COMPETITIVE BIDDING AND THE STATES: WINNERS AND LOSERS

Nicolaas Groenewold
Department of Economics, University of Western Australia, Nedlands, WA, Australia

A.J. Hagger[1]
Centre for Regional Economic Analysis, University of Tasmania, Hobart, Tasmania, Australia

ABSTRACT This paper uses a seven-equation vector-autoregressive model of state unemployment rates and the national employment rate to undertake a numerical analysis of competitive bidding between the Australian states. It examines the possibility that a competitive bidding contest will benefit the losing as well as the winning state and investigate the effects on the other states. Gains and losses are measured in terms of unemployment rates. The broad thrust of the conclusions which the analysis yields is that it is, indeed, possible for a state to gain an economic advantage, in terms of unemployment, by engaging in competitive bidding and to do so, moreover, without imposing significant economic damage on the other states, either individually or as a whole.

1. INTRODUCTION

For some time the assistance given to industry by state and local governments has been of two distinct types: general and selective. General assistance is assistance which is available to all firms such as the provision of information and advice, help with arranging contacts and assistance with the conduct of official negotiations. On the other hand, selective assistance is assistance (usually financial) which is available only to firms which meet specific requirements - which are engaged in a particular export trade for example.

The most transparent type of selective assistance is assistance which offers financial incentives to specific firms or to the organisers of specific special-events to persuade them to locate in the state or local-government jurisdiction concerned *instead of* in some other jurisdiction or to re-locate there *from* some other jurisdiction. The Industry Commission has labelled this particular form of selective assistance "competitive bidding".

Competitive bidding occupied a central position in the recent Industry Commission inquiry into assistance to industry by state and local governments. This was made clear at several points in the draft report of the inquiry (Industry Commission, 1996). For example, page 6 states that "... 'bidding wars' for

[1] The authors wish to thank two referees for useful comments.

investment projects or major events is an area of increasing concern in Australia and, in many ways, the trigger for this inquiry". Page 21 reads that "... selective assistance to industry plays an important role in the bidding wars between jurisdictions for individual projects. It is these forms of assistance, especially those which discriminate between industries and/or firms, with which this inquiry is principally concerned".

The purpose of the present paper is to undertake a numerical analysis of competitive bidding which is regional in character in the sense that it focuses on the individual states rather than on the country as a whole. The broad concern will be to examine the possibility that a competitive-bidding contest between two states may confer benefits on the loser as well as the winner and on states other than the two which are engaged in the contest. It is also of interest to enquire whether the states as a whole may gain from the outcome of a competitive-bidding contest between two states even though some, possibly most, states suffer individually. While the analysis is carried out in terms of states, there is no reason (except perhaps data constraints) why the question and the analysis could not be applied to sub-state regions. In this paper, the region is defined as a state both because the issue of competitive bidding is generally addressed in relation to the states and because data are more readily available for states than for sub-state regions.

In the present context expressions like "gain", "benefit" and "economic advantage" can be interpreted in many different ways. Of the various possibilities, it was decided to proceed in terms of unemployment. Thus an individual state is regarded as having profited from engaging in a competitive-bidding contest if it achieves a permanent reduction in its unemployment rate. Similarly one of the states which is not engaged in the contest will be regarded as suffering if its unemployment rate is permanently higher than it would have been if the contest had not occurred.

The broad thrust of the conclusions which the analysis yields is that it is, indeed, possible for a state to gain an economic advantage, in terms of unemployment, by engaging in competitive bidding and to do so, moreover, without imposing significant economic damage on the other states, either individually or as a whole; though whether this possibility will be realised in any particular instance depends very much upon which states are playing the "competitive bidding" game and on the extent and nature of the financial incentives which it has to offer to win the game.

This finding has considerable significance for the future of competitive bidding. Several undesirable features of competitive bidding have been emphasised in recent discussion. For example, it has been said that, being by nature secretive and discretionary, competitive bidding creates a potential conflict of interest for public officials and a climate conducive to suspicion of corruption. Doubts of this kind have led some (including the Industry Commission) to propose that the states should conclude a formal agreement under which competitive bidding would be "outlawed".

