Assessing Currency Implications of Intra & Inter-Regional Shocks: Application to Australasia

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Abstract
We place regional industry structures at centre stage in currency union analysis, decomposing differences between regional and aggregate cycles into "industry cycle" and "industry structure" effects. One Australasian region, ACT, has a material industry structure effect arising from its heavy central government concentration. No other region has a material industry structure effect; their cycles differ from the aggregate cycle due to region-specific shocks. VAR analysis shows the NZ-Australia exchange rate (NZD/AUD) responds positively to innovations in NZ manufacturing and government-related services. A negative Australian agriculture shock (e.g. drought) also induces an NZD/AUD appreciation. No other Australian-sourced shocks impact significantly on the NZD/AUD.

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1 Introduction

The aims of this paper are twofold. First, we assess whether New Zealand experiences similar economic shocks to those experienced by Australia. This information is important for analysing a potential Australia - New Zealand currency union. Second, we extend the toolkit commonly used for assessing such issues. In particular, we explicitly analyse implications of differences in industrial structure across candidate regions in a currency union. Industrial structure is often referred to implicitly in such analyses, but the current study places this analysis at centre-stage.

In addressing the first aim, the paper supplements prior studies on potential New Zealand-Australia currency union. New Zealand and Australia (together termed Australasia) have virtually free mobility of labour between countries, are culturally and linguistically similar, share a comprehensive free trade agreement and are gradually harmonising other economic institutions (Coleman, 1999; Grimes et al, 2000; Lloyd, 2002; Goddard, 2002). Australia is New Zealand's largest trading partner while New Zealand is one of Australia's top five trading partners. In such an environment, transactions cost arguments favour currency union. However, apart from some automatic social security payments, there are no fiscal flows between the two countries. Traditional currency union analysis posits that fiscal flows are desirable between regions within a currency union to smooth effects of asymmetric shocks, or asymmetric responses to shocks. This is especially important where asymmetries in shocks are large and where labour market flows in response to shocks are small and/or slow (Mundell, 1961).[1]

A number of studies have examined shock asymmetry between Australia and New Zealand, focusing on synchronicity of cycles between the countries (Hall et al, 1998; Hargreaves and McDermott, 1999; Grimes et al, 2000; Haug, 2001; Bjorksten, 2001). Each finds a reasonable degree of business cycle synchronisation, but also some differences. Differences, of course, are inevitable; no two economies can evolve identically over time. Judgements have to be made as to how material are the differences. Without a fully specified structural model of both economies (and possibly even with one), it is difficult to judge from the aggregate evidence alone whether two economies are sufficiently similar to warrant sharing a single currency, given other existing institutional arrangements.

One avenue for addressing this problem is afforded by regional analyses, where one or more of the countries is broken into regions. Within Australia, Dixon and Sheppard (2001) have examined cyclical co-movement of unemployment rates across the country's six regions and two territories. Their tests[2] show that the five largest Australian states share a common cycle and so respond similarly to common shocks, but the smallest state (Tasmania) and the two territories do not share the same cyclical properties. In the Australasian context, Grimes (2005) has examined similarities in trend

[1] 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 stabilisation purposes.

[2] Using the common cycle test of Engle and Kozicki (1993).

employment across 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. Bjorksten et al (2004) has examined appropriate Taylor-rule monetary policy settings across the same Australasian regions, finding that a single Taylor rule would have been as appropriate for New Zealand as for the other large Australasian regions in the 1990s.

Related regional analyses have been undertaken in North America. Kouparitsas (2001, 2002) uses correlation analysis and vector autoregression (VAR) techniques to examine regional business cycle characteristics across US regions. His correlation approach examines: (a) contemporaneous correlation of business cycles across regions; and (b) 1-period lead/lag correlations of business cycles across regions. If the lead/lag correlation exceeds the corresponding contemporaneous correlation, there is *prima facie* evidence of spillovers from one region to another. Because correlations do not allow for an analysis of the sources of, or responses to, disturbances across regions, Kouparitsas uses a structural VAR to decompose them. He finds that common disturbances account for a large proportion of regional cycles, while region-specific disturbances cause regional cycles to differ from one another. He discusses the regional cycles with reference to regional characteristics, such as agricultural intensity, mining intensity and manufacturing intensity. These characteristics are used to interpret, rather to derive, the cycles. The finding that they are helpful in interpreting cycles implies that industrial information is relevant to understanding, and potentially deriving, regional disturbances and hence regional cycles.

Owyang and Wall (2004) examine differences in regional impacts of monetary policy across the US. Using regional VARs, they find material differences both in the magnitude and timing of recessions following a monetary contraction. They demonstrate that the monetary and credit cycle effects correspond to different regional industrial structures. Like Kouparitsas, however, they do not make use of these industrial structure differences directly in their estimates; the structures are used purely to partition regions into groups with different characteristics.

The work of Owyang and Wall and of Kouparitsas indicates that greater insight into regional cyclical responses to shocks may be obtained by disaggregating industrial structure across regions. The focus of these papers differs from ours in that the regions are already part of a currency union. Our analysis centres on whether New Zealand should join a currency union formed by the regions within Australia. A study that is closer to ours in focus is that of Beine and Coulombe (2003) who examine whether individual Canadian provinces should share a common currency with the United States.[3]

[3] 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 share a currency union; they treat the large entity as one region and divides the smaller one into a number of regions.

They depart from the structural VAR methods discussed above, noting that these methods rely for their interpretation on identification assumptions that are to some extent arbitrary. Instead, Beine and Coulombe examine the size and significance of GDP gap correlations between Canadian provinces and the US. They also use employment data to compare cyclical positions of Canadian provinces and US states. Beine and Coulombe note that their 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 dollar) will tend to be reflected in "high" domestic correlations relative to correlations of the provinces with the US. Their approach relies on being able to differentiate trend from cycle. They adopt three different measures for doing so: a Hodrick-Prescott (HP, 1997) filter with λ=1600 (standard for quarterly data), an HP filter with λ=315, and the Baxter and King (1995) band-pass filter. The results are robust to use of all three methods. They find that some regions of Canada, but not others, are strong candidates for inclusion in a North American currency union. To interpret their results, Beine and Coulombe examine features of provincial industrial and trade structures. But like the studies already mentioned, this information is used outside the formal analytical process rather than within it.

Our intention is to incorporate information on industrial sectors across regions into the formal analysis. A brief description of our (regional and industry) data is presented in section 2. Section 3 derives a method for decomposing regional cycles according to the impacts of industry cycles. It also derives a decomposition of the difference between regional and aggregate cycles due to industrial structure differences and industry cycle differences. Section 4 examines the transmission of aggregate shocks across regions and across industries using bivariate approaches. Section 5 presents aggregate and disaggregated VAR results, incorporating also the NZD/AUD (the NZ-Australian exchange rate). Section 6 interprets the results in light of a potential common currency for Australasia.

2 Data

New Zealand and Australia together comprise Australasia. Australia consists of 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", 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
ANZ	Australasia (sum of the nine regions)

[Table 1 about here]

Table 1 presents basic data on each region. Consistent with Bjorksten et al (2004) and Beine and Coulombe (2003), we use quarterly employment data as the basis for calculating cyclical positions across each region.[4] These data are available on a disaggregated basis for each of nine industries (together comprising aggregate employment) in each region. We calculate trend employment and employment shares for each industry in each region and so 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. The two territories are clear structural outliers. Our industry decomposition is as follows:

AFF	Agriculture, Forestry, Fishing
BFS	Business and Financial Services
CON	Construction
EGW	Electricity, Gas, Water
MAN	Manufacturing
MIN	Mining
OTS	Other Services[5]
TSC	Transport, Storage and Communications
WRT	Wholesale and Retail Trade[6]
TOT	Total (sum of all nine industries)

To separate trend from cyclical employment, we filter each regional industry employment series using an HP filter. An identical detrending method (with λ=1600) is used for each series given that the frequency and nature of the data are identical. The "employment gap" or cycle series for each regional industry is calculated as seasonally adjusted employment as a ratio of trend employment. The mean of the employment gap for each series is almost exactly unity.

