REGIONAL UNEMPLOYMENT DYNAMICS: THE BIG NEIGHBOUR EFFECT

N. Groenewold

Department of Economics and Centre for Regional Economic Analysis, University of Tasmania, Hobart, Tasmania, Australia.

A. J. Hagger

Centre for Regional Economic Analysis, University of Tasmania, Hobart, Tasmania, Australia.

ABSTRACT Between February 1978 and February 1993 the average monthly unemployment rate for South Australia, Tasmania and Queensland was above that for the nation as a whole, while the average unemployment rate for Victoria and New South Wales was below the national figure. An important question is whether developments in Victoria which have beneficial effects on Victoria's unemployment problem also have long-term beneficial effects on the unemployment problems of its two high unemployment neighbours, Tasmania and South Australia, and similarly for New South Wales and Queensland. If helpful spillovers do in fact occur, how significant are they? In particular, is it that Tasmania's and South Australia's unemployment problems are mitigated more, in the long term, by favourable developments in Victoria rather than by unemployment reducing developments which occur within their own borders - and similarly for Queensland and New South Wales? The purpose of the paper is to investigate these and other related questions with the help of a vector auto-regressive (VAR) model estimated from monthly data for the period under consideration. The broad finding of the paper is that the "big-neighbour effect" on Tasmania, South Australia and Queensland is highly significant and may well outweigh the beneficial effects on unemployment of developments which are targeted at the three high-unemployment states themselves or which occur accidentally within their borders.

1. INTRODUCTION

Substantial differences in state unemployment rates have been a feature of the Australian economy for at least two decades. The ranking of states according to unemployment rate has changed from time to time but on the average over the fifteen-year period from February 1978 to February 1993 the unemployment rates for New South Wales and Victoria have been well below the national unemployment rate. The unemployment rates for the other four states (Queensland, South Australia, Western Australia and Tasmania) have been well above the national figure.

This substantial and persistent spread of state unemployment rates has provoked intervention, aimed at reducing the imbalance, on the part of both state and Commonwealth governments.

The governments of the four states with above-average unemployment rates have been under pressure to act, partly for political reasons. From time to time political opponents have used the fact of a higher-than-average unemployment rate in the state to mount the charge of incompetence in economic management. To some extent, these governments have been able to defend themselves against this charge by making the obvious point that the interstate inequality of unemployment rates has very little to do with economic management but arises from basic structural differences between the state economies. This, however, has been a fairly weak defence in political terms and, in the end, the only way in which they have been able to blunt the attack has been to act, or at least to appear to be acting. Putting strong pressure on the Commonwealth to develop new infrastructure within the state has been a highly favoured form of action.

The governments of the states with above-average unemployment rates have frequently been able to advance good *economic* reasons for intervention, in addition to the political reasons just discussed. For example, they have sometimes been able to argue that their state's population was already sub-optimal, perhaps from the perspective of the efficient provision of state government services. The net out-migration resulting from their higher-than-average unemployment rate has then been just the reverse of what was required from an economic point of view.

The *Commonwealth* government has also felt obliged to intervene from time to time under its long-standing commitment to balanced regional development - a commitment pursued at present through the Department of Housing and Regional Development. That the Commonwealth is concerned about interstate unemployment-rate differences and is prepared to act to reduce them was made clear in July 1993 when the Minister of Technology, Industry and Regional Development set up a Taskforce on Regional Development under the chairmanship of Mr Bill Kelty. A two-volume report entitled *Developing Australia: A Regional Perspective* which contained a variety of recommendations about possible interventions by the Commonwealth government in the interest of a more balanced regional development, was presented by the Taskforce in December of that year.

In short, the substantial interstate unemployment-rate differences which have characterised Australia in the last two decades have led to intervention, aimed at reducing the spread, by both state governments and the Commonwealth government and there is good reason to expect that such interventions will continue in the future.

This being the case, there is a pressing need for basic research into the way in which the unemployment rates of individual states interact over time. Intervention based on the simple assumption that the unemployment rate of one state is independent of the unemployment rates of the other states is likely to be at best ineffective and at worst dangerous.

One area in which research is particularly needed relates to whether unemployment-reducing developments in Victoria and New South Wales spill over in a helpful way to their high-unemployment neighbours - Tasmania and South Australia in the case of Victoria and Queensland in the case of New South Wales. If they do, how big are the spill-overs?

The main aim of the present paper is to present numerical results on the "spill-over" question which enable the assessment of the quantitative significance of Victoria's big-neighbour influence on Tasmania and South Australia and that of the effect of New South Wales on Queensland. The research is based on a Vector Auto-

Regressive model (VAR model)[1]. In Section 2 of the paper some details of this model are presented and in Section 3, some detailed results generated by the model on the spill-over question. The broad thrust of these results is that Victoria's big-neighbour influence on Tasmania and South Australia and New South Wales' influence on Queensland are both of considerable significance in numerical terms. Section 4 summarises the conclusions derived from Section 3 and mentions some of the limitations to which they are subject.

2. MODEL

2.1 Statement of the Model

A good starting point for an account of the VAR model used in the present paper is the autoregressive model (AR model) which economists have used as a basic tool for the analysis of time series for a very long time[2]. To set out the AR model the following notation is used. Let x_t denote the value of some variable in period t (month t, quarter t, year t, as the case may be) and x_{t-1}, x_{t-2}, ..., x_{t-k} its values in the k periods immediately preceding period t. In terms of this notation the general AR model can be written as :

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \cdots + \alpha_k x_{t-k} + \varepsilon_t \tag{1}$$

In this expression the α's are constants and ε_t is a random element belonging to period t whose probability distribution is specified. The usual specification is that ε_t has the normal distribution with zero mean and constant variance.