A question which is vital in this connection is whether individual states can gain an economic advantage from engaging in competitive bidding. If there is little possibility of gain, the case for the "outlaw" view is greatly strengthened - there are no longer serious arguments on the other side. On the other hand, if significant gains are there to be had, as the findings in this study suggest, there will be arguments both for and against the "outlaw" view and state governments may see little reason to enter into the kind of agreement which is being proposed.

The tool which is used in this paper is a vector autoregressive (VAR) model of the conventional kind. The next section of the paper gives a brief account of the model and in Section 3 and in two appendices the results which enable strong conclusions to be drawn about the possibility of gains from competitive bidding are presented. The final section of the paper summarises the conclusions of the earlier sections and re-states two points which should be kept in mind when these conclusions are being considered.

2. THE MODEL

The model used in this study is a VAR model - a model which depicts a set of inter-related time-series variables. VAR models are distinguished from structural models, such as econometric models, computable general equilibrium models and input-output models, all of which attempt to capture the structure of (the part of) the economy being modelled. The relationships in the VAR are not behavioural relationships between the variables of interest but simply statistical relationships which are often thought of as general reduced-form models. The advantage of the VAR model is its ability to capture complex dynamic interrelationships among variables and to simulate the dynamic effects of shocks to the variables being modelled. The principal weakness of the VAR approach is its lack of structural content which makes the interpretation of results in terms of economic theories impossible.

The general VAR model is shown in equation (1) below. It will be seen that the model consists of a set of n equations in n variables, x_1........., x_n. Each equation shows one of the variables as a linear equation in k lagged values of itself and each of the other variables, the α's, the β's and the γ's are constants, and each equation has a random element, ε. The probability distribution of the ε's is specified, the usual specification being that they follow a joint normal distribution and that each has zero mean and constant variance.

$$
\begin{aligned}
x_{1t} = \alpha_{10} &+ \alpha_{11} x_{1(t-1)} + \alpha_{12} x_{1(t-2)} + \ldots + \alpha_{1k} x_{1(t-k)} \\
&+ \beta_{11} x_{2(t-1)} + \beta_{12} x_{2(t-2)} + \ldots + \beta_{1k} x_{2(t-k)} \\
&+ \ldots\ldots \\
&+ \gamma_{11} x_{n(t-1)} + \gamma_{12} x_{n(t-2)} + \ldots + \gamma_{1k} x_{n(t-k)} + \varepsilon_{1t} \\
\\
x_{2t} = \alpha_{20} &+ \alpha_{21} x_{2(t-1)} + \alpha_{22} x_{2(t-2)} + \ldots + \alpha_{2k} x_{2(t-k)} \\
&+ \beta_{21} x_{1(t-1)} + \beta_{22} x_{1(t-2)} + \ldots + \beta_{2k} x_{1(t-k)} \\
&+ \ldots\ldots \\
&+ \gamma_{21} x_{n(t-1)} + \gamma_{22} x_{n(t-2)} + \ldots + \gamma_{2k} x_{n(t-k)} + \varepsilon_{2t}
\end{aligned}
\qquad (1)
$$

......

$$
\begin{aligned}
x_{nt} = \alpha_{n0} &+ \alpha_{n1}x_{n(t-1)} + \alpha_{n2}x_{n(t-2)} + \dots + \alpha_{nk}x_{n(t-k)} \\
&+ \beta_{n1}x_{1(t-1)} + \beta_{n2}x_{1(t-2)} + \dots + \beta_{nk}x_{1(t-k)} \\
&+ \dots\dots \\
&+ \gamma_{n1}x_{(n-1)(t-1)} + \gamma_{n2}x_{(n-1)(t-2)} + \dots + \gamma_{nk}x_{(n-1)(t-k)} + \varepsilon_{nt}
\end{aligned}
$$

To set up a model within this general framework it is necessary to decide on the number of equations and variables (to give a value to n), to choose variables which will be appropriate to the purpose for which the model is being constructed and to select the maximum lag length (the value of k). The present case uses a model with seven equations and seven variables (n was fixed at seven). The seven variables were an unemployment variable for each of the six states (the two territories were excluded) and a national employment variable. This seemed to be the most appropriate choice of variables since "gain" was to be interpreted in unemployment terms. Thus the first equation in the system will have the unemployment variable for NSW on the left-hand side and a linear combination of the lagged values of unemployment for each of the states and national employment on the right-hand side. There will be a similar equation for the unemployment variable for each of the other states and for the national employment variable.