Use of the HP filter (with λ=1600) is consistent with the preferred method in Beine and Coulombe. Their use of alternative filters to decompose trend from cycle gave similar results to one another when employed in a similar application to ours. We have 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 aggregate Australasian series. Figure 1 plots the resulting two gap series, which are almost identical; the correlation coefficient

[4] Australian and New Zealand employment data are obtained from Australian Bureau of Statistics and Statistics New Zealand respectively. The data are described in Grimes (2005).
[5] I.e. Community/Social/Personal Services; many of which are provided and/or funded by government.
[6] Including Accommodation, Cafes, Restaurants

between the two series is 0.990. Given the almost identical nature of these series, we restrict ourselves solely to consideration of the HP filtered series.[7]

[Figure 1 about here]

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 aggregate employment gap, $G_{i,TOT}$, is derived from the sum of trend employment and the sum of actual employment across the nine industries.[8] 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. Region i's trend employment in industry j is denoted $H_{i,j}$; actual employment is denoted $E_{i,j}$.

Aggregate employment gaps for each region other than NT[9] are shown in Figure 2. 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.

[Figure 2 about here]

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.[10] 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 combined with the effects of fiscal tightening and a labour-market "shake-out" from government enterprises to lead 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). Where our descriptive statistics apply to NZ, we

[7] One advantage of the HP filter over the BK filter is that the HP filter derives values for the whole series, whereas the BK filter omits the first 12 and the last 12 observations.
[8] This aggregate regional employment gap is virtually identical to one calculated directly from a region's aggregate employment series; similarly for the aggregate of each industry across the nine regions and for ANZ. Thus the order of decomposition and detrending is immaterial.
[9] 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 $G_{i,j}$.
[10] Bjorksten et al (2004) noted strong similarities between the NZ and Australian regional output gaps across their sample, but that sample only started in 1992.

report results both for the full sample, 1985(4)-2002(4), and for a shortened sample, 1991(4)-2002(4).

3 Regional versus Aggregate Cycles

Given the potential importance of industry structure in determining cycles, we develop a decomposition of the regional cycle in terms of industry cycles. The decomposition can be used to examine the nature of the cycle within a region and to compare the regional cycle with the aggregate Australasian (ANZ) cycle. It highlights the importance of different industry structures and different industry cycles in explaining a region's cyclical position relative to the aggregate cycle.

For any region, i, in any quarter, aggregate employment is given by:

$$E_{i,TOT} = \Sigma_j E_{i,j} \quad (1)$$

where: $E_{i,TOT}$ is aggregate employment in region i
$E_{i,j}$ is region i's employment in industry j (j = 1, …, 9).

Similarly, aggregate trend employment ($H_{i,TOT}$) is given by:

$$H_{i,TOT} = \Sigma_j H_{i,j} \quad (2)$$

Dividing each side of (1) by $H_{i,TOT}$, multiplying each term on the RHS of the equation by the respective $H_{i,j}/H_{i,j}$, and denoting the trend share for industry j in region i ($H_{i,j}$ / $H_{i,TOT)}$ as $S_{i,j}$, gives the decomposition of region i's aggregate employment gap, $G_{i,TOT}$ ($\equiv E_{i,TOT}/H_{i,TOT}$):

$$G_{i,TOT} = \Sigma_j G_{i,j} . S_{i,j} \quad (3)$$

Equation (3) provides a natural way to decompose cycles within any region. They arise from industry specific cycles, weighted by each industry's trend share in the regional economy.

A comparison of the cyclical position of two regions (i=x,y) at the aggregate industry level, can be obtained by comparing $G_{x,TOT}$ with $G_{y,TOT}$. The difference can be decomposed, by manipulating (3), to yield:

$$G_{x,TOT} - G_{y,TOT} = \{\Sigma_j(G_{x,j} - G_{y,j})[(S_{x,j} + S_{y,j})/2]\} + \{\Sigma_j(S_{x,j} - S_{y,j})[(G_{x,j} + G_{y,j})/2]\} \quad (4)$$

We term the expression in the first set of braces of (4) the "**industry cycle effect**", being the sum of the differences between the regional cyclical positions (employment gaps) in each industry, weighted by the average trend employment shares in the two regions. The term in the second set of braces in (4) is called the "**industry structure effect**", being the sum of the differences between regional trend industry shares, weighted by the average industry cyclical positions in the two regions.

We use (4) to compare the cycle in each region with that of ANZ by defining x as the relevant region and y as ANZ. Thus the deviation between the regional and the aggregate cycle can be decomposed into the effect of different industry structures and of different cycles within each industry. This is germane to common currency analysis since a frequently expressed concern (in Australasia) is the potential disruptive effect of an agriculturally-based economy (NZ) joining with a much larger economy that contains significant mineral wealth (especially in WA, QLD and NT).

In cases where the aggregate cycle is identical in two regions, we can ascertain from (4) whether this is because each region has similar cyclical positions in each industry or whether offsetting cyclical and/or structure considerations are at work. In order to estimate the degree to which offsetting industry gaps are masking the potential for aggregate divergence, we calculate what we term the "**absolute industry cycle effect**" which uses the absolute value of the deviation in employment gaps between two regions in place of the actual value in the first set of braces in (4). Similarly the "**absolute industry structure effect**" uses the absolute value of the difference in trend shares between regions in the second set of braces in (4).

Prior to decomposing the differences between regional and aggregate cycles into industry cycle and industry structure effects, 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 about here]

Using (4), we decompose the idiosyncratic nature of each region's cycle relative to that of ANZ into the industry cycle effect and the industry structure effect. Apart from ACT, each region's industry cycle effect almost completely explains the deviation between the region employment gap and the ANZ employment gap: the correlation coefficient between the two series ranges from 0.94 (NT) to 0.98 (NZ, QLD, SA, TAS and VIC), with NSW and WA at 0.96. In ACT's case, the correlation is considerably lower, at 0.78.

Figure 3 plots the deviation between ACT's aggregate employment gap and that of ANZ. It also plots the industry cycle effect and the industry structure effect (the three series are labeled 'Employment Gap', 'Industry Cycle' and 'Industry Structure' respectively). In each period, the industry cycle and industry structure effects sum to give the aggregate employment gap. For comparison, Figure 4 presents the same information for NZ. ACT's much greater industry structure effect is consistent with its outlying industrial structure shown in Table 1 (especially its exposure to government-related services, OTS). Notably, however, NT (which is also a structural outlier) has much less of an industry structure effect; its cycles are predominantly due to industry-specific shocks.