The VAR model is a straightforward extension of the AR model set out in (1) in the sense that it models not a single time series but a set of n inter-related time series. For purposes of illustration take the case where n is two and let the two variables be denoted by x_1 and x_2. For this case the general VAR model is as follows:

$$\begin{aligned} x_{1t} &= \alpha_{10} + \alpha_{11} x_{1(t-1)} + \alpha_{12} x_{1(t-2)} + \cdots + \alpha_{1k} x_{1(t-k)} \\ &\quad + \beta_{11} x_{2(t-1)} + \beta_{12} x_{2(t-2)} + \cdots + \beta_{1k} x_{2(t-k)} + \varepsilon_{1t} \\ x_{2t} &= \alpha_{20} + \alpha_{21} x_{2(t-1)} + \alpha_{22} x_{2(t-2)} + \cdots + \alpha_{2k} x_{2(t-k)} \\ &\quad + \beta_{21} x_{1(t-1)} + \beta_{22} x_{1(t-2)} + \cdots + \beta_{2k} x_{1(t-k)} + \varepsilon_{2t} \end{aligned} \tag{2}$$

The random elements, ε_{1t} and ε_{2t} are taken to be drawings from a joint probability distribution with specified properties.

---

[1] The atheoretical VAR model was chosen because of its ability to account for complex dynamic interactions between variables. (See, e.g., Sims (1980)). For structural alternatives see Gordon (1985), Groenewold (1993), Pissarides and McMaster (1990), Schachter and Althaus (1993) and Schubert, Gerking, Isserman and Taylor (1987).

[2] For a more general treatment of VAR models, see, e.g. Judge *et.al.* (1988).

Table 1. Test Statistics for Stationarity Tests

Variable	Test Statistic	
	ADF	PP
Unemployment growth rate: NSW	5.35	112.37
Unemployment growth rate: VIC	-4.02	140.31
Unemployment growth rate: QLD	6.52	122.22
Unemployment growth rate: SA	5.61	141.64
Unemployment growth rate: WA	4.04	144.17
Unemployment growth rate: TAS	10.20	192.23

The VAR model used in the present paper was designed to facilitate analysis of the inter-relationships which exist between unemployment in the various states. A requirement of the model, therefore, was that its list of variables include an unemployment variable for each state. The obvious choice of unemployment variable is the unemployment rate for each state (the ACT was included in NSW and the NT in SA). However, the results of preliminary tests indicate that all state unemployment rates are non-stationary. Given the problems involved in estimating and analysing VARs with non-stationary variables (see, e.g. Toda and Phillips, 1993) unemployment growth rates were used instead. These alternative variables were also tested for stationarity. The results are reported in Table 1. The data used are monthly and seasonally adjusted for February 1978 to February 1993.

Two tests were used, the augumented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test (see Dickey and Fuller, 1981 and Phillips and Perron, 1988). Both tests are based on a regression of the form :

$$\Delta x_{it} = \beta_{i0} + \beta_{i1} x_{it-1} + \beta_{i2} t + \varepsilon_{it}$$

where Δ is the first-difference operator, t is a time-trend and ε_{it} is a random error term. In both tests the null hypothesis (non-stationarity) is $H_0 : \beta_{i1} = \beta_{i2} = 0$. The test requires ε_{it} to be serially uncorrelated and the tests differ in the way in which this is achieved - the ADF by adding a sufficient number of lagged Δx_{it} terms to the right-hand side and the PP test by a non-parametric adjustment to the test statistic. The 10 per cent critical value for each of the tests is 5.34. The null of non-stationarity is clearly rejected by the PP test and for four of the six states by the ADF test. It can be concluded that there is no clear evidence of non-stationarity and the paper proceeds on the basis that all variables are stationary.

In addition to the unemployment variables, a variable is also included to capture the state of the national economy. Since the unemployment data used are monthly, national accounting aggregates such as GDP are unsuitable since they are available only at a quarterly frequency. The national employment growth rate was therefore used as the aggregate activity variable. It was tempting to add further variables, particularly labour-force growth rates. However, with potentially 12 lags on each variable, the VAR model quickly runs out of degrees of freedom as further variables are added and, therefore, the number of variables were restricted to seven - the six state unemployment growth rates and the national employment growth rate.

Table 2. Diagnostic Statistics

Equation	R^2	DW	BG(3)	BG(12)	BP	AD	PP
NSW	.48	2.03	4.99	31.25*	107.18*	-3.07	-13.09*
VIC	.54	2.04	5.54	29.51*	44.86	-5.69*	-13.88*
QLD	.47	2.15	13.23*	39.69*	49.93	-3.45	-14.22*
SA	.63	2.02	3.84	33.46*	65.19	-4.46*	-12.91*
WA	.46	2.04	7.50*	35.12*	56.91	-4.95*	-13.27*
TAS	.44	1.94	2.86	38.80*	90.18*	-3.32	-12.68*
AUST	.52	1.89	5.81	28.16*	44.69	-3.75	-12.26*

Note: An asterisk indicates rejection of the null hypothesis.

The next step in model specification was to choose the value of k, the number of lags. It began with a maximum value of $k = 12$ (recall that monthly data are used) and successively tested lower lag lengths. Estimation was carried out using OLS in RATS and the test used was a standard likelihood ratio test that (in the first step) all variables at lag 12 are jointly insignificant. This test was repeated until a rejection occurred - the resulting value of k was 9. Diagnostic statistics for the model with k=9 are reported in Table 2.