This assumes a set of linear relationships among the seven variables in which each variable depends on the lagged values of all variables. The assumption of linearity is one of convenience only. A non-linear model of this complexity would be very difficult, is not impossible, to analyse. Similarly, the convention of including lagged values of all variables in each equation is one of convenience and not based on any explicit structure.

The most straightforward choice for the state unemployment variables would have been the unemployment rate for each of the six states and for the national employment variable, the national employment rate. This choice had to be ruled out, however, because stationarity tests indicated that none of these variables was stationary and this would have created serious problems when the model came to be estimated and used for analysis.[2] Instead of choosing levels, first differences were used all of which proved to be stationary when the appropriate tests were applied. Thus the variable x_{1t} was defined as $(u_{1t} - u_{1(t-1)})$ where u_{1t} is the level of the NSW unemployment rate for period t and $u_{1(t-1)}$ is its level in the previous period; x_{2t} was defined as $(u_{2t} - u_{2(t-1)})$ where u_2 is the level of the Victorian unemployment rate; and so on.[3]

---

2 For a discussion of these problems see Hamilton (1994), Chapter 18.

3 In an earlier paper, Groenewold and Hagger (1995), reacted to the presence of non-stationarity in unemployment-rate levels by choosing unemployed-persons growth rates as the variables for an unemployment VAR model. Unemployment-rate first differences were preferred to unemployed-persons growth rates in the present study because model simulations were more easily interpreted when this choice was made.

Table 1. Test Statistics for Stationarity Tests

Unemployment Rate	ADF		PP	
	Level of Variable	First Difference of Variable	Level of Variable	First Difference of Variable
New South Wales	3.66	-3.54	2.14	-16.69
Victoria	3.26	-2.91	1.83	-17.22
Queensland	3.79	-3.73	1.48	-17.34
South Australia	3.56	-3.48	3.63	-17.84
West Australia	6.23	-3.53	2.76	-19.25
Tasmania	2.57	-3.29	5.15	-19.79
Australia	3.31	-2.79	2.06	-16.38

The test statistics for the stationarity tests referred to in the previous paragraph are shown in Table 1. The data used to calculate these test statistics were monthly and seasonally-adjusted from February 1978 to March 1996. The tests were computed using Shazam 7.0.

Two tests were employed - the Augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) test.[4] Each test was first applied to the level of each of the variables in the model. In this case the null hypothesis was one of non-stationarity. The 5% critical value is 6.25 and clearly the null hypothesis is not rejected for any of the variables, indicating non-stationarity in all cases. Each test was then applied to the first difference of each of the variables. The null hypothesis was again one of non-stationarity. The critical value was -2.86 and non-stationarity can be rejected in all cases except the Australian employment rate using the ADF test. It was concluded that all variables are stationary in first differences.

To set up a model within the framework of equation (1) it is necessary not only to specify the variables but to fix the value of k. This was done in the following way. First examine the value of the Akaike and Schwarz criteria.[5] The Akaike criterion was minimised at $k=2$ while the Schwarz criterion was minimised at $k=1$. A formal likelihood-ratio test of $k=1$ against $k=2$ rejected the restrictions implied by $k=1$. A further test of $k=2$ against $k=3$ failed to reject the restriction of $k=2$. Hence, a value of $k=2$ was chosen.