[Figures 3 and 4 about here]

The domination of the industry cycle effect over the industry structure effect suggests that in all regions other than ACT, industry structure is not important in explaining the different cyclical positions of the region relative to ANZ. Instead, deviations of regional employment gaps from that of ANZ are due almost entirely to idiosyncratic regional shocks within (broadly defined) industries. This may be due to particular industry occurrences within a region. Alternatively, it may be due to a regional shock that impacts on that region's industries but not on other regions' industries (examples might include a localised climate shock or a regional fiscal shock). Broad industry composition (e.g. between mining, agriculture, manufacturing or services) between regions does not seem to be important in creating cycles that differ from the aggregate experience.[11]

One factor that may disguise the potential for deviation of a region's aggregate employment gap from that of ANZ is if industry gaps have (fortuitously or otherwise) offset each other during the period. The absolute industry cycle effect, defined earlier, adopts the opposite extreme of estimating what the industry cycle effect would have been had there been no offsetting effects.[12] Table 2 presents the mean absolute industry cycle effect for each region relative to ANZ for both the full sample and the post-1991 period. The rankings for the size of absolute industry gap are identical over both time periods. NT, ACT, TAS, SA and WA (in that order) have the largest gaps; NSW has the smallest. NZ, QLD and VIC have relatively small gaps.

Overall, 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 is closely related to the core on most measures for the post-1991 period; TAS is related, but less so than for these six regions. ACT and NT cannot be considered as core regions in cyclical terms. Other than in ACT, industry structure (impacting on ANZ-wide industry cycles) does not appear to cause regional cycles to deviate markedly from the Australasian whole. Instead, the *prima facie* evidence suggests that intra-regional shocks (including region-specific industry shocks) are the key determinants of idiosyncratic regional cycles.

4 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 aggregate industry level ($G_{i,TOT}$). We then extend the analysis using other measures. Table 3 presents contemporaneous correlation coefficients for the full sample [1985(4)-2002(4)]. Two features stand out. First is the generally low correlation coefficients compared with Kouparitsas's (2002) findings for 8 US

[11] A finer industry disaggregation may reveal a greater industry structure effect and a smaller industry cycle effect, since regions will be exposed to different industrial sub-sectors.
[12] In practice, shocks will favour some industries at the expense of others. Thus these estimates represent a reasonable upper bound over what might occur by way of industry cycle effects.

regions. The median regional correlation is 0.33 with a mean of 0.39; the US median is 0.77 with a mean of 0.75. 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; 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. We have calculated the correlations involving NZ for 1991(4)-2002(4). The results indicate 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.

[Tables 3 & 4 about here]

Table 4 presents the full-sample correlations relating the employment gap in period t with that in period t+1. The figures on the leading diagonal provide a measure of the degree of persistence in each region's cycle.[13] More relevant for the inter-regional transmission of shocks are the magnitudes of the non-diagonal cells. Each figure is compared with the corresponding figure in Table 3. Where the figure exceeds the relevant figure in Table 3, the implication is that the cycle of the region listed vertically leads the cycle of the region listed horizontally. For instance, the contemporaneous correlation of ACT and TAS is 0.31 whereas the corresponding correlation of ACT in time t with TAS in time t+1 is 0.42, implying that ACT's cycle leads that of TAS. In Table 4, we note in bold any figure that exceeds its corresponding entry in Table 3.

Three regions stand out as leading the cycle of other regions. ACT, QLD and WA each lead at least 5 of the other 8 regions, and each also leads ANZ, while 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 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

[13] The figure is the correlation coefficient; it is not the coefficient on the lagged variable.

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.

We test leads and lags in aggregate cycles more formally with Granger causality tests. Each region's aggregate cycle can be characterised either as an AR(1) process (6 regions) or as an AR(2) process (3 regions). We report, in Table 5, Granger causality tests using one lag in the test (results with two lags are almost identical). 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).[14] The aggregate cycles in each of WST and QLD again show out as major precursors of cycles in other regions and for ANZ. ACT Granger-causes ANZ, consistent with the prior results. TAS also Granger-causes ANZ, possibly reflecting the influence of a more generalised 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.

[Table 5 about here]

The regional results lead to some hypotheses regarding the effects of sectoral shocks on regional and ANZ cyclical outcomes. In particular, we hypothesise that shocks to MIN, OTS and possibly AFF cause regional cycles. The shocks could be generalised across ANZ or be region-specific. We test whether generalised industry shocks cause regional cycles using Granger causality tests for the impact of Australasian sectoral cycles on each of the regional cycles. Table 6 presents the test results.[15] Two sectors are shown to Granger-cause most regions. CON and MAN each Granger-cause six of the nine regions plus ANZ. The only other sector to Granger-cause ANZ at the 5% level is OTS, possibly reflecting a fiscal shock (AFF does so at 10% with one lag, but not with two lags). MIN does not Granger-cause any region or ANZ (with either one or two lags).

[Table 6 about here]

To help interpret these results, we present (in Table 7) Granger causality tests between industry cycles. 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

[14] When the NZ tests are run over the full sample, the only significant test result is QLD causing NZ (at 5%); NZ does not cause any region or ANZ.
[15] The tests for NZ are run over 1991(4)-2002(4); other samples begin in 1985(4). The tests use one lag; the results in this table, and in Table 7, are little changed when two lags are used.

industries - AFF and MIN - are notable for their lack of influence on other sectors.

[Table 7 about here]

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 tests do not pick up this influence. Mining cycles are driven predominantly by two factors: world prices of minerals and 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 Table 7 shows MIN to be Granger-caused by CON (at the 1% level) and by MAN (at 5%). An explanation is that a mining expansion must be preceded by 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 in certain regions are large enough to influence the aggregate economy, we would observe CON in mining regions leading both MIN in those regions and leading the aggregate ANZ cycle. We would also observe future MIN (in period t+s) "leading" the aggregate cycle (in period t) reflecting the "s" quarters that it takes to gear up mining employment following the shock to the industry.

We examine Granger causality tests between CON in each region and the ANZ aggregate cycle, and 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 also 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).

Overall, shocks to government-related services (OTS) appear important in generating cycles in the aggregate Australasian economy. Given ACT's very large exposure to this sector, these shocks cause a material "industry structure effect" in ACT, leading to considerable divergence of the ACT cycle from that of ANZ. Our interpretation of remaining results is that mining is also a significant source of shocks in Australasia (although we cannot be conclusive of this result because of the timing issues). Manufacturing shocks and shocks to construction (to the extent that these shocks are independent of shocks to other sectors) may also play a role. While each of these shocks may be important for particular regions, they are also important for ANZ and hence do not lead to a substantial deviation in regional cycles from the aggregate cycle.

5 Disaggregated Transmission of Shocks

The techniques used in the previous section to examine transmission of shocks between industries and regions are bivariate in nature. We now investigate the industry and regional transmission of shocks in a multivariate setting, using aggregate and disaggregated VARs. By doing so, the effect of innovations in specific regional industries can be traced across other regional industries.

To keep the analysis tractable, we amalgamate some of the industries and a number of the regions together.[16] We retain only industries that comprise a material part of the economy. As a result, we amalgamate MIN with CON, on the basis of links between the sectors already discussed; denoting the resulting industry "COM". We amalgamate EGW with OTS (the sector with which EGW has its highest correlation); the resulting series is almost identical to OTS given the size discrepancies between the two sectors, and is denoted "OTE". We also amalgamate TSC with BFS. Each of these sectors has its highest correlation with the other, and the communications aspect of TSC is closely linked to activities within BFS. The amalgamated series is denoted "BFT". Other sectors (AFF, MAN, WRT) remain unchanged. Thus we now have six industries (together comprising TOT).

Based on the previous analysis, we amalgamate three regions: QLD, WA and NT. QLD and WA each has their highest correlation with the other; NT's highest correlation is with QLD and it has a moderate correlation with WA. Each is linked strongly with mining. The new region is denoted QW. The other five regions within Australia are amalgamated into a single region. NSW and VIC (which dominate the new region) each has their highest correlation with the other, and each of TAS and SA has their highest correlations with NSW and VIC. ACT is something of an outlier, but its size and geographical location make it sensible to place it in the same region, denoted NV.