Table 2 indicates that the model stands up reasonably well on the usual diagnostic tests. R^2 is satisfactory given that all the variables are proportional changes. The values for the DW statistic are consistent with the absence of first-order autocorrelation. The two BG statistics are derived from the Breusch-Godfrey test and are appropriate for test of joint first to third-order and first to twelfth-order autocorrelation (Johnston, 1984). The statistics are χ_3^2 and χ_{12}^2 distributed under the null hypothesis of no autocorrelation. The results in the table indicate little evidence of first to third-order autocorrelation but strong evidence of higher-order autocorrelation. The BP statistic refers to the Breusch-Pagan test which is a test of heteroscedasticity (Johnston, 1984) and the results indicate little evidence of this problem. The final two columns relate to tests of stationarity of the residuals and so, in effect, are Engle-Granger test of the cointegration of all variables in each equation. Since the stationarity tests reported in Table 1 suggest that all variables in every equation are stationary it would be expected that the hypothesis of cointegration is not rejected for any of the seven equations. This expectation is confirmed by the values for the PP statistic. The less decisive results obtained using the AD test reflect the mixed results obtained for the original stationarity tests reported in Table 1. On the whole it may be concluded that the model performs satisfactorily with the exception of the possibility of higher-order autocorrelation.

The model developed therefore consists of seven equations, one for each of the state unemployment growth rates and one for the national employment growth rate. The pattern of each equation was the same as the one depicted in the illustrative two-variable VAR model set out in (2). For example, on the left-hand side of the New South Wales equation is the growth rate in unemployed persons in New South Wales in period t while on the right-hand side is an intercept term, nine terms each with its coefficient in lagged values of the New South Wales unemployment growth rate, nine terms each with its coefficient in lagged values of the Victorian unemployment growth rate and so on for each of the other four states, and nine terms each with its coefficient in lagged values of nationwide employment. Finally there is a random term.

2.2 Putting the Model to Work

The seven-equation VAR model can be used in many different ways. One important use of the model is to obtain *numerical* answers to questions like: What is the effect on unemployment in *Tasmania* of some exogenous event which reduces the unemployment growth rate in *Victoria* by some specified figure, say one percentage point? How do we proceed to get a numerical answer from the model?

The first step is to put the model into "deviation-from-steady-state" form. What this means can be seen most easily by going back to the illustrative VAR model presented in (2) and putting k equal to 1. With k equal to 1 the model reads:

$$\begin{aligned} x_{1t} &= \alpha_{10} + \alpha_{11}x_{1(t-1)} + \beta_{11}x_{2(t-1)} + \varepsilon_{1t} \\ x_{2t} &= \alpha_{20} + \alpha_{21}x_{2(t-1)} + \beta_{21}x_{1(t-1)} + \varepsilon_{2t} \end{aligned} \tag{3}$$

When the "steady-state" of the model is referred to, we have in mind a situation where both of the random elements are zero and have been zero for a sufficiently long time for the effects of non-zero values to have worked themselves out so that the values of the two variables are unchanging period after period. If the two unchanging values are denoted by x and x we have, as the steady-state case of the model:

$$\begin{aligned} x &= \alpha_{10} + \alpha_{11}x + \beta_{11}x \\ x &= \alpha_{20} + \alpha_{21}x + \beta_{21}x \end{aligned} \tag{4}$$

There are no random elements in (4) because, by definition, both are zero in the steady state.

If the first equation in (4) is subtracted from the first equation in (3) and the second equation in (4) from the second equation in (3) we get:

$$\begin{aligned} (x_{1t} - x) &= \alpha_{11}(x_{1(t-1)} - x) + \beta_{11}(x_{2(t-1)} - x) + \varepsilon_{1t} \\ (x_{2t} - x) &= \alpha_{21}(x_{2(t-1)} - x) + \beta_{21}(x_{1(t-1)} - x) + \varepsilon_{2t} \end{aligned} \tag{5}$$

This is the "deviation-from-steady-state" form of the VAR model set out in (3).

With the model in this form, suppose that the one-percentage-point exogenous reduction in the Victorian unemployment growth rate, whose effect on Tasmanian unemployment we wish to trace through, occurs while the model is in the steady state. Designate the period in which the Victorian event occurs as period 0.

The model can then be used to calculate each of the six unemployment growth rates for period 0 and all subsequent periods in terms of deviations from its steady-state value, and the employment growth rate likewise from its steady-state value.

The calculation made for a particular state for a particular month gives the number of percentage points by which the state's unemployment growth rate deviates in that month from its steady-state level as a consequence of the exogenous one-percentage-point reduction in the Victorian unemployment growth rate. In other words the calculation for a particular state shows the number of percentage points by which that state's unemployment growth rate is above or below what it would otherwise have been, that is it shows the pure effect on unemployment in the state concerned resulting from the Victorian event.

The calculation made for Tasmania, month-by-month for 48 months, is shown graphically in Figure 1. Because the bars in Figure 1 alternate between positive and negative it is not easy to give a clear answer to the question raised at the outset, namely: What is the effect on unemployment in *Tasmania* of some event which reduces the unemployment growth rate in *Victoria* by some specified figure, say one

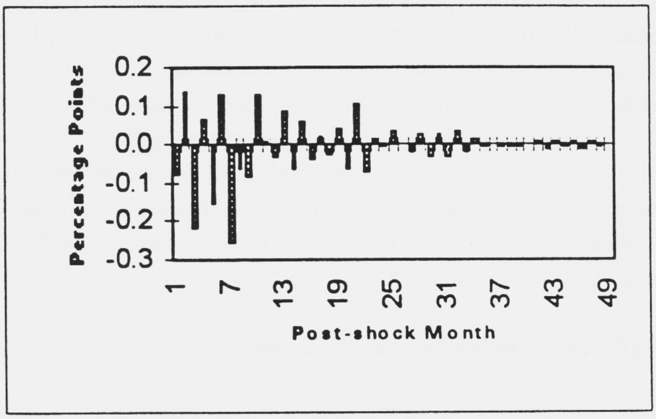

Figure 1. Tasmania (Shock to Victoria)