Diagnostic statistics for the model when estimated with $k=2$ are reported in Table 2. These indicate that the estimated model stands up reasonably well with this lag length. The R^2's are low but are considered satisfactory, given that the dependent variables are unemployment rates in the form of first differences. The values for the *DW* statistics are consistent with the absence of first-order

---

4 See Dickey and Fuller, (1981) and Phillips and Perron (1988). We report both tests since each has weaknesses; the PP test is valid in the face of a larger range of error specifications but it has been found to have undesirable small-sample properties. See Hamilton (1994).

5 See Judge *et al.* (1988), Chapter 18.

Table 2. Diagnostic Statistics

Estimated Equation	R^2	DW	BG(3)	BG(12)	ADF	PP
Unemployment Rate : NSW	0.15	2.09	7.9481	24.7484	-3.65	-15.36
Unemployment Rate : Vic	0.14	1.99	0.1823	17.9658	-2.79	-14.74
Unemployment Rate : Qld	0.14	1.99	4.4527	18.4907	-4.54	-14.51
Unemployment Rate : SA	0.17	2.01	1.3544	19.2746	-4.05	-14.65
Unemployment Rate : WA	0.22	1.99	4.6257	24.9369	-3.87	-14.65
Unemployment Rate : Tas	0.14	1.98	2.2715	24.2378	-3.41	-14.62
Employment Rate : Aus	0.12	2.04	5.2550	37.4613	-3.33	-15.49

autocorrelation. The two BG statistics relate to the Breusch-Godfrey test and are appropriate, respectively, for testing joint first- to third-order, and first- to twelfth-order autocorrelation[6]. BG(3) is distributed under the null hypothesis of no autocorrelation, while BG(12) is distributed under this null. The 5% critical values are 7.81 and 21.03. The figures given in the table for BG(3) and BG(12) indicate little evidence of first- to third-order autocorrelation but some evidence of higher-order autocorrelation, most of which is not detected, however, at the 1% significance level where the critical χ^2 value is 26.22. The final two columns relate to tests of stationarity of the residuals and so, in effect, are Engle-Granger tests of the cointegration of all variables in each equation. The 5 % critical value in each case is 2.82. Since the stationarity tests reported in Table 1 suggest that all variables are stationary, it would be expected that the null hypothesis of cointegration would not be rejected for any of the seven equations. This expectation is confirmed by the values for the PP statistic, and by the ADF test in all but one case. On the whole it may be concluded that the model performs satisfactorily with the exception that higher-order autocorrelation may be present in some equations.

To sum up, the model to be used in the next section to examine the "competitive-bidding" questions raised at the outset of the paper consists of seven equations, one for each of the state unemployment rates expressed as a first difference, and one for the national employment rate, also expressed as a first difference. The pattern for each equation is the same as in (1). For example, on the left-hand side of the NSW equation is the NSW unemployment rate (first difference) for month *t*, while on the right-hand side there is an intercept, two terms, each with its coefficient, in lagged values of the first difference of the NSW unemployment rate, two terms, each with its coefficient, in lagged values of the Victorian unemployment rate (first difference) and so on for each of the other four states, and two terms, each with its coefficient in lagged values of the first difference of the national employment rate. Finally there is a random term. The random term will play a vital role when we put the model to work in the next section.

---

6 See Johnston (1984).

3. MODEL RESULTS

The VAR model outlined in Section 2 is now used to analyse competitive bidding. The broad question of concern is whether individual states can profit, in terms of unemployment, by engaging in competitive-bidding contests and if so whether the states which are not engaged are likely to suffer in the process.

As explained at the outset of the paper a state can use competitive bidding either to persuade a firm or the organisers of a special event to *locate* in the state *in preference to* some other state or to persuade a firm or the organisers of a special event to *re-locate* in the state *from* some other state. The first possibility is referred to as "a competitive-bidding location contest" and to the second as "a competitive-bidding re-location contest". The two cases will be treated separately, beginning with the location-contest case.

