LABOUR MARKET ADJUSTMENT: EVIDENCE ON INTERSTATE LABOUR MOBILITY

Guy Debelle and James Vickery

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Abstract

In this paper, we investigate the behaviour of the Australian state labour markets, focusing on the role of geographic labour mobility. We find that interstate migration does play an important role in reducing differences in labour market conditions between states, although permanent (or very persistent) differences between state unemployment rates remain. We also find that out-migration from a state resulting from a relative downturn in its labour market occurs slowly and steadily. Most of the migration takes place, on average, within four years, and the process of adjustment is complete after seven years.

JEL Classification Numbers: E24, J60

Keywords: labour mobility, migration, unemployment

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1. Introduction

In general, state unemployment rates tend to move quite closely with the national unemployment rate. Nevertheless, in June 1997, the unemployment rate in Tasmania was 10.7 per cent while in Western Australia it was 7.0 per cent, compared with the national unemployment rate of 8.5 per cent. With an efficient labour market, one might not expect such disparities in unemployment rates across different regions of the country to persist.

One suggestion for reducing the rate of unemployment in Australia is increased geographic mobility of labour. If workers were more willing or able to move to different parts of the country, the component of the structural rate of unemployment attributable to geographic mismatch of jobs and workers would decline. Differing degrees of labour mobility is sometimes also advanced as a possible explanation for the relatively low rate of unemployment in the United States compared to Europe.

In this paper, we investigate the role of labour migration as an adjustment mechanism for reducing differentials in labour market conditions between states.[1] In particular, our aim is to discover (a) the extent to which migration of workers acts to reduce unemployment differentials between states, and (b) the speed with which migration operates as a channel of adjustment. We examine various indicators of the degree of labour mobility in Australia, and employ an empirical model used previously in the United States and in Europe to examine the contribution that interstate migration has made to mitigating the employment effects of state-specific shocks.

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1 Here and throughout the paper, 'state' encompasses the two territories in addition to the six states.

The evidence in this paper suggests that migration does play an important role in equalising labour market conditions between states, although the process takes some time. Despite this, there is some evidence of permanent (or very persistent) differences in unemployment rates across states. This is particularly so for Tasmania and South Australia, where the unemployment rate has generally been above the national average over the past two decades.

In the next section, we discuss the theoretical process of adjustment to labour market disequilibria across the states, and summarise the existing evidence on labour mobility both in Australia and overseas. In Section 3, we present some stylised facts of the state labour markets in Australia. In Section 4, we present results of some tests of the role of labour mobility in labour market adjustment. To examine the dynamics of labour migration, in Section 5 we estimate a model similar to that used by Blanchard and Katz (1992) in their study of labour mobility in the United States. We compare our findings to the results of that study, and to the Industry Commission (1993) who use a similar methodology to examine the issue. Section 6 concludes.

2. Theory and Existing Evidence

The Australian states can be considered as a series of small open economies with a fixed exchange rate. Each state is subject to state-specific shocks, in addition to national or aggregate shocks. Because there is a fixed exchange rate between states, when a state is hit by an adverse idiosyncratic shock, the adjustment mechanism of a state-specific depreciation, or a state-specific easing in monetary policy is not available. Rather adjustment can be facilitated by federal (or state) fiscal policy or by changes in factor flows and factor prices. Here we are focusing on the latter adjustment mechanism.[2]

Throughout we assume that there are no state-specific shocks to labour supply. That is, we are only concerned with changes in labour supply induced by interstate migration. Thus we abstract from the fact that a disproportionate number of overseas immigrants settle first in urban New South Wales (*Migration, Australia*,

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[2] These issues are particularly relevant for the European Monetary Union. See Eichengreen (1990) for a comprehensive discussion in that context.

ABS Cat. No. 3412.0), from where they may then subsequently migrate to other states. Also, there seems to be some evidence that there has been an exogenous shift in preferences through time towards living in Queensland (Hagan and Mangan 1996).

Rather, we assume that any shock to the state labour market is in the form of a labour demand shock, related to changes in the demand for the state's product. These shocks may arise because of the different industrial structures of the states – for example, South Australia and Victoria have a higher share of employment in the manufacturing industry than the other states[3] – or from state-specific financial shocks such as the difficulties of the State Bank of South Australia and the State Bank of Victoria in the late 1980s. Monetary policy may also have different regional impacts as certain states may have a higher concentration of more interest-sensitive sectors. Differences in state fiscal policy are another source of state-specific demand shocks.

Suppose there is an adverse state-specific shock, which generates a rise in unemployment relative to the national average. There are four possible avenues of adjustment which can eliminate this relative unemployment differential:

- Wage adjustment. The wage in the state falls relative to the wage rate in the rest of the country. This adjustment can be classified as a purely internal labour market adjustment.

- Firm (or capital) mobility. Firms relocate to the state to take advantage of the relatively larger pool of unemployed workers. This channel would be further enhanced by a fall in the relative wage.

- Labour mobility. Workers in the state migrate to a state where the unemployment rate is lower. Again, a fall in the relative wage would further encourage out-migration.

- Exit from labour force. Workers remain in the state, but leave the labour force.

[3] 17.3 per cent and 19.6 per cent respectively in February 1997, compared to a national average of 13.9 per cent.

Movements in the real wage therefore have an ambiguous effect on labour mobility. On the one hand, a fall in the wage will encourage out-migration because the return to working in the state is relatively lower. On the other hand, the lower wage will increase labour demand and encourage in-migration of firms, thereby reducing unemployment and hence, the incentive to move.

The wage adjustment mechanism depends on the definition of the 'relevant' labour market; for example, whether wages are determined at a suburban, state or national level. This issue has been addressed in a number of papers examining the existence of a 'wage curve'. Blanchflower and Oswald (1994) find a significant negative relationship between the wage level in a region and the regional unemployment rate for a number of countries including Australia. For Australia, they find an elasticity of -0.19 for the effect of changes in the state unemployment rate on average weekly earnings in the state. This suggests that local wage changes may play a major role in the adjustment process.

Kennedy and Borland (1997) re-examine the evidence of a wage curve for Australia and find that it is not robust to the inclusion of state fixed effects. They present evidence that Blanchflower and Oswald's finding of a significant effect of the state unemployment rate on the state wage levels reflects the fact that the state unemployment rate is proxying for other factors that vary across states, particularly housing costs.

It is difficult to assess the role that firm mobility plays in reducing unemployment differentials in the absence of data on job creation and destruction by state. However, there are reasons to believe that this may not be a major part of the adjustment mechanism, and may in fact work in the reverse direction. The existence of demand spillovers (Diamond 1982) implies that a region that has been hit by a negative idiosyncratic demand shock is less likely to attract (say) service sector firms. This would be further enhanced by the negative income effect of decreased employment and lower wages.[4]

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4 The recent decision by Bankers Trust to relocate some of its funds management operations to South Australia does, however, indicate that firms are willing to relocate to an area with an easily accessible pool of high quality unemployed labour.

Consequently, the mechanism we focus on here is labour migration. Harris and Todaro (1970) provide the seminal model of labour migration. In their model, the decision to migrate is dependent on a number of factors:

- Relative wages. The higher the wage in a particular location, the greater the probability of the worker moving to that location. However, even if the unemployment rate is relatively high in a particular location, a worker may still prefer to remain in that location if the wage there is high enough to compensate for the reduced likelihood of finding employment.[5]

- Relative employment prospects; that is the probability of employment in the home state relative to that in other parts of the country.[6]

- Housing costs. Housing is the largest non-tradeable good in the household's consumption basket, and hence, is likely to be the largest source of differences in the real consumption wage across locations. Oswald (1996) finds a positive relationship across countries between home ownership levels and unemployment rates, suggesting that the fixed costs of home ownership discourage migration.

- Other migration costs. These include the costs of physically relocating, as well as the less tangible costs of leaving an established network of friends and family.

Empirical evidence for the United States suggests that migration is a major part of the labour market adjustment mechanism. Blanchard and Katz (1992) find that in response to a state-specific increase in unemployment, labour migration plays the major role in reducing the interstate unemployment differential. A state returns to its trend rate of employment growth, but at a lower level of employment as workers leave the state. The migration response is strong even in the first year after a shock: if relative state employment falls by 10 workers, in the first year,

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[5] This is one of the key results of Harris and Todaro's model which was originally designed to explain urban migration in developing countries. The wage curve evidence of Blanchflower and Oswald provides counter-evidence to this proposition.

[6] One implication of the model is that if workers are risk averse, they will respond more to the relative employment probabilities than to the real wage. Treyz *et al*. (1993) provide evidence that supports this hypothesis.

unemployment rises by 3, the participation rate falls by 0.5, and 6.5 workers leave the state. In the long run (after 7 to 10 years), employment falls by around 13 workers, all of whom have migrated to other states. Thus there is an employment multiplier effect, consistent with Diamond (1982) demand spillovers.

Blanchard and Katz find that the regional nominal wage falls during the adjustment period, but does not contribute much to the adjustment process. However, they find that the regional consumption wage does not fall nearly as far, as house prices also tend to fall when a region is hit by a negative shock. The fall in house prices and resultant fall in household wealth should also reduce the incentive to move. These results suggest that the decision to migrate is driven by the state of the labour market rather than by the fall in the nominal wage. The fact that workers shift rather than firms is thus more surprising, given that the consumption wage is relatively unchanged (decreasing the incentive of workers to migrate out of a depressed region) while the nominal wage falls (increasing the incentive of firms to move in).

Decressin and Fatas (1995) find that labour mobility plays a considerably smaller role in the adjustment of European labour markets to region-specific shocks. They find that unemployment returns to trend after a region-specific shock because of changes in the participation rate rather than migration. That is, workers leave the labour force rather than the region. Bentolila (1997) finds that in Spain, there is evidence even of in-migration to depressed regions, rather than out-migration from depressed regions. This may be due to return migration or compensating differentials such as quality of life and housing prices. He also finds that the level of migration is negatively related to the national level of unemployment. This suggests that the workers perceptions of the probability of employment in other regions is significantly correlated with the national unemployment level. This negative correlation is also found by Faini *et al*. (1997) for Italy, and by Pissarides and Wadsworth (1989) for the UK. Faini *et al*. also attribute the declining rate of inter-regional migration in Italy over the past 20 years to high mobility costs, particularly caused by the lack of national co-ordination of job placement activities.

Pissarides and Wadsworth find that in the UK, the unemployed are more likely to move than the employed. However, Bentolila finds the converse is true for Spain. The employed may be more mobile because they are more likely to transfer states with their existing employer. Secondly, they may be less credit constrained in meeting the adjustment costs of shifting location. On the other hand, the unemployed may have more incentive to search for employment in other regions.