NZ is retained as a separate region, based on some its idiosyncratic experiences over the period (especially early on) and given that our interest is in currency union issues. Retaining two regions (with some notable structural differences) within Australia allows us to compare NZ cycles with those in different regions within (the currency union of) Australia. NZ is now the smallest region (4 million people in 2003) compared with QW (6 million) and NV (14 million).

[16] The cycles are compiled using the seasonally adjusted employment of the combined sectors relative to the HP-filtered employment for the combined sectors.

We analyse the transmission of regional and industry cycles across Australasia by estimating unrestricted VARs. We express the cycle for industry j in region i as Pij_t ($\equiv G_{i,j,t}$ -1), which has zero mean for each i,j. Regions i=1,…,3 correspond to QW, NV and NZ respectively (A denotes ANZ); industries j=1,…,6 correspond to AFF, BFT, COM, MAN, OTE and WRT (T denotes TOT). Thus PAT is the aggregate Australasian cycle across all industries. Given that our focus is on currency union, we estimate the VARs with the NZ-Australia exchange rate[17] included so as to analyse the dynamic impacts between industry and regional shocks and the (floating) exchange rate between the two countries. (The nominal exchange rate between QW and NV remains fixed.)

We estimate each VAR using just one lag of each variable and without a constant (since the mean of each variable is zero by construction). The Schwartz criterion favours this specification over two lags of each variable (with or without a constant). It also favours inclusion of the exchange rate over its exclusion. We analyse the impulse responses using generalised impulses calculated according to the Pesaran and Shin (1998) method in which the construction of the orthogonal innovations does not depend on the VAR ordering. "Significant" responses are taken to be those in which the (plus or minus) two standard error bounds for any of the first ten quarters does not include zero.

Initially we estimate a standard regional VAR at the aggregate industry level for the three regions plus the demeaned exchange rate (NZA0). The impulse responses are shown as Figure 5. Apart from significant "own responses", the only significant regional responses to innovations from other regions are QW (P1T) responding to NV (P2T) and vice versa. Neither of the Australian regions responds significantly to an innovation from NZ (P3T); nor does NZ respond significantly to an innovation from either QW or NV. None of the regions responds significantly to an innovation in the exchange rate, NZA0. The exchange rate shows virtually no response to a QW innovation. However, it appreciates significantly in response to a positive NZ innovation and depreciates (with borderline significance) in response to a positive NV innovation; the estimated peak response to the NZ innovation is almost three times the response to the NV innovation.

[Figure 5 about here]

The exchange rate response to NZ factors can be seen from Figure 6 which plots the NZ cycle (P3T) against NZA0. The contemporaneous correlation between the two series is 0.69. The correlation of the NZ cycle with the following quarter's cross rate is 0.72. Granger causality tests between the two series indicate that the NZ cycle Granger-causes NZA0 (at the 1% level); NZA0 does not Granger-cause the NZ cycle (at the 20% level).[18]

[17] A rise in the rate signals an appreciation in the NZ dollar relative to the Australian dollar. Unit root tests on this variable are indeterminate as to whether it is I(1) or I(0); given its properties shown below and its lack of long term trend, we treat it as I(0) without drift. In the VAR, it is entered minus its 1985(4)-2002(4) mean value 0.8144 and labeled NZA0.
[18] The results are robust to use of 1 or 2 lags in the tests.

[Figure 6 about here]

The lack of exchange rate response to a shock in QW (i.e. the mining states), coupled with the lack of an aggregate NZ cycle response to a QW shock implies that NZ is not materially affected by shocks in the mining states. The NZ cycle also appears to register little response to an NV innovation.

The key role of the exchange rate is to assist adjustment of the NZ cycle to a shock impacting primarily on NZ (rather than on Australia). This result is consistent with the decomposition between the industry cycle effect and the industry structure effect in section 3. Deviations between the NZ cycle and that of ANZ are due primarily to NZ-specific shocks. These shocks could be exogenous to the region (e.g. an idiosyncratic terms of trade shock caused by differing intra-industry exposures relative to other regions) or it could be endogenous to the region (e.g. a domestic fiscal shock).

The importance of QW in determining the cyclical position of the two Australian regions, but not NZ, can be seen in Table 8 which presents the variance decomposition of each variable (after 20 quarters).[19] Two figures are presented in each cell, corresponding to different Choleski orderings. The first has the ordering: P1T, P2T, P3T, NZA0; the second figure uses the reverse ordering. The qualitative results are similar in each case. The QW (P1T) innovation accounts for well over half the variance in each of QW and NV, but for less than 20% of the NZ cycle. The NV (P2T) innovation has little effect on any variable other than itself. The NZ (P3T) cycle is determined principally by NZ-specific innovations. The NZ innovations have little effect on either QW or NV but are the major determining factor for the exchange rate; between 50% and 60% of the NZA0 variance is due to NZ innovations, with most of the rest being sourced from exchange rate innovations themselves.

[Table 8 about here]

To explore the role of regional industry shocks, and their interactions with the exchange rate, we estimate a 19 variable VAR (3 regions by six industries, plus NZA0). Rather than presenting all the impulse responses, we summarise results in Table 9 using the variance decomposition (after 20 quarters) for each regional industry plus NZA0 due to innovations in each variable.[20]

[Table 9 about here]

The decompositions across regions and industries are mostly in accordance with prior results. Own innovations are almost always an important influence

[19] In each case, the decomposition had stabilised after 20 quarters at the reported levels.
[20] The variance decomposition is sensitive to the Choleski ordering in this case. The tables present the average decomposition based on twelve orderings. Six of the orderings have NZA0 named first, and six have it last. In each case the six orderings correspond to the six possible regional permutations; in half of the twelve orderings, the industry order within each region is from 1 to 6, and in the other half the industry ordering is reversed. Thus industries and regions are each treated symmetrically across the twelve orderings.

on a cycle's variance, explaining around 30% of the variance on average (this figure is very similar across the three regions). Other innovations from within the same region account for a further 18-25% of the industry cycles (on average) across each of the regions. In this case, the highest (average) proportion is registered by NV consistent with it being the largest region. NZ comes close behind, however, and has a higher combined (average) influence of region-specific shocks (i.e. own industry plus other industry). Given that NZ is smaller than the other regions, this suggests that NZ is more self-contained than either of the other two regions.

Five regional industries stand out in terms of their impact on other regional industry cycles. The COM cycle in QW (P13) is responsible for over 5% of the variance in ten of the other cycles, seven of which are outside QW itself. This is consistent with previous results regarding the importance of this sector. Three of these cases relate to NZ industries, with 10.2% of the variance in NZ's COM industry attributable to innovations in the QW COM sector. This suggests that the exchange rate has not adjusted fully to shield NZ from such shocks; indeed very little (1.9%) of the exchange rate variance is due to innovations from this source. Innovations to MAN in NV are responsible for over 5% of the variance in 9 other cycles, six of which are outside NV (principally in QW). NV's AFF and WRT innovations also impact relatively heavily on other cycles inside and outside of NV, principally in QW. NZ industries have little impact on the Australian regions. However, NZ's MAN innovations have a key role in influencing other NZ sectors, being responsible for at least 5% of the variance of each of the other industry cycles within NZ.