3.1 Model Results for Competitive-Bidding Location Contests

General Procedure for Generating Model Results

To generate conclusions for the situation when competitive-bidding takes the form of a location contest, proceed as follows. Suppose one of the states succeeds by competitive bidding in attracting to its jurisdiction a new firm or a special event which would otherwise have located in one of the other states. For example, suppose Tasmania succeeds by competitive bidding (by offering financial incentives of one type or another) in attracting to Tasmania a firm or special event which would otherwise have located in Victoria. The VAR model can be used to determine the long-run reduction in Tasmania's unemployment rate consequent on the establishment of the firm or special event and the long-run change (reduction or increase) in the unemployment rates of the other five states including the "losing state", Victoria.

This exercise is then repeated four times with Tasmania still as the winning state but with NSW, Qld, SA and WA replacing Victoria, in turn, as the losing state and then another five times with one of the other states, say Victoria, replacing Tasmania as the winning state and each of the other five states (including Tasmania) taking their turn as the losing state. Continue in this way until each state has had its turn as the winning state. From the large body of results obtained from the 30 model simulations, it is possible to draw a number of important conclusions for the case of a competitive-bidding location contest.

To clarify the general procedure just described, one of the 30 simulations covering competitive-bidding location contests is discussed in detail. This is a contest between Tasmania and South Australia in which Tasmania is the winning state and South Australia is the losing state. Thus Tasmania succeeds in attracting to its jurisdiction some firm or special event which would otherwise have located in South Australia. The model provides an estimate of how much Tasmania will gain in unemployment terms from its win in the competitive-bidding game and what long-run effect this will have on the unemployment rates of the other states.

Model Results for a Tasmanian Win Against South Australia

To activate the model, assume that the firm or special event in question will create 10,000 new jobs in Tasmania and would have created 10,000 new jobs in South Australia had Tasmania not engaged in, and eventually won, a competitive-bidding location contest against that state.

Starting with this assumption, translate the 10,000 new-jobs figure into "shocks" to the error terms of the model. To capture the assumption, non-zero shocks are required for two of the seven error terms and zero shocks for the rest. The first of the error terms requiring a non-zero shock is the error term in the equation governing the national employment variable. In this case a positive shock is required. The second is the error term in the equation governing the Tasmanian unemployment variable. Here a negative shock is called for. The calculated value of the first shock is 0.1239 percentage points while the calculated value of the second is -4.9759 percentage points. The details of these shock-calculations are shown in Appendix 1. Assume that these two non-zero error-term shocks occur in month 0 and that they impinge on a steady state. Also assume that the error terms in question resume their steady state zero values in month 1.

With the values of the two non-zero error-term shocks thus fixed and the values of the remaining five held at zero, the Tasmanian unemployment variable is calculated by the estimated model for month 0, month 1, month 2, and so on indefinitely. Note that the Tasmanian unemployment variable is the first difference of the Tasmanian unemployment rate. The model calculates this first difference as a deviation from the constant first-difference which characterised the steady state. Thus the estimated model gives month-by-month, beginning with month 0, the first difference in the Tasmanian unemployment rate compared with what it would have been in the absence of the two non-zero shocks, i.e. compared with what it would have been if Tasmania had not won its competitive-bidding contest.

Appendix 2 shows that the output of the model for any one of its seven variables can be transformed from first-difference deviations to level deviations. For example the *first differences* of the Tasmanian unemployment rate as deviations from the (constant) steady-state *first difference* which the estimated model generates for month 0 onward, can be transformed into *levels* of the Tasmanian unemployment rate as deviations from the *level* which applies in the steady state. In other words the calculations produced by the estimated model can be transformed to show how the Tasmanian unemployment rate moves month-by-month, compared with what it would have been if Tasmania had not succeeded in bidding the job-creating firm or special event away from South Australia.

The transformed calculations are shown in Figure 1 up to month 24.[7] It will be seen that the Tasmanian unemployment rate reaches a new steady state within a few months of the shocks. In the new steady state the unemployment rate is 3.69

---

[7] These results and all others presented in the remainder of the paper are based on impulse response functions computed using RATS.