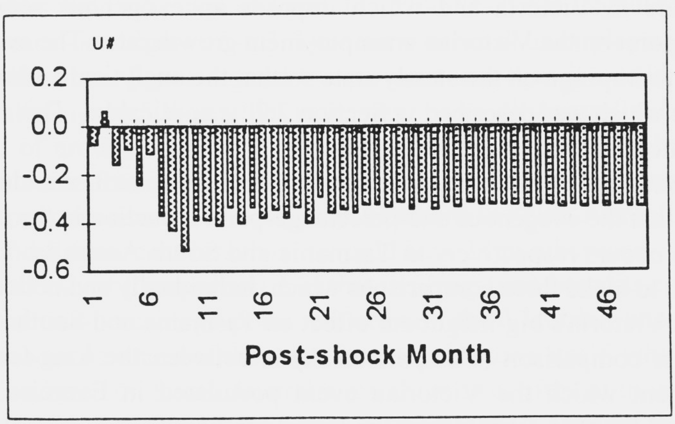

Figure 2. Tasmania (Shock to Victoria)

percentage point? The calculations represented by the bars can, however, be used to calculate, month-by-month from period 0 onwards, the *percentage by which the number of unemployed persons in Tasmania differs from what it was in the steady state* (from what it would have been otherwise) as a consequence of the hypothetical Victorian event which has set the model in motion. This statistic is denoted by U^*. The calculation in question is shown graphically in Figure 2.

From Figure 2, a straightforward numerical answer to the question asked at the outset can be given. The effect on unemployment in Tasmania of the hypothetical Victorian event is that some three years after the event the number of unemployed persons in Tasmania begins to stabilise at a level some 0.3 per cent less than its steady-state level (or less than it would have been otherwise).

3. THE BIG NEIGHBOUR EFFECT

As explained in the opening section of the paper, the main aim in this paper is to throw light on the consequences for unemployment in Tasmania and South Australia of unemployment-reducing developments which take place in their next-door neighbour, Victoria, and the consequences for unemployment in Queensland of developments which occur in New South Wales. This matter has been discussed briefly in the previous section in the course of explaining the way in which the VAR model can be put to work. In this section the matter is given a fuller and more systematic treatment. It begins with the case of Tasmania/South Australia and their Victorian neighbour and then turns to the case of the Queensland/New South Wales neighbourhood.

3.1 Tasmania/South Australia and Victoria

The analysis of the situation of Tasmania/South Australia in relation to Victoria proceeds in the following way. We begin by undertaking three exercises with our VAR model.

In the *first* exercise (Exercise 1), some event (policy or other) is postulated which occurs in Victoria and which imposes an exogenous reduction of one percentage point on the Victorian unemployment growth rate. The event in question is assumed to impinge on the steady state so that the analytical technique based on the statistic which was described in Section 2.2, is applicable. This was calculated month-by-month for each of the six states.

The *second* and *third* exercises (Exercise 2 and Exercise 3) are identical with the first except that the exogenous one-percentage-point reduction in the unemployment growth rate occurs respectively in Tasmania and South Australia. The results can then be used to make three comparisons which, individually and collectively, enable us to assess Victoria's big-neighbour effect on Tasmania and South Australia.

The *first* comparison (Comparison A) is between the long-term benefits to unemployment which the Victorian event postulated in Exercise 1 confers on Tasmania and South Australia and the long-term benefits to unemployment which it confers on Victoria itself. This comparison can be made directly from the results of Exercise 1.

The *second* comparison (Comparison B) is between the long-term benefits to unemployment which the Victorian event postulated in Exercise 1 confers on its next-door neighbours, Tasmania and South Australia, and the long-term benefits which it confers on the two states, Western Australia and Queensland, which are furthest away from Victoria. This comparison can also be made from the results of Exercise 1.

The *third* comparison (Comparison C) is between the long-term benefits which the Victorian event postulated in the first exercise confers on Tasmania and South Australia and the long-terms benefits which the event postulated in Exercises 2 and 3, respectively, confers on those states. This comparison makes use of results from Exercises 2 and 3 as well as results from Exercise 1.

Roughly speaking, Comparison A is a comparison between the benefits which the "big-house" passes on to its small next-door neighbours and those which it keeps for itself. Comparison B is between the benefits which accrue to the next-door neighbours of the big house and those which filter through beyond its immediate vicinity. Comparison C is between the benefits which spill over to the next-door neighbours from the big house and those which they would have obtained if the shock had occurred within their own confines instead of in the big house.

Comparison A is made with the help of Figures 3, 4 and 5. These figures show the month-by-month movement in $U^{\#}$ for Victoria, Tasmania and South Australia, respectively, following some hypothetical event in Victoria which imposes an exogenous one-percentage-point reduction on the Victorian unemployment growth rate.

From the first of the charts it can be seen that, in the case of Victoria, $U^{\#}$ stabilises at close to -1 some two years after the hypothetical one-percentage-point reduction in the Victorian unemployment growth rate. In other words, the number of unemployed persons in Victoria settles down at a figure around 1 percent less than it would have been otherwise - in other words, if the initial exogenous reduction in the Victorian unemployment growth rate had not occurred .

Figure 4 shows that in the case of Tasmania $U^{\#}$ settles down - again after a lapse of around two years - at a figure of -0.3. Thus the number of unemployed persons in Tasmania stabilises at a figure around 0.3 per cent less than it would have been otherwise. Finally Figure 5 shows that in the case of South Australia, $U^{\#}$ comes to rest at a figure of around -0.4 some two and a half years after the hypothetical exogenous reduction of one percentage point in the Victorian unemployment growth rate. In other words the number of unemployed persons in South Australia stabilises at a figure around 0.4 per cent less than it would have been otherwise.