The exchange rate has negligible impact on virtually all regional industries. The major single influence on the exchange rate is its own innovations (accounting for 24.2% of its variance). However one industry, MAN in NZ, accounts for a further 20.9% of its variance. Together, NZ-sourced innovations (other than from NZA0 itself) account for 40.4% of the variance in the cross rate, with 23.2% sourced from NV and just 12.3% from QW. These results are consistent with the aggregate findings and indicate that the cross rate does not act materially to cushion NZ from shocks in the mineral-rich regions of Australia. Rather it primarily assists adjustment to domestic over- (or under-) heating, and, to a lesser extent, responds to the NV cycle.

Examination of the (generalised, Pesaran and Shin) impulse response functions of NZA0 to each of the 19 innovations indicates only three significant effects of regional industry innovations on NZA0. A MAN innovation in NZ (P34) has a significant positive impact on the exchange rate over quarters 2 to 9 inclusive, while an NZ OTE innovation has a significant positive impact over quarters 1 to 3. An AFF innovation in NV has a significant negative impact on the exchange rate over quarters 2 to 3. In addition, there is a significant effect stemming from an NZA0 own innovation over quarters 1 to 4. The nature of the NZA0 responses to an innovation in each of MAN and OTE in NZ, AFF in NV, and from itself are depicted in Figure 7.

[Figure 7 about here]

The major impacts arise from the NZ innovations (plus NZA0's own innovation), consistent with the raw data in Figure 6. Intuitively we could think of a number of factors contributing to the NZ MAN shock, including climatic factors affecting agricultural processing (which is included in manufacturing). The NZ OTE shock can be interpreted as a domestic fiscal shock. An increase in government expenditure is likely to raise OTE employment and place upward pressure on the NZ dollar. The NV AFF shock may reflect the impact of a climate shock in NSW and VIC. A negative innovation, for instance due to a drought, may lead to lower AFF employment and exports, feeding through to a generalised depreciation in the Australian dollar and hence to an appreciation in NZA0.

In the cases of the NZ MAN and OTE innovations, the NZA0 response is in accordance with standard adjustment mechanisms considered appropriate for the domestic economy (i.e. an appreciation as the domestic economy overheats). In the NV AFF case (based on the interpretation above) this is also the case for Australia as its exchange rate depreciates in response to a negative shock to an exporting industry. The effects of this shock on NZ are complex. The NZD/AUD appreciates in response to a negative NV AFF shock even though there has been no positive innovation to any of the NZ sectors. This suggests that a drought in Australia could lead, through the exchange rate mechanism, to a downturn in exchange rate sensitive sectors in NZ (e.g. manufacturing and tourism). In fact, however, a negative NV AFF innovation results in positive impulse responses for most NZ sectors (albeit bordering on statistical significance only for COM). The reason could be that the drought causes a generalised depreciation in the AUD that results in a tandem depreciation in the NZD against third currencies, tempered by some upward movement in the NZD relative to the AUD. Thus the NZD/AUD appreciates, but NZ industries benefit from an overall exchange rate depreciation. If this is the case, the NZD/AUD is again adjusting in a manner that helps equilibrate the NZ economy.

6 CONCLUSIONS

We have extended previous analyses of the regional implications of currency union by placing regional industrial structures at centre stage. Our decomposition of the difference between a regional and an aggregate cycle according to the "industry cycle effect" and an "industry structure effect" proves useful in isolating whether generalised industry shocks impact on regions differently because of their industrial structure. One region in our analysis, ACT, has a material industry structure effect arising from its concentration on central government-related services. Shocks to this sector cause the ACT cycle to depart markedly at times from the Australasian average. While the cycles in other regions also differ (at times markedly) from the Australasian average, we show that these differences are almost entirely due to region-specific occurrences and cannot be attributed to Australasia-wide industry shocks.

In cyclical terms (since 1985), the core of the Australasian economy has been formed by NSW and Victoria, with the other Australian states quite closely linked into the aggregate cyclical position. ACT and NT cycles have had only a low positive correlation with the Australasian cycle. Unlike ACT, NT's different cyclical outcomes relative to Australasia have been almost wholly due to idiosyncratic regional developments within industries, rather than to industrial structure differences. NZ has been as attached to the Australasian cycle as have most of the Australian states since 1991, but experienced significant differences during its reform period of 1985-1991. NZ's cyclical differences from Australasia are almost wholly attributable to NZ-specific shocks rather than to industrial structure differences.

Our aggregate and disaggregated VAR analyses show consistent results regarding transmission of shocks between Australasian regions and from the regions to the NZD/AUD. Shocks experienced by the Australian "mining states" (Western Australia, Queensland and Northern Territory) flow through to the remainder of Australia. The effects of these shocks on NZ, in aggregate, are slight. However shocks from the Construction/Mining sector in the mining states do have material impacts on some NZ sectors. These latter shocks do not, however, impact on the NZD/AUD to any material degree.

The NZD/AUD is affected materially by innovations to NZ manufacturing and government-related services, with the rate appreciating as employment in these sectors contributes to domestic overheating. A shock to agriculture in the Australian (non-mining) states also impacts on the NZD/AUD, with significant appreciation in the cross rate between the two countries arising from an agricultural downturn in Australia (e.g. following a climatic shock). No other Australian-sourced shocks (including shocks to the mining industry) have significant impact on the NZD/AUD.

The other major factor determining the NZD/AUD over the period are innovations to the exchange rate itself. This result is important in its own right. These innovations are unrelated to regional or sectoral shocks. The nature of the VAR means that they arise from shocks (e.g. financial market shocks) that are orthogonal to shocks hitting regional industries. They may reflect expectations of such developments, in which case they may be a stabilising mechanism for the economy as rational, forward-looking agent theories predict. Alternatively, they could reflect "animal spirits" in which case they may not act in a stabilising manner. Exchange rate innovations have not impacted materially on any of the regional industries, suggesting that this latter explanation has not been of major importance. Nevertheless, investigation of the nature, and potential causes, of the exchange rate's "own innovations" could shed additional light on the interaction of the exchange rate and real sector developments across Australasia.

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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 (2005).

TABLE 2: Cyclical Differences Between Region & ANZ*

	Mean Absolute Deviation (%)	Standard Deviation (%)	Absolute Industry Cycle Effect (%)	Mean Absolute Deviation (%)	Standard Deviation (%)	Absolute Industry Cycle Effect (%)
	1985(4) - 2002(4)			1991(4) - 2002(4)		
ACT	1.5	1.8	6.6	1.6	1.9	6.5
NSW	0.5	0.6	1.7	0.4	0.6	1.7
NT	3.0	3.9	9.6	2.9	3.8	8.7
NZ	1.1	1.4	2.2	0.8	0.9	2.1
QLD	0.7	0.8	2.3	0.6	0.7	2.2
SA	0.7	0.9	3.2	0.7	0.9	3.3
TAS	0.9	1.2	4.3	0.8	1.0	4.1
VIC	0.7	0.9	2.1	0.5	0.6	2.2
WA	0.7	0.8	2.8	0.6	0.8	2.7

*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 absolute industry cycle effect uses the absolute value of the industry gaps between region i and ANZ in the first set of braces in (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.