Pissarides and Wadsworth also find that an unemployed worker in a high unemployment region is no more likely to move than an unemployed worker in a low unemployment region. DaVanzo (1978) finds that the converse is true in the United States. McCormick (1997) finds that differences in regional unemployment rates in the United Kingdom are primarily the result of differences in the unemployment rate of manual workers. In response to an adverse region-specific shock, non-manual labour tends to migrate, whereas manual labour tends to leave the labour force.

In Australia, the Industry Commission (1993) analysed the impact of labour migration on relative unemployment rates in a framework very similar to the one used in Section 5 of this paper. Their empirical work employs a vector error correction model, based on unit root tests suggesting that all the variables used in their model are non-stationary. They find that changes in the participation rate are a major part of the adjustment mechanism to state-specific shocks and that migration has a relatively minor role in the adjustment process. The different stationarity assumptions, as well as the shorter sample period employed in their study accounts for the differences between their results and those presented in Section 5.

Borland and Suen (1990) analyse the interaction between labour mobility and unemployment differentials for Australia. They conclude that state-specific shocks exacerbate unemployment differentials in the short run, although labour mobility acts to equalise unemployment rates in the long run. The implication of this analysis is that long-run differentials in unemployment rates between states reflect compensating differentials (in terms of real wages or lifestyle factors).

Kilpatrick and Felmingham (1996) examine the issue of inter-industry labour mobility in Australia. They find that mobility varies significantly across states, and for males is dependent on the state of the cycle, and the length of job tenure. The likelihood of mobility is not affected by education levels or occupation (which may be seen as proxying for skill), counter to the results found for the UK. Their study is based on analysis of unit record data in the ABS survey of labour mobility

(Cat. No. 6209.0). Unfortunately, the published survey contains little useful information about interstate labour mobility, and without access to the unit record files, we do not make much use of the survey in this paper. The most recent Labour Mobility survey (for the year ended February 1996) reveals that among interstate migrants who were marginally attached to the labour force, approximately half were employed both at the time the sample was taken and twelve months previously, while the other half were either unemployed, or out of the labour force, at either the start or the end (or both) of the year of their migration.

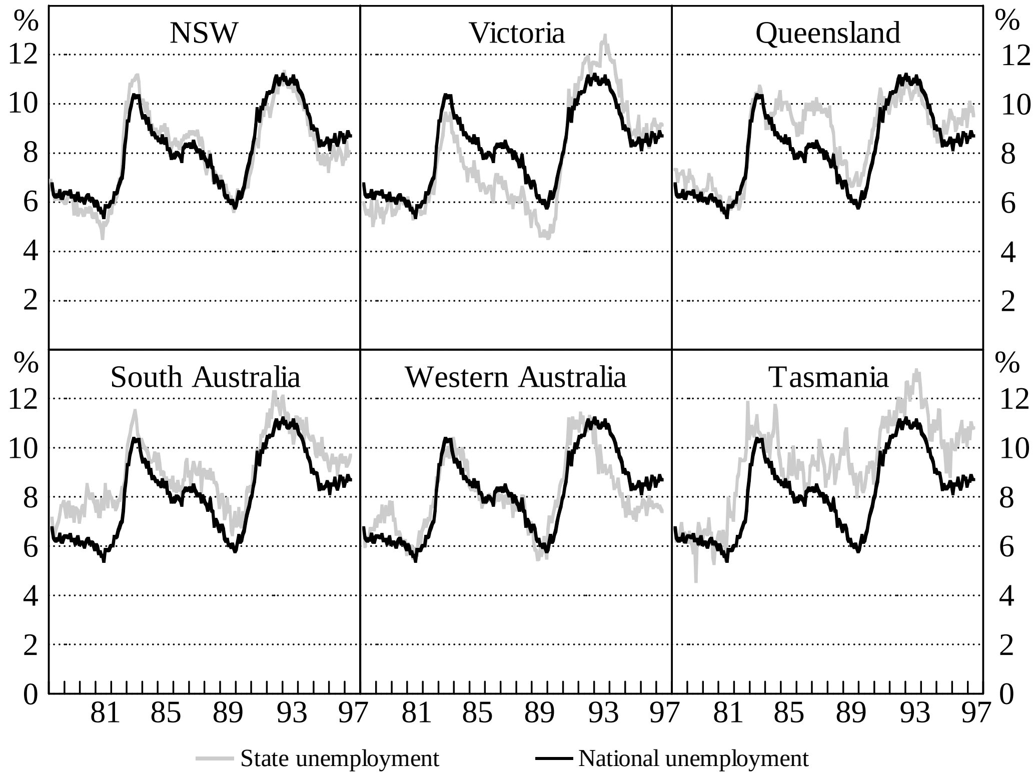
Finally, the definition of a region we are looking at in this paper is the state. We are implicitly assuming that the intra-state labour market functions relatively effectively and that the major barriers to mobility are at the interstate level. Gregory and Hunter (1995) suggest that this may not be so, in that labour may be relatively immobile between suburbs within a city, because of the importance of informal job placement and informal job networks. Intra-state immobility would further raise the natural rate of unemployment by increasing geographic mismatch between workers and jobs.

3. Stylised Facts of the State Labour Markets

In this section we present some stylised facts about the relative performances of the state labour markets over the past 20 years. Figure 1 shows the relative unemployment performance of the states over the past two decades. The grey line plots the unemployment rate of the state, and the black line the national unemployment rate.

The panels show that the unemployment performance of the states has varied both in comparison with each other and through time. Nevertheless, most of the movement in state unemployment rates can be explained by variation in the national rate. As evidence of this, the coefficient of determination (R^2) between the state and national unemployment rates is generally high, varying between 0.75 (for Western Australia and Tasmania) and 0.9 (in the cases of New South Wales and South Australia). That is, at least three-quarters of the variation in a state's unemployment rate is attributable to variations in national unemployment. Groenewold (1990) finds that the variation in unemployment rates between states compared to the national unemployment rate can be partially, although not entirely, explained by the different sensitivities of states to the business cycle.

Figure 1: Unemployment Rate by State

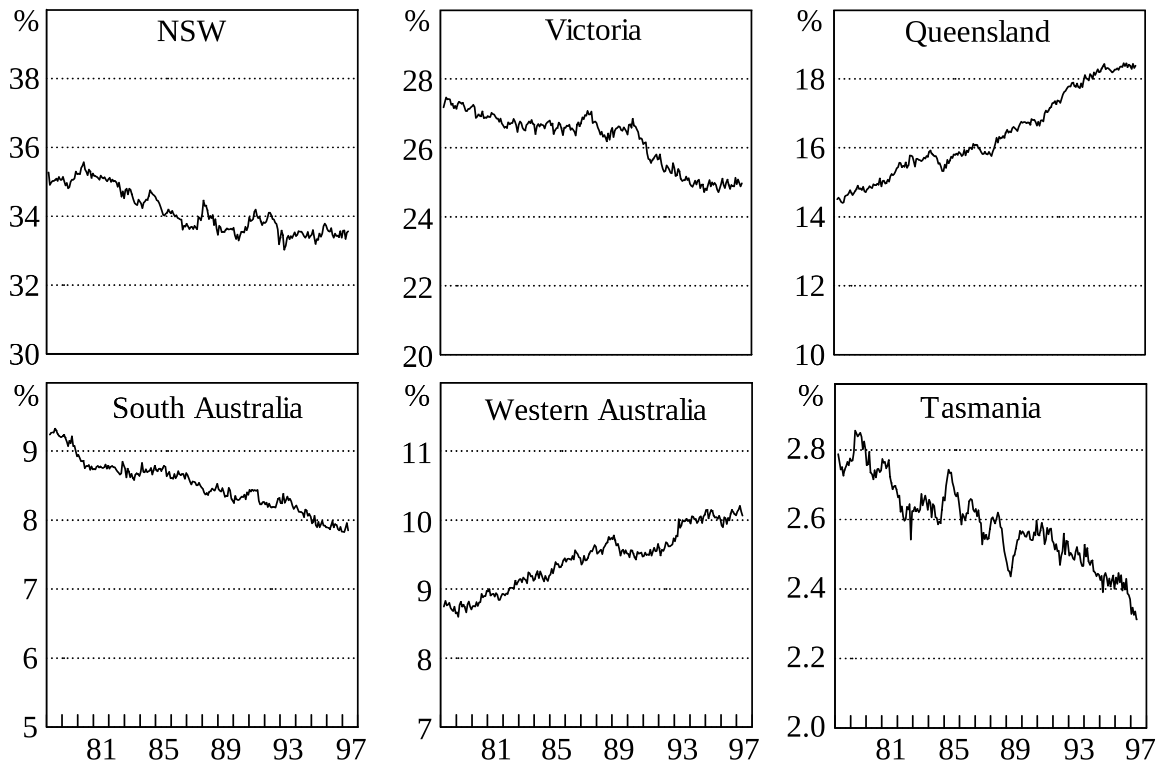


We now turn to a more detailed examination of the state unemployment rates. The unemployment rate in New South Wales has generally fluctuated in a relatively narrow range around the national average. In the 1980s, the unemployment rate in Victoria was considerably below the national average by as much as 2 percentage points; however, Victoria was particularly hard hit by the recession in the early 1990s. The unemployment rate in Western Australia was similar to the national rate through much of the 1980s, but fell considerably faster than the national average during the recent recovery. In both South Australia and Tasmania, unemployment rates have remained persistently higher than the national average. The unemployment rate in Tasmania has averaged around 1.3 percentage points above the national average over the past 20 years. The ACT enjoyed low unemployment rates throughout the 1980s, and due to high levels of public sector employment was less affected by the recession than any other state or territory. However, public sector downsizing has seen an increase in the unemployment rate in recent years. The Northern Territory also experienced lower than average unemployment rates over most of the sample period.

Queensland has had a high unemployment rate relative to the national rate in recent years. However, a different perspective is gained when we examine the relative *employment* performance of the states (Figure 2). The panels show the share of national employment in each state. The scales have been adjusted to reflect differences in population size.