Thus the outcome of Comparison A is that the long-term benefits conferred on Tasmania by the one-percentage-point reduction in the Victorian unemployment growth rate are about one-third of those conferred on Victoria itself, while the long-term benefits conferred on South Australia are about two-fifths of those conferred on Victoria. On the basis of Comparison A, therefore, it appears that Victoria

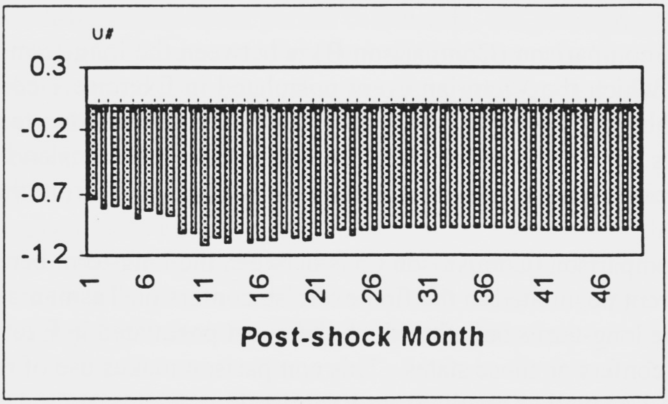

Figure 3. Victoria (Shock to Victoria)

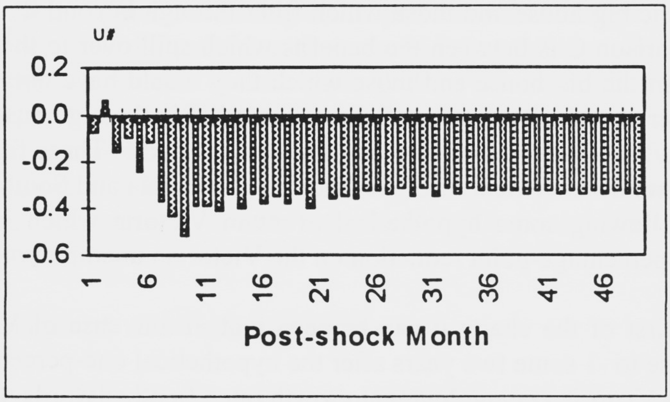

Figure 4. Tasmania (Shock to Victoria)

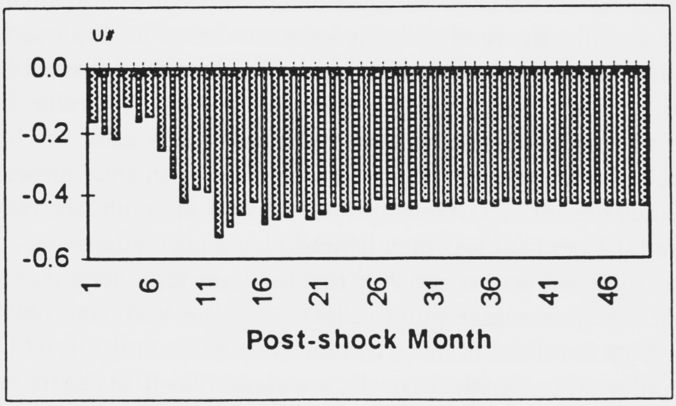

Figure 5. South Australia (Shock to Victoria)

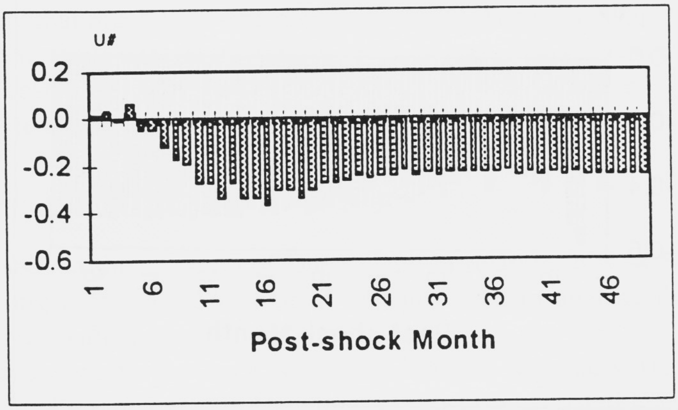

Figure 6. Queensland (Shock to Victoria)

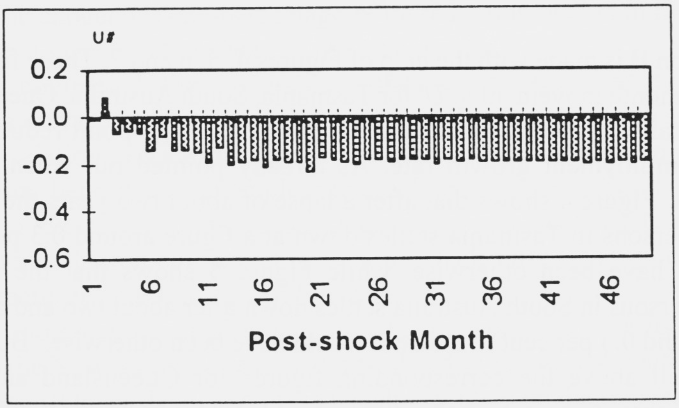

Figure 7. Western Australia (Shock to Victoria)

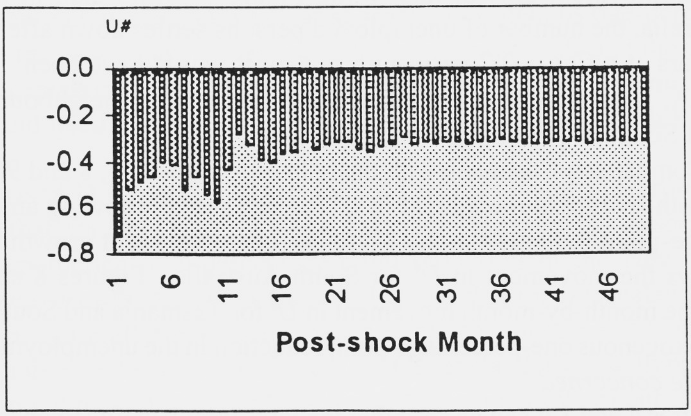

Figure 8. Tasmania (Shock to Tasmania)

