has little causal influence according to the formal statistics. There are two possible resolutions of this paradox. The first is that the link between mining intensity and the leading regions is purely coincidental; some other feature associated with those regions may be at play.

The second is that mining is a major source of the regional shock but the Granger causality tests do not pick up this influence.[16] Mining cycles are driven predominantly by two factors: world prices of minerals and new discoveries of mineral deposits. Neither of these are likely to be caused in an economic sense (as opposed to a temporal, or Granger causality, sense) by other sectoral cycles within Australasia. Yet both Tables 11 and 12 show MIN to be Granger-caused by CON (at the 1% level in each case) and by MAN (at 5% and 10% with 1 lag and 2 lags respectively). An explanation is that a mining expansion must be preceded by considerable construction work prior to the mine opening (or expanding). Thus we would observe MIN being led in a temporal sense by CON (and possibly also by manufacturing via manufacturing sub-sectors that service the mining industry). However, in an economic sense, it is the mining shock that causes CON (and MAN). If this explanation holds, and if mining shocks are large enough to influence the aggregate economy, we would observe CON in mining states leading both MIN in those states and leading the aggregate ANZ cycle. We would also observe future MIN (in period t+s) "leading" the aggregate cycle (in period t)

[16] We have also used the contemporaneous and lead/lag correlation approach to examine the influence of industry cycles on other industries and regions, with similar results to the Granger causality test results.

reflecting the "s" quarters that it takes to gear up mining employment following the shock to the industry.

We examine Granger causality tests (with 2 lags) between CON in each region and ANZ total industry cycles; the results are consistent with this explanation. Construction in each of WA and QLD lead the ANZ cycle (at the 1% level); only one other region (VIC) has its regional construction cycle leading the ANZ cycle (also at 1%; no other regions are significant at 10%).

We test for Granger-causality from $G_{ANZ,MIN,\ t+s}$ to $G_{ANZ,TOT,\ t}$ for each of s = -4, …, 0, …, +4, and find a pattern consistent with this explanation. In each case (retaining 2 lags in the test) where s = 0, …, -4, the combined coefficient on $G_{ANZ,MIN}$ in the Granger-causality test is negative. Where s = +1, … +4, the combined coefficient is positive; in three of these cases the coefficients are jointly significant at the 5% level and in the other case, at the 10% level (longer lags are not significantly different from zero).

While we cannot be conclusive that mining is a significant source of shocks in Australasia, the tests are consistent with this hypothesis. Shocks to government-related services (OTS) also appear important in generating cycles in the aggregate Australasian economy. Manufacturing shocks and shocks to construction (to the extent that these shocks are independent of shocks to other sectors) may also play a role.

4 Cyclical Interactions with the Exchange Rate

Since 1991, the New Zealand economic cycle has generally been as closely correlated with the cycle in the larger Australian regions as those regions are with each other. However the causality tests in Tables 7 and 8 imply that the NZ cycle has not been driven particularly strongly by the cycles of the Australian regions. No Australian region Granger-causes the NZ cycle at the 5% level when two lags are used in the test, and only ACT and SA do so when one lag is used. By contrast, six (seven) regions Granger-cause TAS at the 5% level with two lags (one lag).

One possible reason for NZ's relative insulation from the cycles of Australian regions is that the floating NZDAUD[17] may have acted to buffer NZ from the effect of Australian-sourced shocks. Here we test this possibility, again through the use of Granger-causality tests. Specifically, we test whether each of the regional industry cycles ($G_{i,j}$) Granger-causes NZDAUD. In addition, we test whether the aggregate cycle in each region ($G_{i,TOT}$) Granger-causes NZDAUD, whether the Australian industry cycle ($G_{AUS,j}$) Granger-causes NZDAUD, and whether the Australian overall cycle ($G_{AUS,TOT}$) Granger-causes NZDAUD. We use the Australian cycle in these latter cases in place of the ANZ cycle since we are dealing with the cross exchange rate between the two countries.