Figure 2: Employment

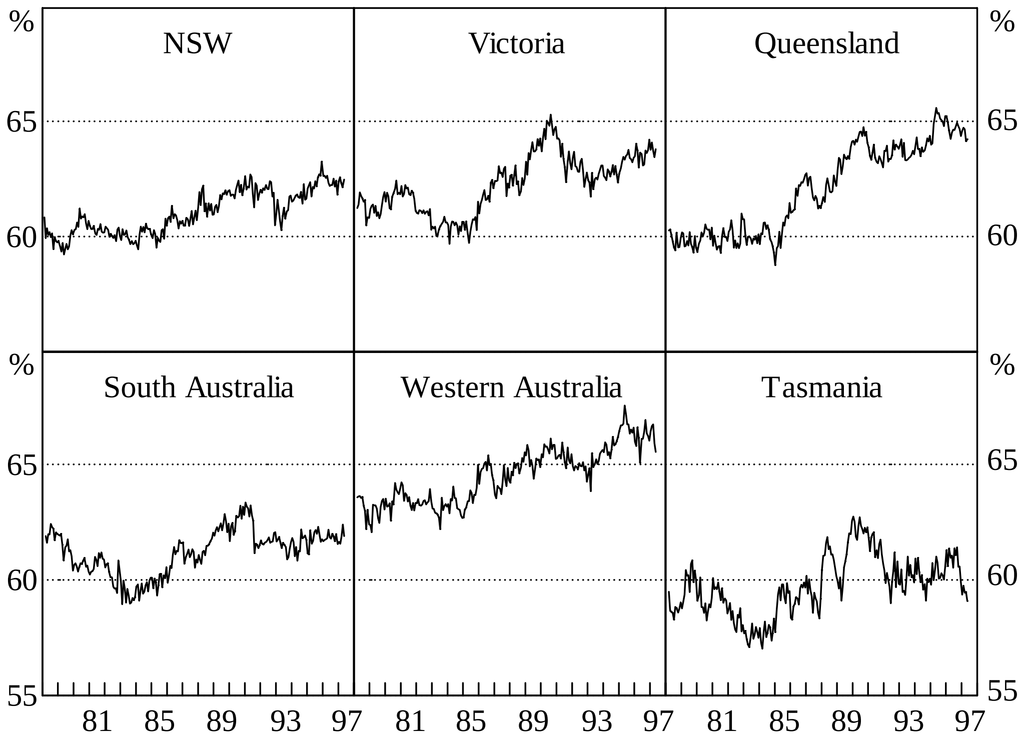
Employment in each state as a proportion of total employment



The rise in the employment share of Queensland over the past two decades is particularly noticeable. The Queensland labour market has absorbed a large amount of labour over this time. The fact that it has not completely absorbed all the in-migration is one of the reasons for the relatively high unemployment rate in that state. Hagan and Mangan (1996) argue that this suggests that the in-migration experienced by Queensland reflects supply-side factors (at least in part). Also clearly evident in Figure 2 is the trend decline in the employment shares in South Australia and Tasmania.

The trends in, and levels of, the participation rate also reflect these relative labour market performances (Figure 3). Participation rates in both Western Australia and Queensland, where employment growth has been strong, are significantly higher than the national average. Further, the participation rate in Queensland has been trending upward at a much faster rate than the national average (which has itself risen over the sample period). Participation rates in Tasmania, South Australia and New South Wales have been below the national average. Furthermore, the participation rates in Tasmania and South Australia have not risen over the sample period, reflecting the relatively poor employment opportunities in those states. The low participation rates in Tasmania and South Australia may also reflect a discouraged worker effect, and correspondingly a higher degree of hidden unemployment compared to other states.

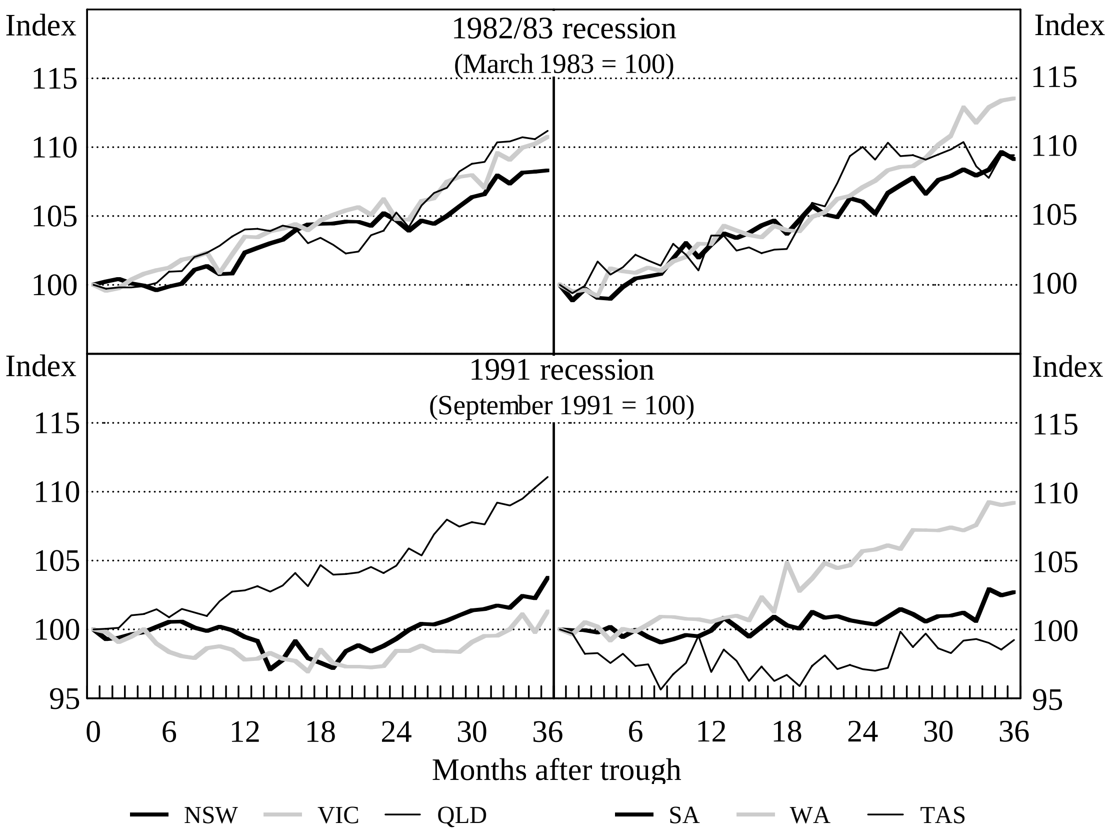
Figure 3: Participation Rate



There have been significant differences in the relative performances of the state labour markets following the 1991 recession, unlike the experience following the 1982/83 recession. Figure 4 shows the path of employment in the states following the two recessions. During the recovery after the 1982/83 recession, all the states experienced roughly the same growth in employment, although Western Australia and Queensland had slightly stronger employment growth than the other states.

However, in the more recent recovery, employment growth in both Western Australia and Queensland has been considerably higher than in the other states, and the relatively weak employment performance in South Australia and Tasmania is also apparent. In Tasmania, employment levels are still only around those at the trough of the recession. The contrasting experiences following the two recessions suggest that migration has a larger role to play as an equilibrating mechanism in the current recovery than it has in the past.

Figure 4: Employment after Recessions



4. Tests of Labour Mobility

In this section of the paper, we examine how variation in labour market performance across states has been affected by labour mobility. We present the results of three simple tests of the role of mobility in labour market adjustment. First of all we present some facts about interstate migration.

Total interstate migration activity can be examined by considering gross flows data (gross flows are defined as the sum of in- and out-migration for a state). By this measure, migration flows have increased somewhat; gross flows as a share of population have risen from 3.3 per cent in 1976 to 4.0 per cent in 1996, an increase of 18 per cent.[7] This result is consistent with the view that economic integration between Australian regions has increased over time.

Another perspective on labour mobility can be obtained by examining data from the ABS Survey *Australians' Employment and Unemployment Patterns* (ABS Cat. No. 6286.0). Table 1 shows the response of job seekers to the question 'Would you be prepared to move interstate if offered a suitable job?'

Table 1: Willingness to Move Interstate

Percentage of job seekers willing to move interstate if offered a suitable job

State	Percentage	State	Percentage
New South Wales	31.4	Western Australia	34.2
Victoria	36.9	Tasmania	41.2
Queensland	34.1	Northern Territory	50.0
South Australia	43.1	ACT	48.2

In general, respondents in states with relatively poorly performing labour markets (particularly South Australia and Tasmania) are more receptive to moving interstate to find employment. This result supports the view that labour migration does respond to state labour market conditions. Respondents in smaller states are generally more willing to move interstate, possibly because the breadth and diversity of job opportunities is less in smaller states.

The above survey question assumes that the respondent has been offered a job in another state with certainty. If employment in the new state is not guaranteed, two further impediments to mobility exist, in addition to the costs of migration discussed in Section 2 in terms of the Harris-Todaro model. Firstly, individuals may have inadequate or misleading information about relative job opportunities in different states. Secondly, prospective interstate migrants have limited access to local job networks in other states, reducing their probability of employment

7 *Migration, Australia*, ABS Cat. No. 3412.0.

interstate. Both these factors act to reduce the incentive for an individual to migrate.

Table 2 details migration levels for each state and territory for the year ended 30 June 1996. Note that the table only reflects internal flows within Australia, not flows to and from other countries.

Three states experienced positive net migration flows: Queensland, Western Australia and the Northern Territory. Of these, flows to Queensland were by far the largest. In fact, interstate migration to Queensland was large enough to absorb the net out-migration from New South Wales, Victoria and South Australia. Tasmania and South Australia experienced the largest net out-migration relative to population. Both these states lost about half of 1 per cent of population through interstate migration over 1995/96.

Table 2: Interstate Migration in Australia

Year ended 30 June 1996

State	Arrivals (000s)	Departures (000s)	Net migration (000s)	Net migration/ population (per cent)
New South Wales	87.9	103.5	-15.7	-0.25
Victoria	57.1	73.4	-16.4	-0.36
Queensland	113.5	76.0	37.5	1.12
South Australia	25.9	32.1	-6.2	-0.42
Western Australia	33.2	29.4	3.8	0.22
Tasmania	10.6	13.3	-2.7	-0.58
Northern Territory	18.9	18.7	0.1	0.07
ACT	19.0	19.5	-0.5	-0.15

Thus, the two states with the lowest employment growth have the highest out-migration, and the two with strongest employment growth have the highest in-migration. This evidence is consistent with the view that workers migrate in response to labour market differentials between states. However, this conclusion should be treated cautiously, since the direction of causality between labour migration and employment growth is unclear.

If labour was perfectly mobile across the states, we might expect all the states to have the same unemployment rate in the longer term. In practice, however, there might be persistent differences in state unemployment rates, because of compensating differentials in wages, lifestyle etc. One simple test of the role of labour mobility as an equilibrating mechanism, is to examine whether the state unemployment rates are cointegrated with the national rate.[8] In conducting this test, we allow for a constant difference between a state's unemployment rate and the national rate.