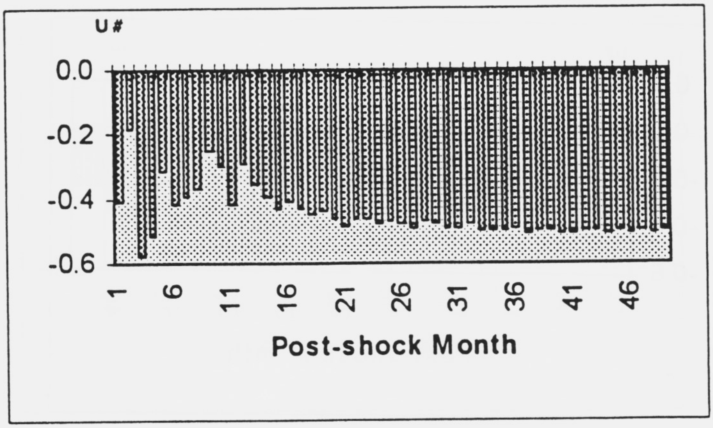

Figure 9. South Australia (Shock to South Australia)

exercises a highly significant big-neighbour influence on Tasmania and South Australia.

Comparison B is made with the help of Figures 4, 5, 6 and 7. These figures show the month-by-month movement in $U^{\#}$ for Tasmania, South Australia, Queensland and Western Australia following an exogenous one-percentage-point reduction in the Victorian unemployment growth rate. As already pointed out when discussing Comparison A, Figure 4 shows that after a lapse of about two years the number of unemployed persons in Tasmania settles down at a figure around 0.3 per cent less than it would have been otherwise, while Figure 5 shows that the number of unemployed persons in South Australia settles down after about two and a half years at a figure around 0.4 per cent less than it would have been otherwise. Both of these figures are well above the corresponding figures for Queensland and Western Australia. Figure 6 shows that, in the case of Queensland, the number of unemployed persons stabilises at a figure around 0.25 per cent less than it would have been otherwise following an exogenous one-percentage-point reduction in the Victorian unemployment growth rate, while Figure 7 shows that, in the case of Western Australia, the number of unemployed persons settles down after some two and a half years at a figure 0.2 per cent less than it would have been. Thus like Comparison A, Comparison B suggests that Victoria's big-neighbour effect on Tasmania and South Australia is quite significant.

Finally, Comparison C is made with the help of Figures 4, 5, 8 and 9. Figure 4, shows the month-by-month movement in $U^{\#}$ for Tasmania following an exogenous one-percentage-point reduction in the Victorian unemployment growth rate, while Figure 5 shows the movement in $U^{\#}$ for South Australia. Figures 8 and 9 show, respectively, the month-by-month movement in $U^{\#}$ for Tasmania and South Australia following an exogenous one-percentage-point reduction in the unemployment growth rate *in the state concerned.*

From Figures 4 and 8 it can be seen that the long-term benefits to unemployment which Tasmania reaps from an exogenous reduction in the unemployment growth rate in *Victoria* are approximately the same as those which it reaps from an exogenous reduction of the same size in *its own* unemployment growth rate. Figures 5 and 9 show that much the same applies to South Australia. Thus Comparison C confirms the findings of Comparisons A and B, namely that Victoria's big-neighbour effect on Tasmania and South Australia is of considerable significance in quantitative terms.

3.2 Queensland and New South Wales

In this section the situation of Queensland in relation to New South Wales is analysed using a procedure similar to that just used to analyse the situation of Tasmania and South Australia in relation to Victoria.

In this case, two further exercises are undertaken with the VAR model. In the first (Exercise 4) some event in New South Wales is postulated which imposes an exogenous reduction of one percentage point on the New South Wales unemployment growth rate and proceed (on the "steady-state" assumption) to make the appropriate $U^{\#}$ calculations. The second exercise (Exercise 5) is identical to the first except that the exogenous one-percentage-point reduction occurs in the Queensland unemployment growth rate instead of the New South Wales.

Having completed these exercises, the results are used to make three comparisons corresponding to the three made in Section 3.1 for Tasmania/South Australia in relation to Victoria. The first comparison (Comparison D) is between the long-term benefits to unemployment which the New South Wales event postulated in Exercise 4 confers on Queensland and the long-term benefits to unemployment which it confers on New South Wales itself. This comparison can be made directly from the results of Exercise 4.

The second comparison (Comparison E) is between the benefits to unemployment which the New South Wales event postulated in Exercise 4 confers on its next-door neighbour (Queensland) and those which it confers on the two states which are furthest away from the New South Wales neighbourhood - Tasmania and Western Australia. This comparison can also be made directly from the results of Exercise 4.

The third comparison (Comparison F) is one between the long-term benefits to unemployment in Queensland which arise from an exogenous one-percentage-point reduction in the New South Wales unemployment growth rate and those which arise from an exogenous one-percentage-point reduction in the unemployment growth rate of Queensland itself. This comparison draws on the results of both Exercise 4 and Exercise 5.

Comparison D is made with the help of Figures 10 and 11. From Figure 10 it can be seen that, for New South Wales, $U^{\#}$ stabilises at just under -1 some three years after the hypothetical one-percentage-point reduction in the New South Wales unemployment growth rate, while Figure 11 shows that for Queensland $U^{\#}$ stabilises at about -0.3, again after about three years. Thus the outcome of Comparison D is that, the long-term benefits conferred on Queensland by the hypothetical one-percentage-point reduction in the New South Wales unemployment growth rate are about one third of those conferred on New South Wales itself.