[17] I.e. the New Zealand - Australia cross rate, measured as the number of Australian dollars per NZ dollar. Thus an increase in the NZDAUD signifies an appreciation of the NZD.

Thus we have 100 tests (nine regions plus Australia, covering each of nine industries plus the overall economy); the potential cycles range from that of an almost miniscule industry (e.g. MIN in ACT) to that of the entire Australian economy. NZ is one of the regions, so we can test the relative importance of NZ-sourced shocks and Australian sourced shocks. Since the exchange rate in each country has been floating over the entire sample, our preferred sample is the full 1985(4)-2002(4) period. In addition, since the exchange rate is a forward-looking jump variable, we would expect that the test should include at most one lag. However, we subject significant test results to robustness checks, covering both the shortened sample [1991(4)-2002(4)] and using two lags (over both samples).

Only 8 (6) of the 100 tests are significant at the 10% (5%) level over the full sample using one lag. The 8 cycles that impact significantly on NZDAUD are (with those significant just at 10% in brackets): $G_{NZ,MAN}$, $G_{NZ,OTS}$, $G_{NZ,TOT}$, $G_{AUS,AFF}$, $G_{NSW,AFF}$, ($G_{TAS,AFF}$), ($G_{TAS,TOT}$), and $G_{SA,MIN}$.

The first three of these cycles are NZ-sourced, reflecting a major sector (MAN),[18] government-sourced shocks (OTS) and the overall economic cycle (TOT). The sign of the coefficient on each of these variables in the Granger causality test is positive as expected if NZDAUD is acting in an equilibrating fashion, appreciating in response to domestic over-heating.

The next three cycles reflect agricultural shocks emanating from Australia. The signs on each are negative. Again the direction of this response is as expected if the exchange rate is acting in an equilibrating manner. One can

[18] MAN employment averaged over 17% of total NZ employment during the sample, and a high proportion of its exported output is sent to Australia.

interpret the reaction here most easily in the circumstances where Australia experiences a drought and agricultural employment is consequently below trend. The reduction in Australian agricultural exports places downward pressure on the AUD, but there is no need for similar depreciation of the NZD since its climatic conditions are generally quite independent of those in Australia.[19] Thus the NZDAUD appreciates in these circumstances, as indicated by the coefficient in the test. The (weak) $G_{TAS,TOT}$ effect most probably reflects the same agricultural effect given the importance of AFF in the Tasmanian economy. This effect is no longer significant at the 10% level when two lags are used in the test, whereas the other seven tests remain significant with the use of two lags.

The $G_{SA,MIN}$ effect may indicate that mining shocks have had some impact on NZDAUD. However, this effect seems like a "rogue" test result. South Australia's mining employment has averaged only 0.7% of its total employment, and has averaged just 0.06% of overall Australian employment over the sample. Further, the coefficient on $G_{SA,MIN}$ in the test is positive. If taken at face value, this result would suggest that the AUD depreciates relative to the NZD when there is a positive shock to MIN in Australia.[20] Over the shorter sample, the significance level of this variable drops to 9.7% with one lag, and to 24% with two lags. We therefore discount the relevance of this result.

Over the shortened sample, the three Australian AFF cycles (for NSW, TAS and AUS) no longer Granger-cause NZDAUD at the 10% level (using each of one and two lags in the test). This suggests that the Australian AFF effects may

[19] The two countries are separated by a 2,000 kilometre stretch of ocean.
[20] The correlation coefficient between $G_{SA,MIN}$ and $G_{AUS,MIN}$ is positive (0.21).

not be robust.[21] The New Zealand OTS effect also is no longer significant over the shortened sample. This may reflect the impact of New Zealand's Fiscal Responsibility Act, 1991 that sought to reduce shocks to fiscal policy. We treat each of the Australian AFF and New Zealand OTS effects with caution as a result of their lack of robustness.