The results of the cointegration tests show that the null hypothesis of no cointegration can be rejected for South Australia, Tasmania and the two territories, suggesting some degree of labour mobility (Appendix A). In contrast, Groenewold (1992) finds that state unemployment rates have no tendency to converge to a common national rate, even in the long run. Note however, that our test for cointegration does not impose a common unemployment rate because we allow for constant terms in the cointegrating relations.

We also estimate a VAR of the state unemployment rates and test for cointegrating relations between the states using the Johansen (1988) procedure. If labour market adjustment acts to close unemployment-rate differentials between states over time, then there should be seven cointegrating relations between the eight states and territories. Results of this test are also presented in Appendix A. Two cointegrating relations were found between the eight state unemployment rates. To better identify the nature of the cointegrating vectors, a series of exclusion restrictions was tested but each of these restrictions was rejected at the 5 per cent level.

These results suggest that labour market adjustment does act to decrease unemployment differentials between states over time, although a modelling strategy based on unemployment rates alone is not sufficient to capture the relevant adjustment mechanisms.

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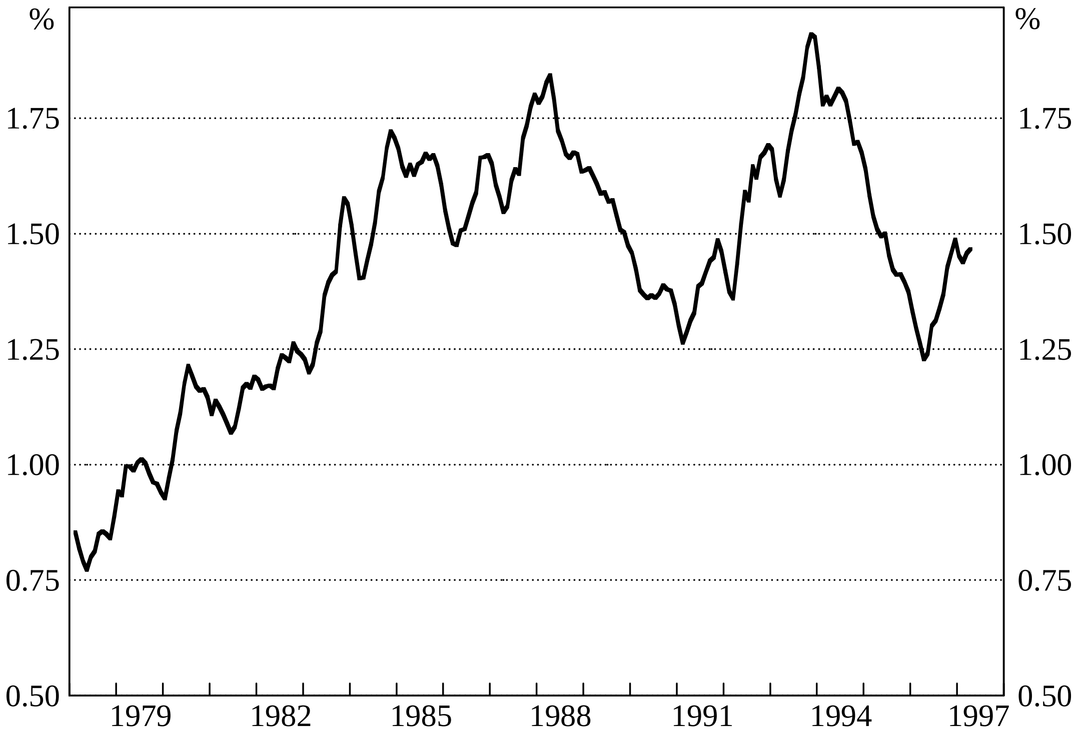
8 Clearly a precursor to undertaking this analysis is establishing that the state unemployment rates are actually non-stationary. A panel unit root test was conducted on the pooled state unemployment rates which concluded that it was not possible to reject the null hypothesis that the state unemployment rates were integrated of order 1 at the 5 per cent level of significance.

A second simple indicator of the degree of labour mobility is the standard deviation of the state unemployment rates. If labour was perfectly mobile we would expect that the standard deviation would be close to zero, as unemployment differentials would be quickly eliminated. Figure 5 shows that the standard deviation of the state unemployment rates has risen over time to around 1.5 per cent (the figure is just over 1 per cent if the territories are excluded from the calculation). This is only slightly higher than the dispersion of the state unemployment rates in the United States and considerably lower than the dispersion of regional unemployment rates for the European Community reported in Eichengreen (1990), suggesting that labour mobility in Australia may be similar to that in the US.

Figure 5: Unemployment Dispersion

Standard deviation of state unemployment rates from national rate



However, this measure of mobility is affected by the dispersion of shocks across the different states. If the states in the US have larger idiosyncratic shocks than in Australia (for example, because of greater differences in industry composition), in the short run, we would expect greater dispersion of unemployment rates in the US, regardless of the degree of labour mobility. On the other hand, there are larger distances between capital cities in Australia, and hence, greater costs of relocation, which may increase the persistence of state unemployment differentials.

Thirdly, we regress the ratio of net migration into a state to the state's population on the state's relative unemployment rate differential. Our prior is that a high state unemployment rate will encourage out-migration from that state, thus the coefficient on the unemployment rate differential should be negatively signed. We also regress the absolute value of the net migration ratio on the absolute value of the unemployment differential and the national unemployment rate. If individuals are liquidity constrained in times of high unemployment, then the magnitude of total migration flows might be expected to fall.

In both cases, a fixed-effects panel regression was conducted. The results are presented in Table 3.

Table 3: State Unemployment and Migration

Regression 1:

$$\frac{\textit{net migration}_{it}}{\textit{population}} = \alpha_i \underset{(6.21)}{-0.2547} \left(\textit{state unemployment rate}_{it} - \textit{national unemployment rate}_t\right)$$

α_{NSW}	= -0.0041	(-3.55)	α_{WA}	= 0.0023	(1.98)	$\bar{R}^2 = 0.34$
α_{VIC}	= -0.0056	(-4.76)	α_{TAS}	= 0.0010	(0.77)	
α_{QLD}	= 0.0156	(13.97)	α_{ACT}	= -0.0060	(-4.74)	
α_{SA}	= -0.0000	(-0.04)	α_{NT}	= -0.0011	(-0.78)	

Regression 2:

$$\frac{|\textit{net migration}_{it}|}{\textit{population}} = \alpha_i \underset{(2.00)}{+0.0768} \left|\textit{state unemp}_{it} - \textit{nat. unemp}_t\right| - \underset{(-3.40)}{0.0643}\ \textit{nat. unemp}_t$$

α_{NSW}	= 0.0090	(5.08)	α_{WA}	= 0.0081	(4.58)	$\bar{R}^2 = 0.41$
α_{VIC}	= 0.0092	(5.21)	α_{TAS}	= 0.0089	(5.00)	
α_{QLD}	= 0.0199	(11.29)	α_{ACT}	= - 0.0217	(12.06)	
α_{SA}	= 0.0074	(4.23)	α_{NT}	= - 0.0126	(6.84)	

Notes: t-statistics in parentheses
unemp refers to *unemployment rate*

As expected, the higher a state's unemployment rate relative to the national rate, the more people leave (less people enter) the state. If a state's unemployment rate rises one percentage point above the national unemployment rate, there is a 0.25 percentage point increase in net out-migration relative to population. The state-specific constant terms are significant in most cases, indicating that some net interstate migration occurs even in the absence of interstate unemployment differentials. The migration/population rates have been annualised, thus a coefficient of 0.0165 (as for Queensland), implies an annual net migration/population ratio for that state of 1.65 per cent in the absence of unemployment differentials. The results in the second regression show that the higher the national unemployment rate, the less people migrate between states.

Collectively, the evidence from these three tests suggests mobility does play a significant role in labour market adjustment. In particular, the relatively low dispersion of state unemployment rates, and the significant influence of unemployment differentials on migration patterns supports the role of migration as an adjustment mechanism. However, in the case of Tasmania and South Australia, this mobility has been insufficient to reduce unemployment in those two states to the national average. In addition, the cointegration analysis provides somewhat ambiguous evidence of labour mobility as an adjustment mechanism to state-specific shocks. Since state unemployment rates are highly correlated with aggregate unemployment; and given that labour migration already appears to work reasonably well in moderating state labour market differentials, it is questionable whether higher mobility would greatly reduce the national unemployment rate.

5. Dynamics of State Labour Market Adjustment

In the above discussion we have paid little attention to the actual dynamics of migration flows in response to factors that adversely affect employment in a particular state. In this section we address this issue using a VAR model of the state labour markets that incorporates information on state employment, unemployment and participation rates. The model is based on Blanchard and Katz (1992), and although it does not explicitly incorporate net migration, an estimate of migration flows can be backed out of the model based on the time paths of the other variables.

We use monthly data on employment, the labour force and population for the states and territories as the basis of our empirical work. From this data, we construct three labour market variables. The first variable is (the natural logarithm of) employment in the state as a proportion of total employment. The second variable compares the unemployment rate in the state to the national unemployment rate. It is actually defined as the log ratio of the state and national 'employment rates' (where the employment rate is one minus the unemployment rate). This definition is consistent with the equivalent variables defined in Blanchard and Katz, and Decressin and Fatas (1995).[9] The third variable is a log ratio of the state participation rate to the national participation rate.

In each case, the variable is a ratio between the state and national levels and is thus a measure of the relative performance of the state. The variables are defined in this way because it is differences between labour market conditions across states (such as unemployment rate differentials) that should encourage the movement of labour between states.

The actual definitions of the variables are:

$$em = \ln\left(\frac{\textit{employment in the state}}{\textit{total employment}}\right)$$

$$\begin{aligned} ur &= \ln\left(\frac{1 - \textit{state unemployment rate}}{1 - \textit{national unemployment rate}}\right) \\ &= \ln\left(\frac{\textit{employment in the state / labour force in state}}{\textit{total employment / total labour force}}\right) \end{aligned}$$

$$\begin{aligned} pr &= \ln\left(\frac{\textit{state participation rate}}{\textit{national participation rate}}\right) \\ &= \ln\left(\frac{\textit{labour force in the state / population in state}}{\textit{total labour force / total population}}\right) \end{aligned}$$

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9 The distinction between defining this variable in terms of employment rates or unemployment rates is not crucial, since $\ln[(1 - U_S) / (1 - U_N)] \approx U_N - U_S$, whereas $\ln(U_S/U_N) = \ln(U_S) - \ln(U_N)$.