TABLE 5: 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) 1991(4)-2002(4)

TABLE 6: 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 1991(4)-2002(4)

TABLE 7: 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 8: Aggregate VAR Variance Decomposition of "Y" due to "X" (%, after 20 quarters)

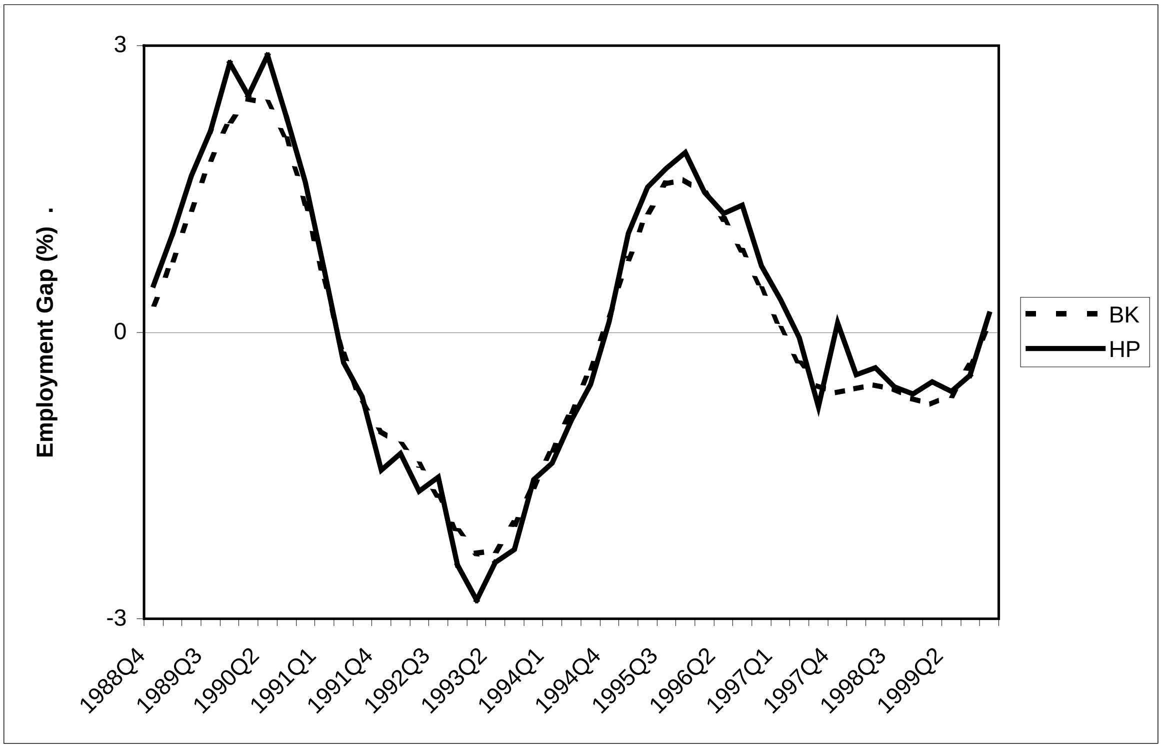
Y	**X**			
	P1T	**P2T**	**P3T**	**NZA0**
P1T	81.1	3.3	1.9	13.6
	72.8	9.6	5.1	12.5
P2T	72.1	16.3	0.6	11.0
	57.5	30.0	1.2	11.4
P3T	8.3	8.8	82.3	0.5
	17.5	1.9	77.6	3.0
NZA0	0.4	8.8	57.1	33.7
	1.5	7.9	52.1	38.5

TABLE 9: Disaggregated VAR Variance Decomposition of "Y" due to "X" (%, after 20 quarters)*

Y	X																		
	P11	**P12**	**P13**	**P14**	**P15**	**P16**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P31**	**P32**	**P33**	**P34**	**P35**	**P36**	**NZA0**
P11	39.5	4.5	4.3	1.5	2.8	2.9	3.6	1.4	2.0	2.1	2.7	9.7	2.0	3.6	2.8	3.2	3.2	6.0	2.1
P12	3.4	16.1	9.0	3.0	5.8	2.5	7.6	7.4	1.7	10.8	3.7	3.6	3.4	2.1	5.6	3.9	6.1	2.0	2.3
P13	1.6	2.7	25.2	3.0	2.9	2.6	9.0	6.7	1.9	13.6	1.6	8.9	2.8	4.3	3.5	2.3	1.7	4.3	1.5
P14	2.5	2.4	10.0	23.4	1.7	7.1	11.4	4.9	2.9	9.5	5.3	4.7	1.1	1.4	3.3	2.5	2.4	2.0	1.7
P15	3.4	3.9	3.8	2.1	52.4	1.5	2.4	0.8	0.9	7.5	1.7	0.5	3.8	1.5	1.1	2.8	6.6	1.4	1.9
P16	2.9	5.8	6.0	1.8	3.0	30.3	4.0	1.5	0.7	7.7	2.9	10.6	2.5	0.9	2.4	3.6	4.2	7.5	1.9
P21	4.6	2.8	2.7	4.1	3.7	7.4	50.0	3.2	1.4	4.2	1.4	1.7	1.1	2.8	1.2	2.6	2.7	0.9	1.3
P22	2.0	3.6	13.5	4.8	2.1	3.8	10.5	14.7	3.5	12.8	2.1	9.0	2.5	1.8	3.4	2.3	2.3	3.6	1.5
P23	4.6	4.5	12.0	2.5	3.7	4.9	9.0	4.5	14.7	6.8	1.3	14.3	1.6	2.4	2.5	2.1	2.0	4.0	2.6
P24	0.8	0.9	12.2	2.9	4.3	2.7	10.4	2.4	1.1	25.7	3.7	2.6	2.9	2.4	16.3	3.5	3.3	1.2	0.7
P25	2.2	2.2	4.2	4.1	8.0	4.2	7.7	4.4	0.9	2.5	39.2	1.7	0.8	2.6	3.8	6.3	1.7	2.1	1.5
P26	1.8	5.2	9.3	4.1	2.3	3.2	11.1	3.6	1.1	7.9	2.0	29.9	3.2	2.8	4.0	1.1	1.7	2.8	2.9
P31	2.8	1.7	6.5	2.5	2.6	4.3	3.2	1.8	2.0	3.5	3.4	5.5	33.0	8.9	5.7	7.8	2.6	0.7	1.7
P32	4.8	0.8	4.0	4.8	3.3	3.6	3.0	4.0	2.1	1.2	4.6	2.2	3.3	33.7	3.9	12.5	2.7	1.9	3.6
P33	1.6	1.3	10.2	4.1	1.0	4.4	13.0	4.1	1.4	7.6	4.5	4.1	3.3	3.0	22.9	5.8	3.5	2.0	2.3
P34	5.4	1.8	3.7	5.3	0.8	3.5	3.6	3.0	2.6	3.5	3.2	3.5	1.5	7.8	2.8	37.5	3.0	3.6	3.9
P35	2.2	1.4	2.1	2.1	5.4	3.9	3.1	2.5	1.9	1.6	10.6	1.8	1.0	3.5	4.3	13.8	30.6	3.5	4.6
P36	6.8	3.6	5.3	3.2	2.9	0.9	4.2	3.8	1.2	2.4	3.0	3.8	2.5	4.8	7.4	12.3	1.8	27.7	2.3
NZA0	2.6	1.8	1.9	2.1	2.4	1.5	6.6	2.1	1.1	4.8	3.4	5.1	1.6	3.3	4.7	20.9	5.3	4.6	24.2