The two results that are robust across sample periods and across the use of each of one and two lags in the test are the impacts of $G_{NZ,MAN}$ and $G_{NZ,TOT}$ on NZDAUD. Each cycle retains a significant positive impact on NZDAUD in each of the four variants of the test. Thus the data indicate that, of all regional industry effects, the NZDAUD is affected principally by the overall NZ cycle, with the manufacturing component of that cycle being the most important contributor. The influence of the overall NZ cycle on NZDAUD can be seen clearly in Figure 2 which plots each of $G_{NZ,TOT}$ and NZDAUD (suitably scaled). The contemporaneous correlation between $G_{NZ,TOT,t}$ and $NZDAUD_t$ is 0.69. The correlation of $G_{NZ,TOT,t}$ with the next period's cross rate ($NZDAUD_{t+1}$) is 0.72. The greater correlation of $G_{NZ,TOT,t}$ with $NZDAUD_{t+1}$ than with $NZDAUD_t$ is consistent with Kouparitsas's approach to finding causality. Further, while $G_{NZ,TOT}$ Granger-causes NZDAUD (at the 1% level), NZDAUD does not Granger-cause $G_{NZ,TOT}$ at even the 20% level. Thus the causality is in one direction only.

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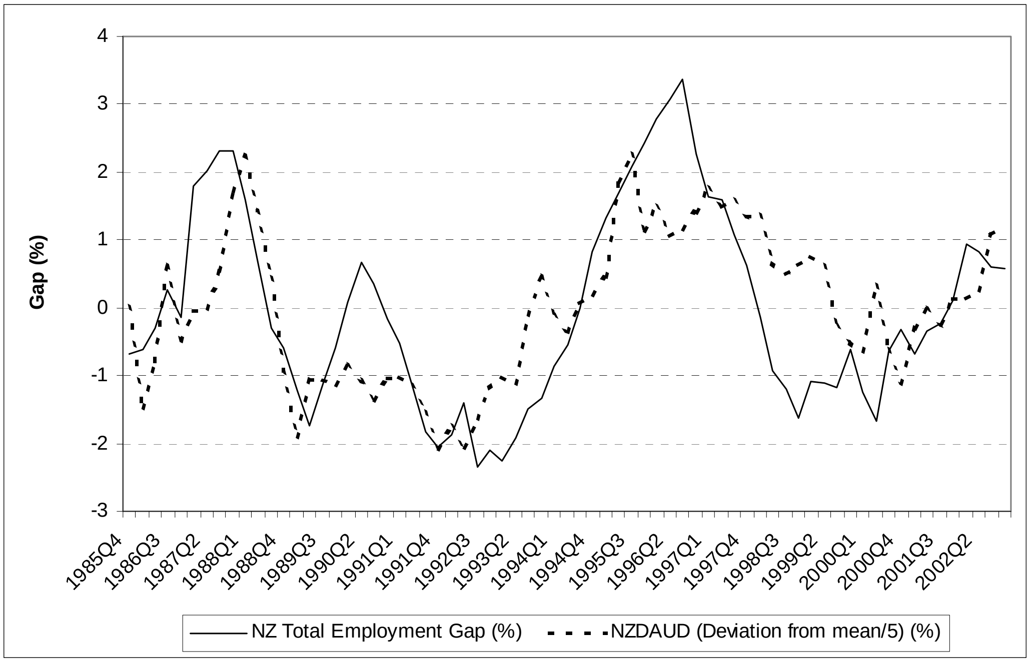
[21] Alternatively, it may be that their key effect was early in the sample. However, the variation in each of $G_{AUS,AFF}$ and $G_{NSW,AFF}$ was greater in the latter part of the sample than the earlier part of the sample, so if their effect on NZDAUD was robust, they should have maintained their significance over the shorter sample.