The exact specification of the model chosen is dependent upon the time series properties of the variables. In Blanchard and Katz, the employment share (*em*) is treated as integrated of order 1 (I(1)) and first differenced, while the other two variables are modelled in levels. We conduct two tests to investigate whether this specification is consistent with the Australian empirical evidence on the persistence of the three variables. Firstly, we apply a panel unit root test on each variable across all the states. Secondly, we conduct univariate unit root tests on each variable for each state. Results of both tests are presented in Appendix A.

From the panel unit root tests, the employment share (*em*) is I(1) (although it is possible to reject the null of non-stationarity at the 10 per cent level), while the unemployment rate and participation rate are both stationary at the 1 per cent level of significance. However, the unit root tests on the individual series often produce contradictory results for the same variable. The employment share is found to be I(1) in seven cases, but stationary in Tasmania. Results for the relative unemployment rate imply a stationary relative unemployment rate in four cases (South Australia, Tasmania, ACT and the Northern Territory), and a unit root in the other four. Our results from Section 4 on the stationarity of relative unemployment rates are also mixed, with some state unemployment rates found to be cointegrated with the national rate while others are not. The relative participation rate is generally found to be stationary.

Based on the panel unit root results we tentatively conclude that the employment share is integrated of order 1 and the relative unemployment rate and the relative participation rate are stationary. The model specification we use is:

$$\begin{aligned}
\Delta em_{jt} &= \alpha_{1,j} + \sum_{s=1}^{n} \delta_{1,s} \Delta em_{t-s} + \sum_{s=1}^{n} \beta_{1,s} ur_{t-s} + \sum_{s=1}^{n} \phi_{1,s} pr_{t-s} + \varepsilon_{1jt} \\
ur_{jt} &= \alpha_{2,j} + \sum_{s=0}^{n} \delta_{2,s} \Delta em_{t-s} + \sum_{s=1}^{n} \beta_{2,s} ur_{t-s} + \sum_{s=1}^{n} \phi_{2,s} pr_{t-s} + \varepsilon_{2jt} \qquad (1) \\
pr_{jt} &= \alpha_{3,j} + \sum_{s=0}^{n} \delta_{3,s} \Delta em_{t-s} + \sum_{s=1}^{n} \beta_{3,s} ur_{t-s} + \sum_{s=1}^{n} \phi_{3,s} pr_{t-s} + \varepsilon_{3jt}
\end{aligned}$$

where *j* denotes a state.

This system can be viewed as the reduced form of an (unknown) structural model of regional labour markets. The structure described above is a standard VAR except that changes in the share of total employment (Δem) feed through simultaneously into the unemployment rate and the participation rate (*ur* and *pr*).

Since we model the relative unemployment rate as a stationary variable, our specification dictates that, at least in the long run, shocks to state unemployment rates relative to the national rate will be eventually unwound. Therefore our assumptions imply that migration does work in the long run to eliminate unemployment differentials between states. There may, however, be persistent differences between state unemployment rates during the adjustment process to a shock. As the figures in Section 4 and the unit root tests suggest, this process of adjustment might take many years in some cases.

Given data limitations we impose the rather strong assumption that the responses to a shock (that is the coefficients) are identical across all states. This assumption is unlikely to hold true in practice. Our results should thus be interpreted as the *average* response across states to a labour demand shock. The model does incorporate fixed differences between states by allowing the constant term α to vary across states. Thus, the model can allow for constant steady-state differences in unemployment rates or participation rates between states but the adjustment path to a shock is the same in each case. For the moment, the effect of a labour demand shock on the real wage is ignored; this transmission channel is introduced in Section 5.2.

5.1 Estimation Results

The model is estimated using ordinary least squares[10] over the period 1979:Q2 to 1997:Q1, which with six states and two territories yields a total of 576 quarterly

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[10] An alternative estimation technique would be to apply Feasible Generalised Least Squares (FGLS), which is asymptotically efficient where there are correlations between the error terms in each equation in the system. In the context of a standard VAR, it can be shown that OLS is equivalent to FGLS because the same set of right-hand-side variables appears in every equation. This is not strictly true of the system estimated above, because Δem enters contemporaneously into two of the equations. But it was found through some preliminary estimation that the gains to using FGLS are small in this context, because of the near-VAR structure of the model.

observations.[11] A common lag length of six quarters is employed for each equation.[12] Tests of the joint significance of the lags of each variable in each of the three equations are presented in Appendix B. Each of the variables is significant in each equation at the 1 per cent level. The adjusted R^2 for the unemployment rate and participation rate equations are high, 0.87 and 0.99 respectively. The adjusted R^2 for the employment equation is much lower (0.25), in part reflecting the fact that the employment variable is modelled in first differences.

Figure 6 summarises the results by showing the response of the system to a 1 per cent negative shock to the employment equation. The upper panel shows the impulse response of employment, unemployment, and the participation rate to the employment shock. The unemployment rate and participation rate shown are the actual percentage point deviation of each variable from the baseline.[13] Initially, the 1 per cent decrease in employment results in a decrease in the participation rate of 0.4 per cent, and a 0.2 per cent increase in the unemployment rate. Most of the initial decrease in employment is later reversed. The participation rate and unemployment rate return back to their base levels (by construction). The process of adjustment takes approximately four years.

The lower panel shows the net migration response to the negative employment shock, which is computed as a 'residual' from the time path of the three variables in the VAR.[14] Approximately half of the out-migration occurs in the first year after the shock, and three quarters of the net migration is complete within two

[11] The data is available at a monthly frequency, but is aggregated into quarterly observations for estimation purposes. The primary motive for this is so that wages (which are only available on a quarterly basis) can be added seamlessly to the model. Estimation results are generally robust to whether quarterly or monthly data is used.

[12] The Schwarz criterion indicated an optimal lag length of 1, which would not provide a rich enough dynamic structure for the model. Consequently, six was chosen as a 'reasonable' lag length. As is demonstrated in the sensitivity analysis in Appendix B, the choice of a lag length is not crucial to the inferences generated from the VAR model.

[13] These are derived from the *ur* and *pr* variables using $d(U/L) = (E/L)*dln(L/E)$ and $d(L/P) = L/P*dln(L/P)$ where *E*, *L* and *P* refer to employment, the labour force and population respectively.

[14] It can be obtained from the identity: $dln(P) = dln(E) - dln(E/L) - dln(L/P)$, where *P* is population, *L* is the labour force and *E* is employment, and all variables are expressed as a proportion of the national level.

years of the shock. The cumulative out-migration generated increases steadily, reaching its peak three years after the shock.

Figure 6: Impulse Responses to a Negative Employment Shock

Model excluding wages

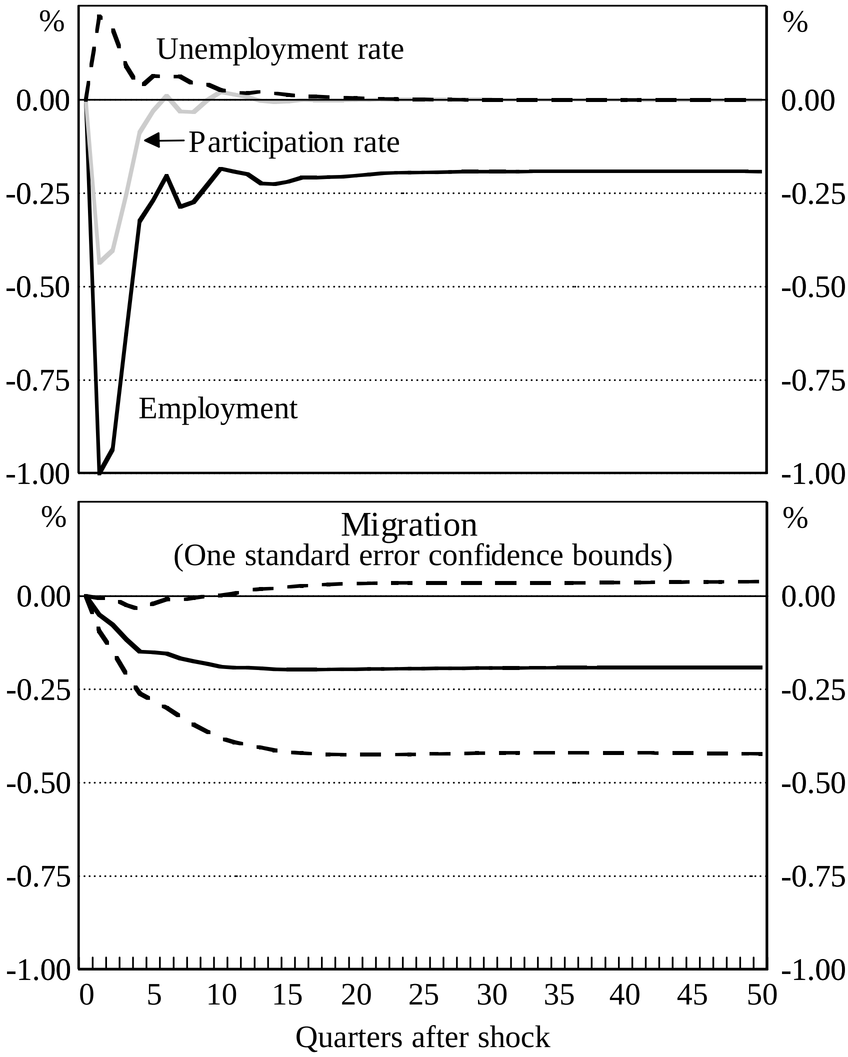


Figure 6 also presents one standard error confidence bounds for net migration. These were obtained through stochastic simulation with 1 000 replications. Notably, zero is (just) inside the confidence band for the migration response. Thus, although our point estimate of the level of net migration in the long run is negative (-0.19), a considerable degree of uncertainty should be attached to this figure. Confidence bands were also generated for each of the three variables in the model, although for clarity, these are not presented in Figure 6. The bands are of similar width to the confidence intervals reported in Blanchard and Katz (1992). The largest uncertainty is associated with the employment response.

5.2 Incorporating Wages

The above analysis ignores the potential effect of lower labour demand in a state on the real wages in the state. As discussed in Section 2, the net effect of the real wage on migration is ambiguous. A lower real wage can increase labour demand, reducing unemployment and thereby decreasing mobility; but a lower real wage also increases the incentive to move interstate to seek higher-paid employment. Consequently we extend the VAR framework to include real wages.