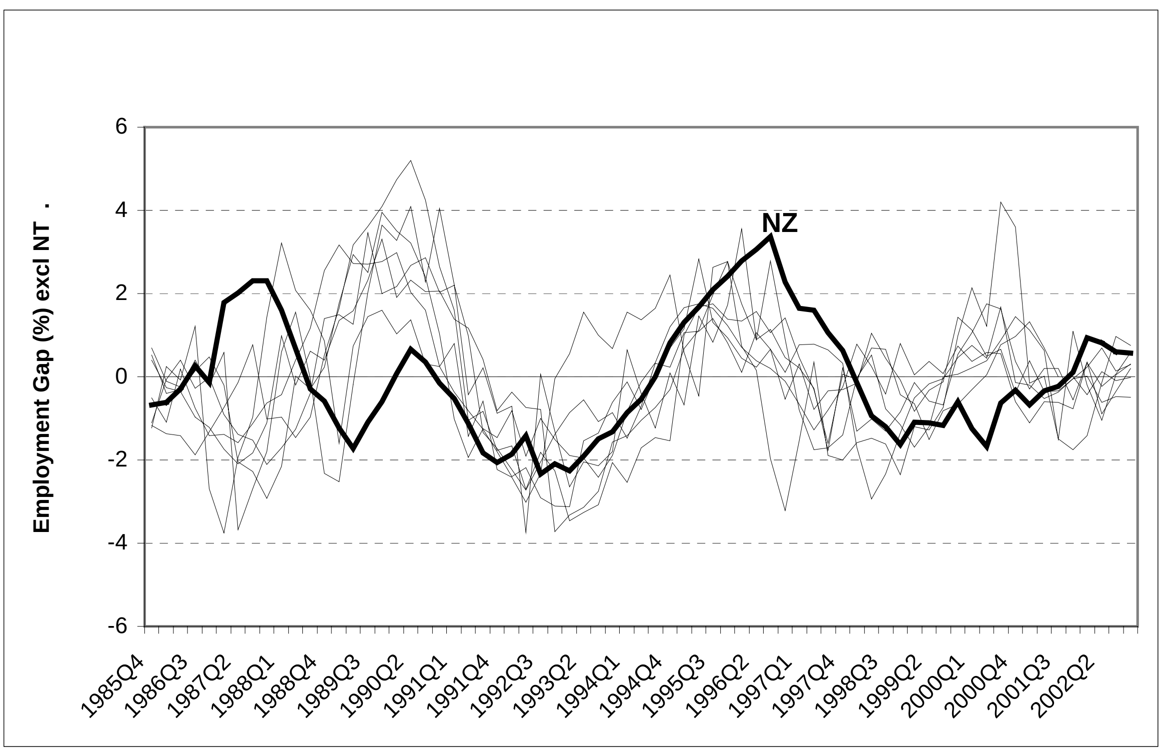
* Average of 12 alternative Choleski decompositions (described in text)

FIGURE 1: Employment Gaps, ANZ TOT (%): HP & BK Filters*



*Hodrick-Prescott & Baxter-King filters, each expressed as ($G_{ANZ,TOT}$ -1)*100

FIGURE 2: Regional Employment Gaps (%) excl NT: Total Industry*



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

FIGURE 3: ACT - ANZ Employment Gap & Industry Cycle Effects (%)

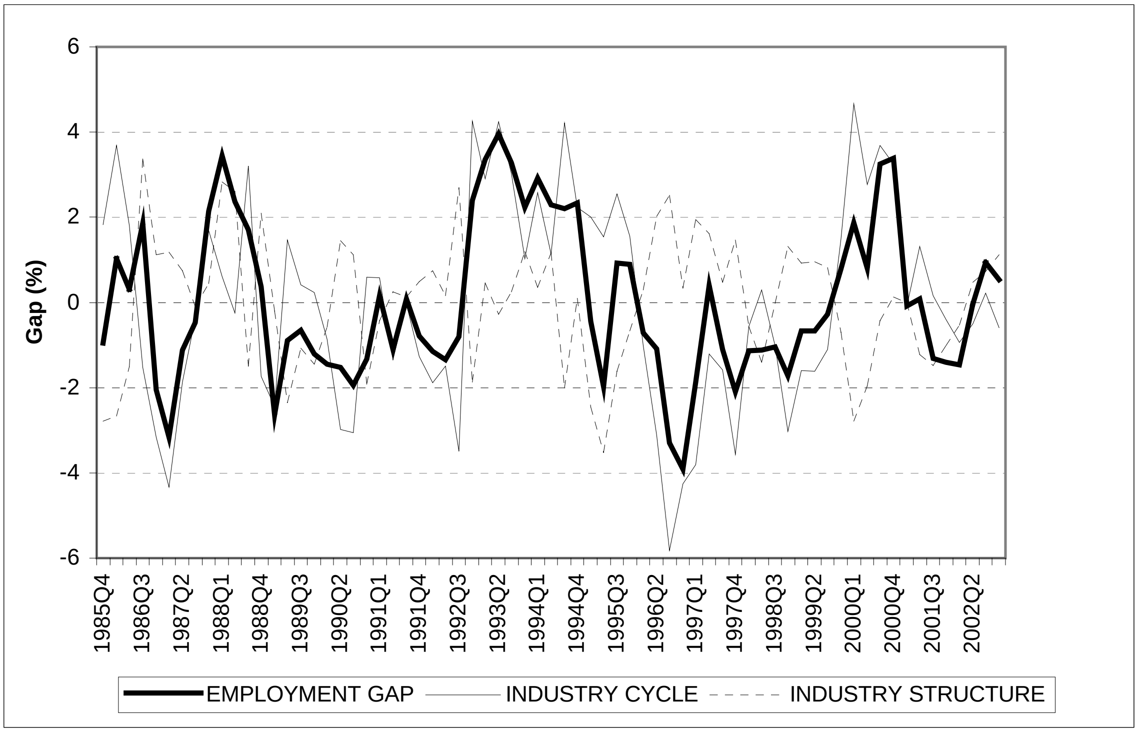


FIGURE 4: NZ - ANZ Employment Gap & Industry Cycle Effects (%)

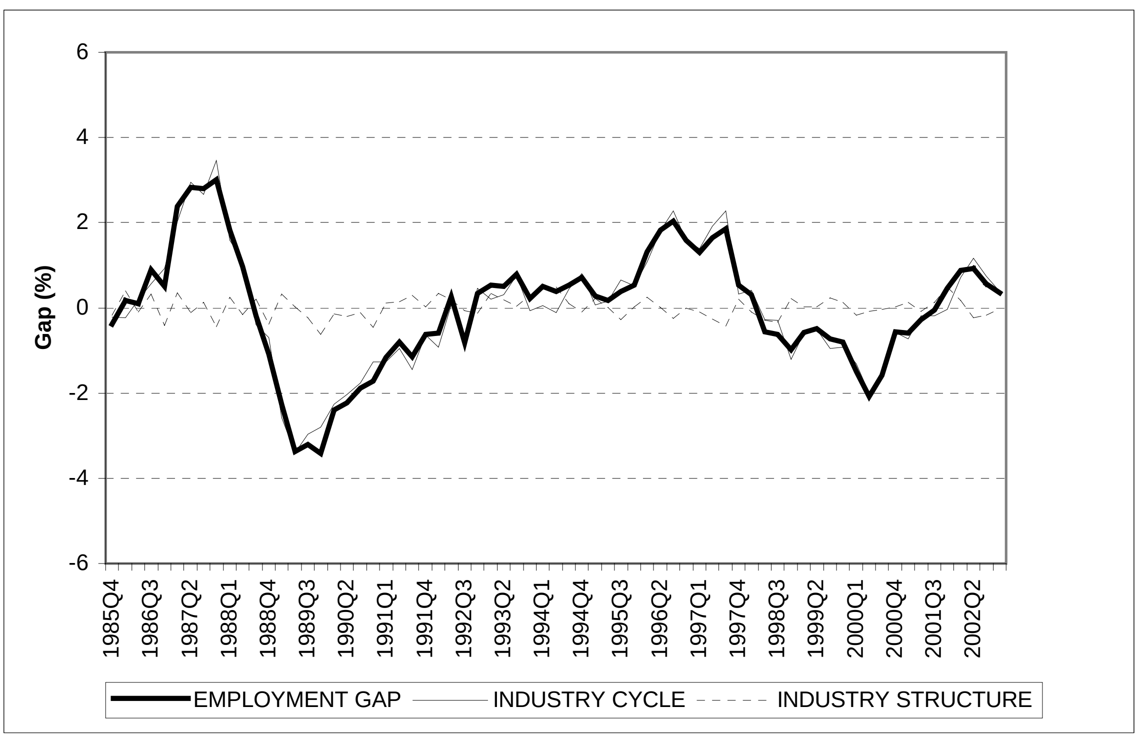


FIGURE 5: VAR Responses (Aggregate Industry)