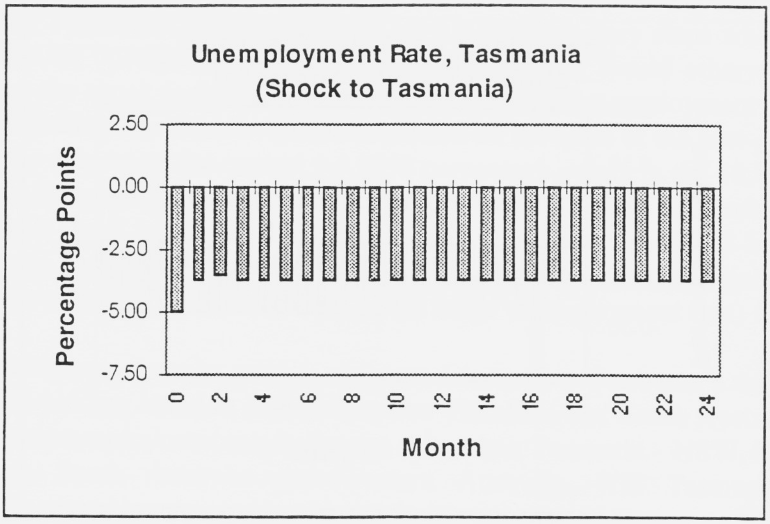

Figure 1

percentage points less than it would have been in the absence of the two shocks.

Can "in the absence of the two shocks" be taken to mean "if Tasmania had not won the competitive-bidding contest against South Australia"? The answer is "no"; the two would be identical only if Tasmania's failure to win the contest means that not only the shocks fail to materialise in *Tasmania*, but that they fail to materialise *anywhere*. In fact, if the shocks fail to materialise in Tasmania (if Tasmania loses the contest) they will appear, by assumption, in South Australia. This being the case, they will have effects not only on South Australia but on each of the other states, including Tasmania. The estimated model can be used to calculate the consequences for Tasmania. All that is required is to translate the 10,000 boost to employment in South Australia consequent on the advent of the new firm or special event into a shock to the error term of the South Australia unemployment equation; and using the same shock to the error term of the national employment equation, run a model simulation which focuses on the *Tasmanian* unemployment rate. In other words, reverse the roles of the two states; South Australia now becomes the winning state and Tasmania the losing state.

The results of this simulation are shown in Figure 2. It will be seen that, once again, the Tasmanian unemployment rate settles into a new steady state within a few months of the shocks and reaches a figure 0.26 percentage points below what it would otherwise have been. This reduction would have occurred even if Tasmania had lost the competitive-bidding contest against South Australia and must be subtracted from the 3.69 figure emerging from the first simulation if we are to find the unemployment reduction which can be properly attributed to Tasmania's win.

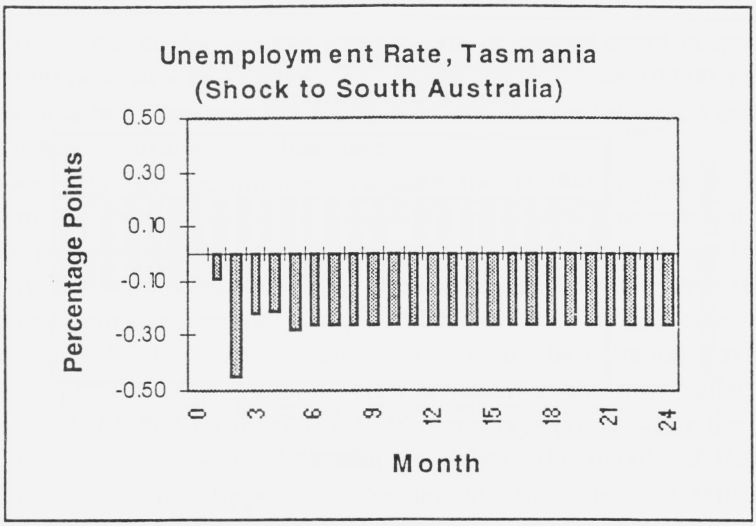

Figure 2

The final conclusion, therefore, is that, because of its win in the competitive-bidding location contest against South Australia, Tasmania has secured a long-run reduction in its unemployment rate, below what it would otherwise have been, of 3.43 percentage points. This is the answer which the model gives for the gain which Tasmania reaps from its win in the competitive-bidding location contest against South Australia.