The wages variable is defined as follows:

$$wage = \ln\left(\frac{\text{average weekly earnings for the state}}{\text{average weekly earnings for Australia}}\right)$$

Wage measures the relative level of average weekly earnings, compared to the national average. Individual unit root tests conducted on the wage variable were inconclusive, with five of the eight states indicating a stationary relative wage. The panel unit root test suggested that *wage* was I(1) at the 5 per cent level of significance (although not at the 10 per cent level). Based on these somewhat inconclusive results, *wage* is initially modelled as an I(1) variable, allowing the impulse response of relative wages to deviate from zero in both the short and long run. We investigate the effect of modelling *wage* as I(0) in Appendix B.

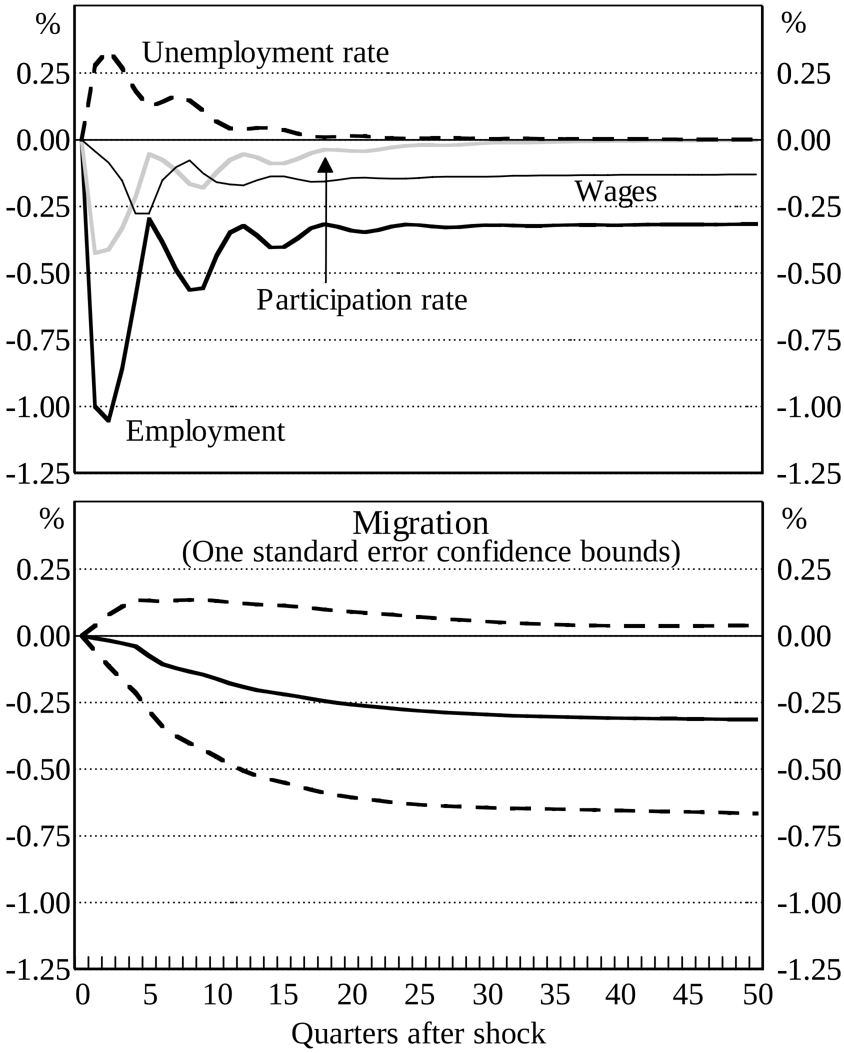
Real wage data is available by state only from 1981:Q4. Furthermore, wages data from the ACT and Northern Territory is not available until even later (1983:Q4), and is of relatively poor quality. As a result, the model was estimated from 1981:Q4, with the two territories excluded from the analysis. The three-variable model described at the beginning of this section is appended by including the first difference of the *wage* variable described above. Summary statistics for this model are presented in Appendix B.

In the first three equations, each of the four variables is usually significant in explaining variation in the dependent variable. The exception is the wages equation, where the level of the other three variables (i.e. the relative labour market conditions in the state), play little role in determining the increase in real wages. In addition, the adjusted R^2 for the wages equation was only 0.09. These results suggest that state wage bargaining processes in Australia over the sample period were largely driven by factors other than relative labour market conditions. This in turn implies that wage adjustments provide only a weak mechanism for the transmission of labour demand shocks.

Impulse response results from this four-variable VAR are presented in Figure 7. In this specification, a 1 per cent negative shock to employment is associated with a rise in the unemployment rate of approximately 0.3 per cent. The participation rate decreases initially by 0.4 per cent before rising back towards its baseline value. The looser labour market conditions also place some slight downward pressure on

Figure 7: Impulse Response to a Negative Employment Shock

Model including wages



wages. The effect on wages occurs with a lag: the decrease in relative wages peaks near 0.3 per cent, one year after the shock. In the long run, the participation rate and unemployment rate return to their baseline values, while there is a permanent downward shift in the real wage. Again, this permanent difference is a direct result of modelling the real wage in differences.

The 1 per cent negative shock to employment causes long-run out-migration of 0.31 per cent of the labour force. This out-migration occurs gradually over a number of years. There is a small amount of net out-migration in the first year after the shock. Approximately one third of the out-migration takes place within two years, and nearly two thirds of the net migration takes place within three years of the shock. The rate of out-migration then flattens out, although it is seven years after the initial shock before the out-migration is entirely complete. The slow initial migration response and the long period over which migration occurs appears reasonable, given the inertia associated with a decision to move interstate, and the high costs of adjustment involved.

The magnitude of the impulse responses for the four-variable model is broadly consistent with the responses in the three-variable model presented in Figure 6. The process of migration does, however, occur over a longer period than in the three-variable model. It should be noted that the results are not exactly comparable with those above, because the sample periods are different, and the four-variable VAR excludes the Northern Territory and ACT.

The speed of adjustment is broadly consistent with results found by Blanchard and Katz (1992) for the United States, and Decressin and Fatas (1995) for Europe. However, the dynamics of adjustment are quite different in each case. In Blanchard and Katz, employment continues to fall further after the initial shock, and significantly overshoots its long-run response value. After one year the fall in employment is double the initial shock, before finally converging to a long-run response of 1.3 times the initial size of the shock. The impulse response of employment for Europe is closer to the results presented here; in Decressin and Fatas, the employment response falls away towards zero in the periods following the shock.

Explaining the difference in the dynamics between the US and Australia is a difficult task. The Blanchard and Katz results for the US are consistent with Diamond-type externalities. For example, if the employment shock is the closing of a particular industry, one might expect spillovers into other industries that supplied the industry, so that the long-run effect exceeds the short-run effect. In contrast, our results suggest that Australian states have an internal adjustment process that mitigates the size of the initial shock. For example, a boom in mining may generate a surge in construction employment which dies out over time so that the long-run boost to employment is less than the initial increase.

Another possible explanation for our result is that, after a positive demand shock, the increase in the real wage tends to dampen the initial employment shock, so that there is some drop-off in employment creation. Conversely, the fall in real wages following a fall in labour demand may induce firms to move into a depressed region lessening the impact of the initial adverse shock. Thus the Australian results could possibly reflect a higher degree of firm mobility.

However, wages are generally regarded as being more flexible in the US than in Australia, so one would expect that the off-setting effect of the wage response to the initial employment shock would be greater in the US than in Australia. Rather, Blanchard and Katz find a large multiplier effect, in spite of the movement in wages. This result then remains something of a puzzle.

To gauge the incremental effect of the wage channel on migration, we recalculate the impulse responses while setting the wage response equal to zero. From this, we can see how suppressing the wage channel affects migration and other impulse responses. Suppressing the wage channel resulted in out-migration of 0.29 per cent after 50 quarters (almost identical to the estimate of 0.31 per cent above).

Extending the model to include the real-wage channel acts to marginally increase the migration response to the decreased labour demand. However, the impulse responses of the unemployment and participation rates, and the migration response, are little altered by the suppression of the real wage variable. Furthermore, the migration response when wages are suppressed is well inside the one standard error confidence band of the four-variable model.

Taken together, the results presented above suggest the introduction of a wages channel does little to change the employment and migration dynamics. This is possibly, in part, related to the federally based award system that existed over much of the sample period. This finding is also consistent with the implication of the Harris-Todaro model that risk-averse workers should care more about relative employment opportunities than about the wage in assessing their migration decision. Blanchard and Katz also find that the addition of a wage variable to their model makes little difference to their results.

As mentioned earlier, the Industry Commission (1993) investigated labour mobility in a framework very similar to that employed here. However, that study adopted different stationarity assumptions for the variables in the system so that the system was estimated as a vector error correction model. These different assumptions appear to be the major explanation for the conclusion of that study that migration plays very little role in labour market adjustment. In contrast to the findings of this paper, the Industry Commission concludes that the participation rate is the main adjustment mechanism. Labour mobility plays a much weaker role than in our model and is close to zero, three quarters after a shock.

We conducted a range of exercises to test the sensitivity of our results to changes in model specification. A detailed discussion of this sensitivity analysis is provided in Appendix B. We find weak evidence that the size of the migration response to a shock is larger in the second half of the sample, although the size of the difference is not statistically significant, and the speed of adjustment is similar. Changing the order of integration of the variables in the VAR usually acts to reduce the size of the migration response, however, a negative shock to labour demand still induces out-migration in nearly all cases. We find that if annual data instead of quarterly data is used to estimate the model (annual data was used in Blanchard and Katz's study), the speed of adjustment to a shock is somewhat slower. Finally, the model conclusions are robust to the exclusion of each individual state in turn.

5.3 State Fixed Effects

In the model described above, permanent differences between states are modelled by allowing the constant term to vary between states for the same equation. In this way, the model can incorporate permanent differences between participation rates, unemployment rates, employment growth rates or growth rates in relative wages in different states.

We test whether these permanent differences between states are significant in a statistical sense. If the state fixed effects are significant, then unemployment rates will not converge to one uniform national rate, even in the long run. Instead, there will be a different steady-state unemployment rate in each state and territory.