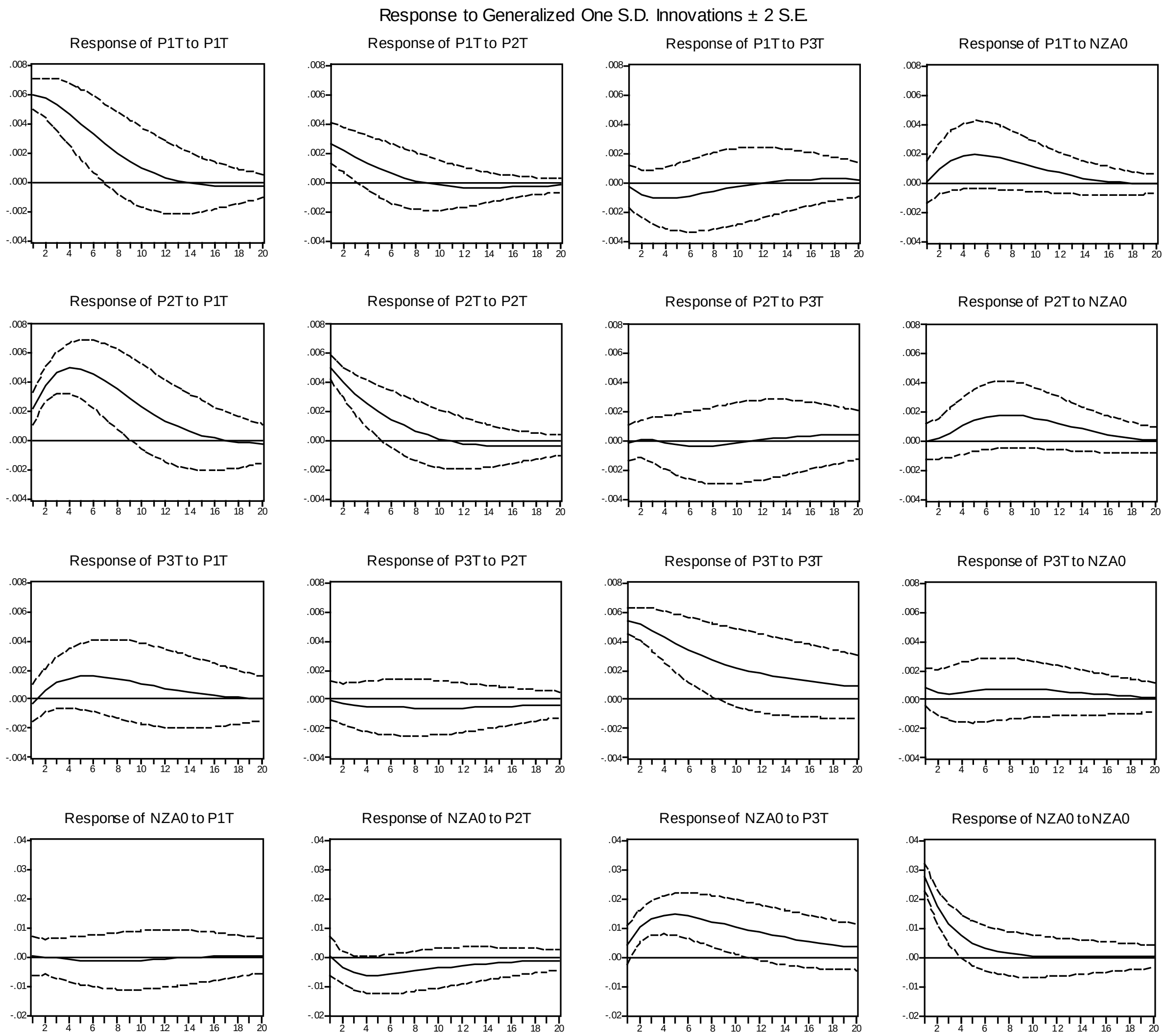


FIGURE 6: NZ Cycle (P3T) and Demeaned Cross Rate (NZA0)

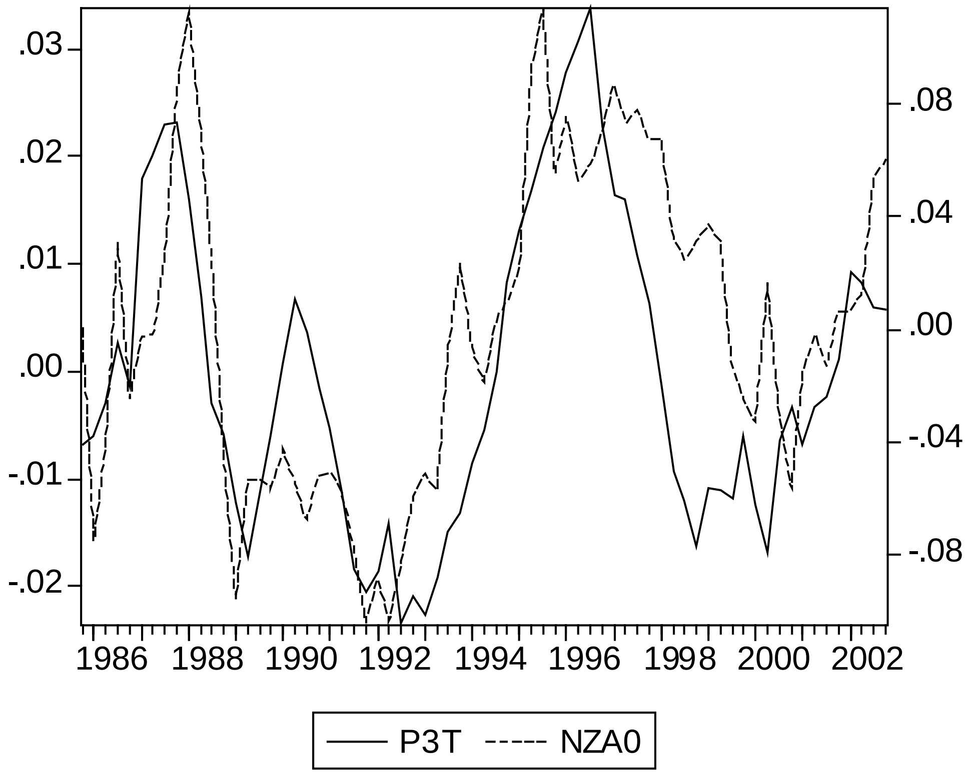


FIGURE 7: NZA0 Disaggregated VAR Responses