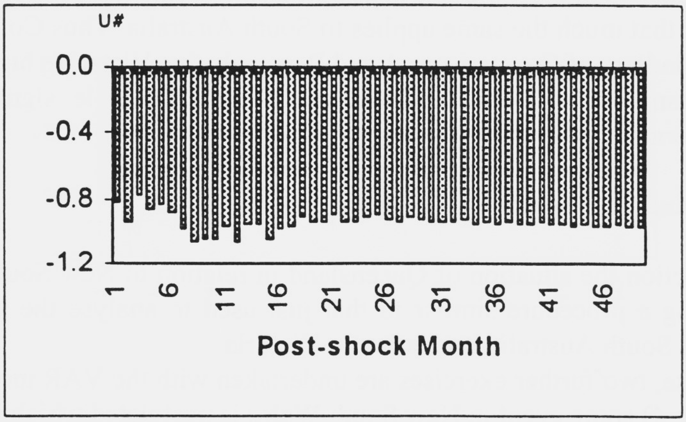

Figure 10. New South Wales (Shock to New South Wales)

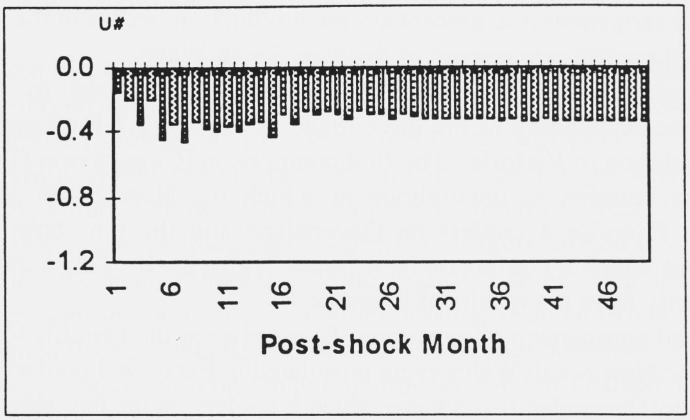

Figure 11. Queensland (Shock to New South Wales)

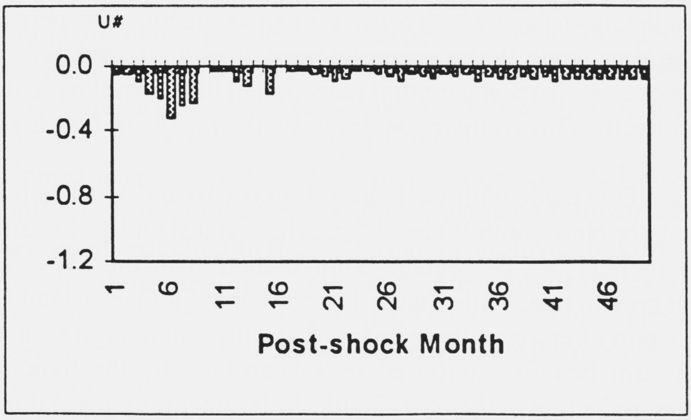

Figure 12. Tasmania (Shock to New South Wales)

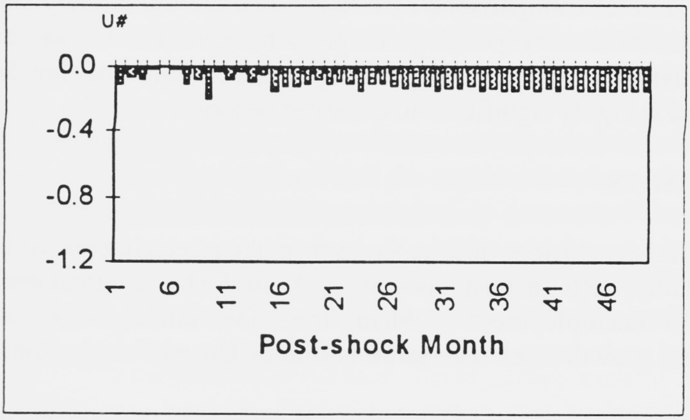

Figure 13. Western Australia (Shock to New South Wales)

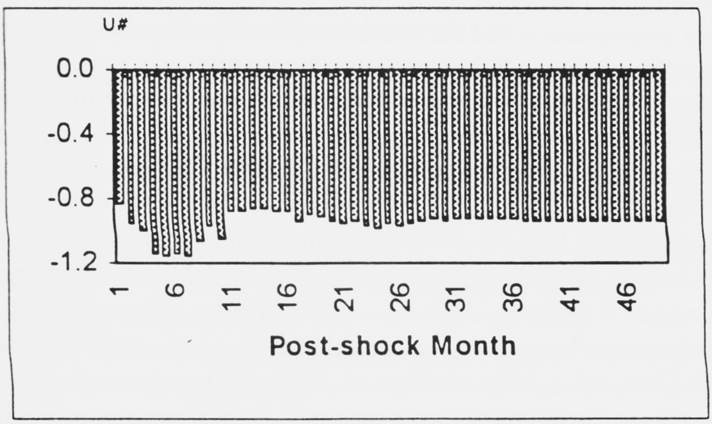

Figure 14. Queensland (Shock to Queensland)

Comparison E is made with the help of Figures 12 and 13. These figures show the month-by-month movement in $U^{\#}$ for Tasmania and Western Australia following an exogenous one-percentage-point reduction in the New South Wales unemployment growth rate. It will be seen from Figure 12 that, for Tasmania, $U^{\#}$ stabilises after about three years at a figure of -0.08, while from Figure 13 it can be seen that, for Western Australia, $U^{\#}$ stabilises at around -0.15. Thus the long-term benefits to unemployment conferred on Tasmania and Western Australia, the two states which are furthest removed from the New South Wales neighbourhood, are only about one-fifth and one-third, respectively of those conferred on its next-door neighbour.