F-tests are conducted to test the joint significance of the state fixed effects for each of the four equations in the model.[15] For each equation except the wages equation, the state fixed effects are found to be jointly significant at the 1 per cent level of significance. This suggests that there are deterministic differences in labour force patterns between states. As further evidence of the importance of permanent

[15] The form of the F-test used here can be found in Greene (1993, p. 468).

differences between states, the four-variable model re-estimated without state fixed effects is found to be dynamically unstable, suggesting that the exclusion of state fixed effects represents a fundamental mis-specification of the appropriate model structure. That the restriction is valid in the wages-growth equation again possibly reflecting the nationally based wage structure embedded in the Australian wage-fixing system over the sample period.[16]

In our modelling work, we assume that the fixed effects for each state are independent of the shocks to employment. An implication of this is that (for instance) the relatively high rate of unemployment in Tasmania reflects a preference for Tasmanian residents to live in that state, rather than the outcome of a sequence of adverse shocks to unemployment in Tasmania. If this assumption of independence is invalid then state specific shocks may permanently influence relative state unemployment rates.

Alternatively, it may be the case that the high unemployment rates in Tasmania and South Australia reflect a series of negative shocks to employment whose effect on unemployment, while temporary, has not yet dissipated. In this case, the unemployment rates of Tasmania and South Australia might be expected to eventually return to the national rate after a period of continuing net out-migration.

6. Conclusions

This paper has analysed the role that interstate labour migration has played in the adjustment of the labour market to state-specific shocks. The results in Section 4 suggest that the migration decisions *are* affected by relative labour market conditions between states, and, in particular, that individuals are more likely to migrate from a state with a high unemployment rate. Thus, labour mobility does appear to play an important role in reducing differences in labour market conditions between states.

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[16] These results are consistent with the finding of Groenewold (1992) that long-run equilibrium differences in unemployment rates exist between states. Groenewold also finds that equilibrium wage levels differ between states. This is a different hypothesis to testing the significance of constant terms in our wage equation. We are testing for equality of wage growth rates between states (since our wage variable is modelled in log-differences).

We also find that movements in the national unemployment rate explain most of the variation in state unemployment rates, suggesting that aggregate, rather than state-specific factors, are most important in understanding Australia's high aggregate unemployment rate.

The results from our model in Section 5 suggest that out-migration from a state resulting from a relative downturn in its labour market occurs slowly and steadily. Most of the migration takes place, on average, within four years, and the process of adjustment is complete after seven years. We also find that movements in relative wages across the states have not been an important part of the adjustment process historically. We do, however, find some evidence of permanent (or at least very persistent) differences between state unemployment rates, employment growth rates and participation rates. This finding is consistent with the fact that unemployment in South Australia and Tasmania has remained above the national average over most of the past 20 years. These persistent differences between states may reflect compensating lifestyle differentials, a sequence of relative adverse shocks, or possibly the inability of internal migration to entirely equalise labour market opportunities.

We have not examined here the barriers to mobility which might limit the extent of migration. In order to develop policy prescriptions, further information would be required. Two potential barriers to mobility are adjustment costs associated with housing, and lack of information about interstate job opportunities.

Finally, as discussed in Section 2, labour mobility is not the only solution to geographic mismatch. An equally important issue is why firms do not move to take advantage of the pools of unemployed labour (possibly also at lower wages) in less buoyant regions.

Appendix A: Unit Root and Cointegration Tests

Table A1 presents single equation tests of cointegration between state and national unemployment rates using the two step procedure suggested in Engle and Granger (1987). Table A2 applies the Johansen (1988) procedure to test for the number of cointegrating relations between the vector of state unemployment rates. Results from these tests are discussed in more detail in Section 4.

Table A1: Two-step Engle-Granger Tests

State	Engle-Granger test statistic: T(p-1)
New South Wales	-9.31
Victoria	-5.06
Queensland	-12.41*
South Australia	-35.07***
Western Australia	-11.81*
Tasmania	-19.35***
Northern Territory	-37.74***
ACT	-42.25***

Note: ***, ** and * refer to significance at the 1%, 5% and 10% levels respectively.

Table A2: Johansen Test for Cointegration

H_0: Rank of p	-T log (1-μ)	95% critical value	-TΣlog (1-μ)	95% critical value
$p = 0$	66.8	51.4	224.9	156.0
$p \leq 1$	59.5	45.3	158.1	124.2
$p \leq 2$	36.4	39.4	98.6	94.2
$p \leq 3$	27.5	33.5	62.2	68.5
$p \leq 4$	15.0	27.1	34.8	47.2
$p \leq 5$	11.2	21.0	19.8	39.7
$p \leq 6$	4.7	14.1	8.5	15.4
$p \leq 7$	3.9	3.8	3.9	3.8

Table A3 presents stationarity tests on the variables in Section 5 of the paper. Unit root tests are conducted based on the methodology in Dickey and Fuller (1979, 1981).

Table A3: Individual Augmented Dickey-Fuller Tests

	NSW		VIC		QLD	
	T(p-1)	F-test	T(p-1)	F-test	T(p-1)	F-test
Employment share (*em*)	-18.35 *	4.13	-6.20	1.48	-17.42	4.16
Change in employment share (Δ*em*)	-80.34 ***	19.05 ***	-82.69 ***	19.29 ***	-91.96 ***	12.64 ***
Average weekly earnings (*wage*)	-26.71 **	4.91	-11.17	2.34	-27.39 **	6.14 *
Change in average weekly earnings (Δ*wage*)	-77.74 ***	17.52 ***	-139.52 ***	31.23 ***	-64.95 ***	14.89 ***
Unemployment rate (*ur*)	-7.94	1.72	-3.09	0.75	-9.70	2.26
Change in unemployment rate (Δ*ur*)	-73.69***	17.61***	-70.42***	16.95 ***	-72.20***	17.31 ***
Participation rate (*pr*)	-15.06**	3.58	-17.58**	4.38 *	-0.58	5.49 **
Change in participation rate (Δ*pr*)	-921.67***	10.45***	-111.89***	27.17 ***	-20.36***	12.52 ***
	SA		WA		TAS	
	T(p-1)	F-test	T(p-1)	F-test	T(p-1)	F-test
Employment share (*em*)	-16.61	5.29	-13.71	3.31	-23.40 **	3.07
Change in employment share (Δ*em*)	-58.01 ***	13.72 ***	-77.47 ***	19.23 ***	-338.36 ***	11.66 ***
Average weekly earnings (*wage*)	-7.13	1.54	-32.36 **	5.24	-48.86 ***	4.35
Change in average weekly earnings (Δ*wage*)	-92.77 ***	21.75 ***	-105.20 ***	23.89 ***	-99.93 ***	5.27
Unemployment rate (*ur*)	-18.48 **	4.48 *	-12.54 *	2.73	-21.18 ***	5.27 **
Change in unemployment rate (Δ*ur*)	-59.38 ***	10.24 ***	-49.40 ***	12.20 ***	-100.75 ***	24.09 ***
Participation rate (*pr*)	-6.74	2.36	-23.46 ***	5.52 **	-13.42 *	2.83
Change in participation rate (Δ*pr*)	-76.09 ***	6.99 ***	-101.73 ***	24.85 ***	-120.89 ***	17.36 ***
	NT		ACT			
	T(p-1)	F-test	T(p-1)	F-test		
Employment share (*em*)	-20.41 *	6.30 *	-6.15	1.38		
Change in employment share (Δ*em*)	-98.47 ***	23.25 ***	-70.83 ***	16.59 ***		
Average weekly earnings (*wage*)	-4.33	2.29	-28.46 ***	5.13		
Change in average weekly earnings (Δ*wage*)	-82.98 ***	19.16 ***	-94.59 ***	22.75 ***		
Unemployment rate (*ur*)	-29.83 ***	7.01 ***	-16.23 **	3.52		
Change in unemployment rate (Δ*ur*)	-425.17 ***	24.17 ***	-48.30 ***	5.26 **		
Participation rate (*pr*)	-34.54 ***	7.90 ***	-34.68 ***	6.14 **		
Change in participation rate (Δ*pr*)	-184.78 ***	18.49 ***	-390.70 ***	23.58 ***		

Notes: ***, ** and * refer to significance at the 1%, 5% and 10% levels respectively.
The ADF regression included a constant, but no time trend, with the exception of the employment share and relative wages variables, for which a time trend was included.

The methodology of the panel unit root test is based on Im, Pesaran and Shin (1995). Their approach involves estimating an augmented Dickey-Fuller (ADF) regression for each variable and state, and comparing a statistic based on the average t-statistic on the lagged level variable against a critical value, to test the null hypothesis of a unit root. The authors present Monte-Carlo evidence which suggests this approach has good power in finite samples compared to alternative panel unit root tests.

The test employs the following test statistic (Im, Pesaran and Shin 1995, Equation 59 p. 16).

$$z = \frac{\sqrt{N}[\bar{t}_{NT} - a_{NT}]}{\sqrt{b_{NT}}} \quad \underset{\sim}{a} \quad \mathrm{N}(0,1)$$

where N is the number of time series in the panel, $\bar{t}_{NT}$ is the average t-statistic from a series of univariate ADF tests on each variable (where the number of lags in the regression is determined using the Schwarz criterion), and a_{NT} and b_{NT} are the expected small sample mean and variance of the distribution of t-statistics under the null hypothesis of non-stationarity (found through Monte-Carlo simulation). This statistic is asymptotically distributed as a standard normal variable. The appropriate hypothesis is a one-sided test of $z = 0$ against the alternative $z < 0$.

Table A4: Panel Unit Root Test

Variable	z
Employment share (*em*)	-1.29 *
Change in employment share (Δ*em*)	-12.81 ***
Wages (*wage*)	-1.60 *
Change in wages (Δ*wage*)	-13.97 ***
Unemployment rate (*ur*)	-3.23 ***
Change in unemployment rate (Δ*ur*)	-13.15 ***
Participation rate (*pr*)	-3.66 ***
Change in participation rate (Δ*pr*)	-13.81 ***

Note: ***, ** and * refer to significance at the 1%, 5% and 10% levels respectively.

Appendix B: VAR Results and Sensitivity Analysis

The two tables below present summarised results from the two VAR models in Section 5 of the paper. In the tables, the first number quoted is the sum of the lag coefficients, the second number is the p-value for the F-test that the lags are jointly significant. These tables are followed by discussion of sensitivity analysis conducted on the two models.