Of course this figure is conditional on the 10,000 new-jobs figure assumed at the outset and to that extent is arbitrary. However, it is possible to work out what the "advantage" figure will be for any other "new-jobs" figure simply by straight proportioning. For example, the advantage figure for 2,500 jobs (25 per cent of 10,000) will be -0.86 percentage points (-3.43 divided by 4). This proportioning is valid as a consequence of the fact that the shocks for, say, a 2,500 new-jobs figure are 25 per cent of those for a 10,000 figure and that the model is linear.

Another point which must be stressed is that the percentage-point reduction associated with a particular new-jobs figure (3.43 for 10,000 new jobs, 1.72 for 5,000, 0.86 for 2,500 and so on) is an *upper-bound or potential* advantage figure. The extent to which the potential gain is realised in any actual situation (the extent to which the actual gain falls below the potential gain) will depend on the size and nature of the financial incentives which Tasmania has to give the firm or the organisers of the special event to ensure that the 10,000 new jobs (or 5,000 or 2,500 or whatever) are located in Tasmania instead of South Australia.

Regardless of their form, the provision of financial incentives will necessitate some form of budgetary adjustment by the Tasmanian government - either the Tasmanian government will have to increase its tax collections above what they would otherwise have been, or it will have to reduce its spending below what it would otherwise have been, or it will have to borrow more than it would otherwise have. Inevitably, therefore, in the course of winning the location contest, the Tasmanian government will have taken budgetary steps which cause the Tasmanian unemployment rate to be higher than it would otherwise have been. Thus the shock to the error term in the Tasmanian unemployment equation will be something less than the shock calculated on the basis of the new-jobs total which is the subject of the contest (-4.9759 percentage points in the 10,000 new-jobs case). However, only if the number of jobs lost in the course of winning the contest is at least equal to the number gained will the potential economic advantage to Tasmania from winning the contest (in the 10,000 new-jobs case a long run reduction of 3.43 percentage points in its unemployment rate) fail to be realised.

The model can now be used to estimate what effect Tasmania's win in the competitive-bidding location contest between Tasmania and South Australia will have on the unemployment rates of states other than Tasmania - NSW, Victoria, Queensland, South Australia and Western Australia. Will Tasmania have achieved its unemployment-rate reduction at the expense of one or more of these states?

"The effect of Tasmania's win" on, say, New South Wales is interpreted as the change in the New South Wales steady-state unemployment rate which occurs *with* the win *minus* the change which would have occurred *without* the win. With the win, 10,000 new jobs, say, are located in Tasmania; without the win these jobs would have gone to South Australia. Thus to gauge the effect of the contest on New South Wales, the model estimates what change occurs in the New South Wales steady-state unemployment rate when the unemployment shock impinges on Tasmania and what change occurs when the unemployment shock impinges on South Australia. Subtracting the second change from the first gives the effect of the win on New South Wales. Should the final figure be positive, the model's answer will be that Tasmania's win has an adverse effect on New South Wales; and *vice versa*.

The model calculations required to determine the effect of Tasmania's win in the competitive-bidding location contest between Tasmania and South Australia are shown in Table 3.

It will be seen that, of the states other than Tasmania, only South Australia (the losing state) is adversely affected by Tasmania's win in the competitive-bidding location contest. South Australia's steady-state unemployment rate rises by 0.78 percentage points as a result of Tasmania's win (South Australia's loss) but all other states record a slight fall of between one-quarter and one-half of a percentage point in their steady-state unemployment rate. Thus the results show that Tasmania's gain from winning the contest against South Australia is not at the expense of any of the other states apart from South Australia itself. Indeed, the other states gain.