Figure 2: NZ Employment Gap and NZDAUD*



NZ employment gap expressed as ($G_{NZ,TOT}$ -1)*100
NZDAUD expressed as (NZDAUD-NZDAUD)*20, where NZDAUD is NZDAUD sample mean; series multiplied by 20 for scaling purposes

5 Conclusions

Within Australasia, four regions are prominent in leading the cycles of other regions. ACT leads the ANZ cycle and leads the cycle of a number of regions. The finding that the OTS industry also leads the ANZ cycle, coupled with the strong representation of OTS (largely government services) within ACT (containing Australia's capital city) points clearly to the importance of Australian fiscal shocks in leading the Australasian cycle. The three major mining regions, Western Australia, Queensland and Northern Territory, each also lead the ANZ cycle and the cycles in a number of individual regions. Here, however, the evidence that it is mining shocks that are at work is less clear-cut; MIN cycles do not lead other industries and nor do they lead the cycles in other regions. Some indirect evidence suggests that MIN shocks may nevertheless be playing an economic role in causing the cycles in other regions even though the measured MIN cycles occur after the onset of cycles in other industries and regions.

Since 1991, the NZ cycle has been as highly correlated with the ANZ cycle and with the cycle of other large regions, as have the cycles of most of those regions themselves. This was not the case between 1985 and 1991, when New Zealand's economic reform process gave the country quite idiosyncratic cycles relative to those elsewhere in Australasia. Despite the high post-1991 correlation, there is not strong evidence that the NZ cycle has been "caused" by the cycles in other Australasian regions or industries. One potential explanation for this latter result is that cycles in NZ and in the Australian states since 1991 have each been influenced principally by factors external to Australasia, particularly by trading partner experiences. In this case, cycles could be highly correlated without inter-regional transmission of cycles within ANZ.

Another potential explanation of this finding is that the NZDAUD (the New Zealand - Australia cross exchange rate) has played a buffering role in response to Australian sourced shocks that has insulated the NZ cycle from Australian shocks. Our disaggregation of the available regional data into regional industry cycles is particularly useful in testing this hypothesis. We have analyzed which regional industry cycles have had a causal influence on (the floating) NZDAUD since 1985(4). By far the strongest regional industry impacts on the NZDAUD stem from the overall NZ cycle, and from the NZ manufacturing cycle. These effects are robust over different sample periods and different specifications of the Granger causality test. In addition, there is some weak evidence that NZ fiscal shocks have impacted on the NZDAUD, particularly earlier in the sample.

There is some weak evidence also that Australian agriculture shocks (particularly in NSW and, to a lesser extent, in Tasmania) have had some impact on the NZDAUD, again mainly earlier in the sample period. There is no evidence of other Australian industries or regions impacting on the cross rate. In particular, Australian mining booms do not appear to have had any material impact on the NZDAUD.

An often voiced concern in New Zealand regarding potential common currency with Australia is that New Zealand would lose the ability to adjust to Australian mineral booms through exchange rate adjustment. While in theory this is correct, the evidence over the floating rate period suggests that the NZDAUD has not played this role in practice, even though the NZD has been floating independently of the AUD. Thus loss of monetary sovereignty in this respect may not be of major consequence. Further, the lack of NZDAUD adjustment to Australian AFF shocks in the post-1991 period suggests that again there may not be a material loss of flexibility in response to an Australian drought or other Australian-sourced agriculture shock.

The evidence instead suggests that a more important loss of monetary sovereignty may arise through the loss of exchange rate flexibility consequent on a New Zealand-specific shock, especially one that hits the manufacturing sector.[22] It is these types of shocks that the NZDAUD has been most responsive to since it was floated in 1985. The exchange rate response has generally been in an equilibrating direction for the economy, with an NZDAUD appreciation as the

[22] Examples might include domestic fiscal shocks, climatic shocks and terms of trade shocks affecting products for which NZ has a much stronger exposure than does Australia. (NZ manufacturing has a high food processing content so climatic and terms of trade shocks can impinge materially on the MAN cycle.)

economy overheats. If these cycles could be dampened, this role for NZD flexibility would be diminished. If, however, these cycles cannot be materially dampened, then the establishment of a common currency could create a macroeconomic cost for New Zealand. Whether this cost is outweighed by the microeconomic benefits cannot be ascertained from the current analysis. Nevertheless the results indicate that formation of a common currency is not a "win-win" situation. Instead, a trade-off between macroeconomic and microeconomic considerations would, most likely, be involved.

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