Table B1: Summary of Coefficients in the Three-variable Model

	Equation		
LHS variable:	Change in employment (Δem)	Unemployment rate (ur)	Participation rate (pr)
Change in employment (Δem)	2.02 [0.00]	0.16 [0.00]	0.29 [0.00]
Unemployment rate (ur)	-0.28 [0.00]	0.85 [0.00]	0.13 [0.00]
Participation rate (pr)	-0.45 [0.00]	0.07 [0.00]	0.90 [0.00]
$\bar{R}^2$	0.25	0.87	0.99

Table B2: Summary of Coefficients in the Four-variable Model

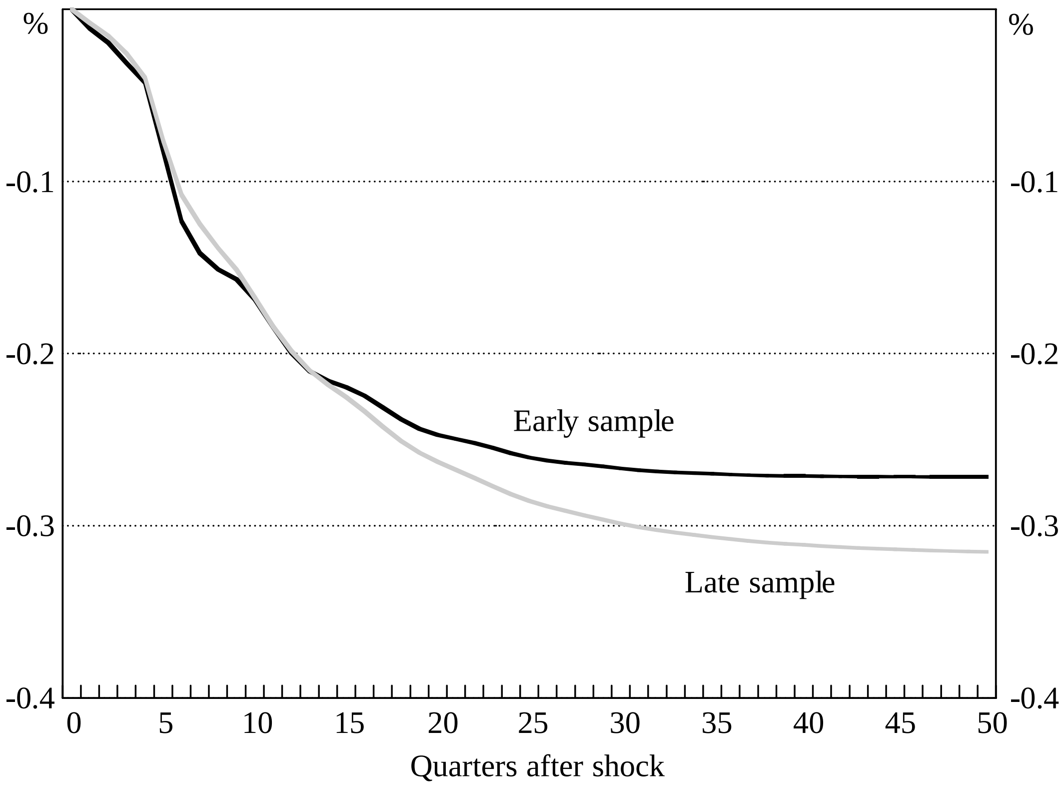
LHS variable:	Change in employment (Δem)	Unemployment rate (ur)	Participation rate (pr)	Change in average weekly earnings ($\Delta wage$)
Change in employment (Δem)	2.28 [0.00]	0.36 [0.00]	-0.03 [0.00]	-1.17 [0.00]
Unemployment rate (ur)	-0.05 [0.00]	0.87 [0.00]	0.12 [0.00]	-0.01 [0.27]
Participation rate (pr)	-0.26 [0.00]	0.04 [0.19]	0.94 [0.00]	0.13 [0.10]
Change in average weekly earnings ($\Delta wage$)	0.11 [0.52]	-0.04 [0.00]	0.01 [0.01]	-0.92 [0.00]
$\bar{R}^2$	0.30	0.92	0.99	0.09

These models were then subject to a range of sensitivity tests to examine the robustness of conclusions from the VAR model. Firstly, to gauge whether the propensity to migrate has become more pronounced over time, the sample was split into two equal sub-samples, and the migration response estimated for each sub-sample using the four-variable model.

The results of this exercise are shown in Figure B1, and provide some, albeit limited, support for the view that the Australian workforce has become more geographically mobile over the sample period. The long-run migration response in the second half of the sample suggests that an initial negative shock to employment of 10 workers results in long-run net out-migration of 3.2 workers, compared to 2.7 workers in the first half of the sample. The difference between these figures was not, however, statistically significant at the 10 per cent level based on the bootstrapped standard errors. In addition, the speed of the migration response was very similar between the two sub-samples. The larger migration flows and the higher standard deviation of the state unemployment rates reported in Figure 5 in more recent times may also indicate that there have been larger state-specific shocks in the latter part of the sample.

Figure B1: Migration Response

Sample split at 1989:Q3



Given that the unit root tests were not altogether conclusive for several variables, we investigate the sensitivity of the impulse response functions to alternative model specifications. These include:

- modelling the relative wage as I(0);
- changing the lag length to three, nine and twelve quarters;
- excluding the ACT and Northern Territory from the panel as both of these have relatively low population bases and correspondingly lower data quality;
- estimating the VAR with the employment share *em* as I(0); and
- treating the relative unemployment rate *ur* as I(1), rather than I(0).

Figure B2 presents sensitivity bounds for the projected migration response from the shock. We obtain this by ranking the migration responses under each combination of the specification changes in ascending order,[17] and taking a two-tailed 90 per cent 'sensitivity interval' of the migration response based on this distribution. This approach, in the spirit of Leamer and Leonard (1983), provides a concise way of summarising the effect of specification changes on the model's main results.

The key results are generally robust to the changes in specification listed above. In a number of cases where the employment share is specified in levels, the model was not dynamically stable (implying that the migration path after a shock does not settle down to a long-run value, but instead explodes). This provides further evidence that the employment share is best modelled as being non-stationary. This result aside, Figure B2 suggests that the results in the model are robust to a wide range of specification changes. Two main results stand out. Firstly, decreased labour demand nearly always seems to induce out-migration (although the lower bound of the long-run migration response is actually below zero). Secondly, the upper bound on the migration effect is only 0.35, much less than Blanchard and Katz's (1992) estimate of 1.3 for the US economy.

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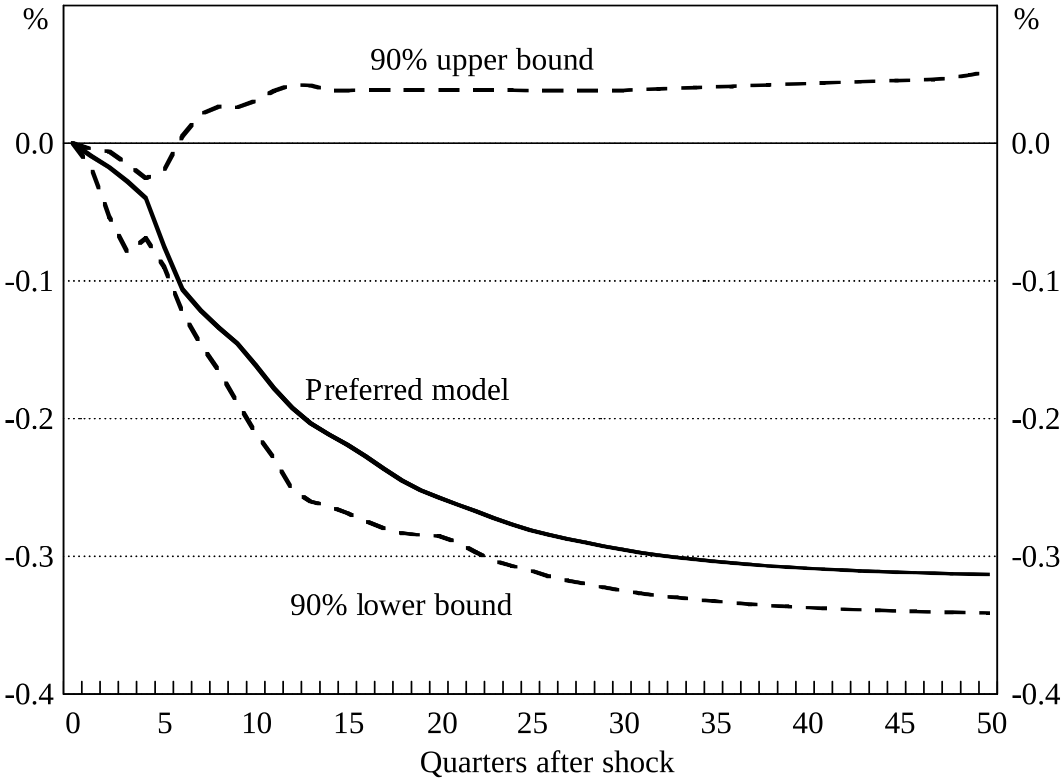
[17] There are 2^4 x 4 = 64 specification combinations in total.

Figure B2: Migration Response

Robustness to specification changes



Blanchard and Katz's estimates are based on a model using annual data, while our model uses quarterly data. As a further sensitivity test, we re-estimate the four-variable model with annual data. The long-run employment response is higher than that for the quarterly model, and is between 0.4 and 0.65 depending on the lag length used (we experimented with lag lengths between one and four). The duration of the adjustment period is also longer than in the quarterly model, implying that migration acts less quickly to equalise labour market conditions than in the quarterly model. We prefer the quarterly specification because it employs all the available information, which the annual model does not. However, we do note that our results are relatively sensitive to changing the periodicity of the data.

As a final robustness test, the model is re-estimated excluding each of the states in turn. Although this results in some variation in the impulse response functions for each variable, the main inferences from the model are not affected by the exclusion of any particular state.

Appendix C: Data Sources

Employment, unemployment and population by state

Source: *Labour Force*, Australia, ABS Cat. No. 6203.0, Table 8.

Willingness to migrate survey results

Source: *Australians' Employment and Unemployment Patterns 1994-96*, ABS Cat. No. 6286.0, unit record data.

Gross migration and net migration

Source: *Migration, Australia,* ABS Cat. No. 3412.0, Table 4.

Real wages by state

Source: *Average Weekly Earnings, Australia*, ABS Cat. No. 6302.0, Table 12.

We use average weekly earnings by state as a measure of wages,[18] both in nominal terms and deflated by state CPIs. The empirical results were generally invariant to this distinction, because state CPIs move closely together over time.

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[18] The task of finding a reasonable measure of wage relativities between states is made more difficult because differences in average earnings between states reflect compositional differences in the employment mix as well as wage relativities. A state such as Western Australia, with a higher proportion of workers in the resources and mining sector, would have higher average weekly earnings for that reason. However, given imperfect substitution between employment in different industries, a wage differential caused by compositional differences would not induce migration flows. The model can accommodate a constant 'wedge' in average weekly earnings between two states through the state-specific constant term; however, average weekly earnings is a less than satisfactory measure in the case where relative workforce composition between states changes over time.

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