Finally, Comparison F is made with the help of Figures 11 and 14. From these two Figures it can be seen that the long-term benefits to unemployment which Queensland reaps from an exogenous reduction in the unemployment growth rate in *New South Wales* are about one-third of those which it reaps from an exogenous reduction of the same size in *its own* unemployment growth rate.

The outcome of Comparisons D, E and F is therefore broadly similar to the outcome of the three corresponding comparisons made for Tasmania and South Australia in relation to Victoria - that the big-neighbour effect of New South Wales on Queensland is highly significant in quantitative terms.

4. CONCLUSION

The general conclusion which emerges from the research reported in this paper is that, potentially, both Tasmania and South Australia have a great deal to gain, in terms of their unemployment problem, from favourable shocks to Victoria's unemployment growth rate. The same is true of Queensland in relation to New South Wales.

One feature of the results which gives extra weight to this conclusion should be noted. In all of the model exercises from which the numerical results ultimately derive, the postulated favourable shock to the unemployment growth rate in question is assumed to be withdrawn after one month - the shock is "one-off" in this sense. An alternative assumption is that the shock is "maintained" - that it persists for, say, three months before being withdrawn. Were the modelling exercises to be extended to allow for the possibility of maintained shocks, Victoria's potential big-neighbour effects on Tasmania and South Australia would be seen to be even greater, numerically speaking. The situation would be similar for Queensland in relation to New South Wales.

For example, if the long-term benefits to unemployment conferred on Tasmania by an exogenous one-percentage-point reduction in the *Victorian* unemployment growth rate which is maintained for *two* months were compared to the benefits conferred on Tasmania by an exogenous reduction in the *Tasmanian* unemployment growth rate of *twice* the size but lasting *one* month only, it would be found that the long-term benefits to Tasmania of the former exogenous change were slightly greater than those of the latter.

The general conclusion that the big-neighbour effect is potentially of considerable importance to at least three of the four high-unemployment states, has important implications for policy-makers at both the Commonwealth and state levels. For Commonwealth policy-makers it means that Commonwealth unemployment-reducing initiatives in Victoria and New South Wales, whatever their motivation, will have favourable spin-offs of considerable significance for the neighbouring states and hence will represent a worthwhile, though not obvious, contribution to the Commonwealth's regional balance policy objective. For policy-makers in Tasmania and South Australia it means that support for unemployment-reducing projects in Victoria, particularly if they are large and lasting, is an effective way in which those states can help themselves and may even produce more substantial results than efforts undertaken within their own boundaries. The same is true for policy-makers in Queensland in relation to New South Wales.

The limitations to which the general and specific conclusions are subject should be noted. They are primarily the three-fold limitations of the VAR model on which the entire analysis is based.

First the VAR model is not a structural model and cannot therefore be used to identify the channels through which the effects of a favourable shock to the unemployment growth rate of a particular state are spread throughout the rest of the country. It tells *what* happens but not *why*.

Second, as explained in Section 2, the VAR model contains only seven variables - six state unemployment growth rates and the national employment growth rate. Other variables should be included if a satisfactory account of the dynamics of interstate unemployment is to be obtained. Variables which come immediately to mind are labour-force growth rates, both state and national.

Third, model diagnostics implies some reservations about the estimated version of the model from which the calculations underlying the conclusions have ultimately been made.

It is believed, however, that the broad conclusion of the research, that the big-neighbour effects of both Victoria and New South Wales are of considerable significance in quantitative terms, is unlikely to be undermined by refinement of the basic VAR model, though the precise measures of the significance may well be affected, possibly but not necessarily, adversely.

REFERENCES

Dickey, D.A. and Fuller, W.A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 49, pp. 1057-1072.

Gordon, I. (1985) The cyclical interaction between regional migration, employment and unemployment: A time-series analysis for Scotland. *Scottish Journal of Political Economy*, 32, pp. 135-158.

Groenewold, N. (1993) The interactions of regional unemployment rates, regional wages and inter-regional migration in Australia. *CREA Paper TS-04*, Centre for Regional Economic Analysis, University of Tasmania.

Johnston, J. (1984) *Econometric Methods*, (3rd. Edition) McGraw-Hill: Tokyo.

Judge, G.G., Hill, R.C., Griffiths, W.E., Ltkephl, H. and Lee, T-C. (1988) *Introduction to the Theory and Practice of Econometrics*, (2nd. Edition), Wiley: New York.

Lesage, J.P. and Reed, J.D. (1990) Testing criteria for determining leading regions in wage transmission models. *Journal of Regional Science*, 30, pp. 37-50.

McCracken, K.W.J. (1987) How many going where? Postcensal estimates of interstate migration in Australia, 1981-1986. *Australian Geographer*, 18(2), pp. 176-179.

Phillips, P.C.B. and Perron, P. (1988) Testing for a unit root in time series regression. *Biometrika*, 75, pp. 335-346.

Pissarides, C.A. and M^C^Master, I. (1990) Regional migration, wages and unemployment: Empirical evidence and implications for policy. *Oxford Economic Papers*, 42, pp. 812-831.

Schachter, J. and Althaus, P.G. (1993) The assumption of equilibrium in models of migration. *Journal of Regional Science*, 33(1), pp. 85-88.

Schubert, U., Gerking, S., Isserman, A. and Taylor, C. (1987) Regional labour market modelling: A state of art review. In M.M. Fischer and P. Nijkamp (eds.), *Regional Labour Markets: Analytical Contributions and Cross-National Comparisons*. North-Holland: Amsterdam.

Sims, C.A. (1980) Macroeconomics and reality. *Econometrica*, 48, pp. 1-49.

Taskforce on Regional Development (1993) *Developing Australia: A Regional Perspective*. Department of Technology, Industry and Regional Development: Canberra.

Toda, H.Y. and Phillips, P.C.B. (1993) The spurious effects of unit roots on vector autoregressions. *Journal of Econometrics*, 59(3), pp. 229-255.