Table 3. Effect of Tasmania's Win Against South Australia on States Other Than Tasmania

	Change in Steady-State Unemployment Rate		
	(1)	(2)	(3)
State	Shock to Tasmania	Shock to South Australia	(1) - (2)
NSW	-0.6971	-0.1799	-0.4572
Vic	-0.5979	-0.1134	-0.4845
Qld	-0.3737	-0.1073	-0.2664
SA	-0.2087	-0.9847	0.7760
WA	-0.4607	-0.0887	-0.3720

Full Results and Conclusions for Competitive-Bidding Location Contests

In the two preceding sections, the general procedure for generating model results for a competitive-bidding location contest was explained and applied to a contest between Tasmania and South Australia which is won by the former. In this section, the full set of simulation results for competitive-bidding location contests is presented with a number of general conclusions about the workability of this form of competitive bidding. The results are presented in two tables, Table 4 and Table 5. Both are based on a 10,000 new-jobs figure.

Begin with Table 4. The first row of the table deals with the case where NSW succeeds by competitive bidding in attracting 10,000 new jobs which would otherwise have gone to Victoria. In the column headed "Gross" is shown the reduction in the NSW steady-state unemployment rate consequent on the positive shock implied by this figure for the error term of the national employment equation and the implied negative shock for the error term of the NSW unemployment equation (0.1239 percentage points and 0.3573 percentage points, respectively). In the column headed "Deduction" is the reduction in the NSW steady-state unemployment rate which would have occurred even if NSW had *not* won the contest - if Victoria had won. Finally, in the column headed "Net" is shown the reduction in the NSW steady- state unemployment rate which is properly attributable to its win against Victoria in the competitive-bidding location contest.[8] All other rows in the table are interpreted in exactly the same way.

Table 4 yields several important conclusions of a general nature. The first is that the creation of new jobs anywhere in the economy will generally benefit all states in terms of reducing their unemployment rates. This is evidenced by the generally negative entries in the "Deductions" column in Table 4.

The second is that *permanent* gains can be achieved from wins in competitive-bidding location contests; generally speaking it is not the case, as might be supposed, that the winners of such contests are better off in the short-run

[8] The figure in this column (-0.31) corresponds to the figure of -3.43 found for Tasmania in the Tasmanian-South Australian simulation analysed in detail above; the results for this simulation appear in the second last row of the table.

Table 4. Gains from Winning Competitive-bidding Location Contests

State		Change in Steady-state Unemployment Rate of Winning State (Percentage Points)		
Winning	Losing	Gross	Deduction	Net
NSW	Vic	-0.4063	-0.0948	-0.3115
NSW	Qld	-0.4063	0.0688	-0.4751
NSW	SA	-0.4063	-0.1799	-0.2264
NSW	WA	-0.4063	-0.0568	-0.3495
NSW	Tas	-0.4063	-0.6971	0.2908
Vic	NSW	-0.3658	-0.1039	-0.2619
Vic	Qld	-0.3658	-0.1166	-0.2492
Vic	SA	-0.3658	*-0.1134*	*-0.2524*
Vic	*WA*	-0.3658	-0.1493	-0.2165
Vic	Tas	-0.3658	-0.5979	0.2321
Qld	NSW	-0.5180	-0.1028	-0.4152
Qld	Vic	-0.5180	-0.0347	-0.4833
Qld	SA	-0.5180	-0.1073	-0.4107
Qld	WA	-0.5180	-0.1274	-0.3906
Qld	Tas	-0.5180	-0.3737	-0.1443
SA	NSW	-0.9847	-0.0838	-0.9009
SA	Vic	-0.9847	-0.0227	-0.9620
SA	Qld	-0.9847	-0.0789	-0.9058
SA	WA	-0.9847	-0.1633	-0.8214
SA	Tas	-0.9847	-0.2087	-0.7760
WA	NSW	-0.8426	-0.1045	-0.7381
WA	Vic	-0.8426	0.0101	-0.8527
WA	Qld	-0.8426	-0.0907	-0.7519
WA	SA	-0.8426	-0.0887	-0.7539
WA	Tas	-0.8426	-0.4607	-0.3819
Tas	NSW	-3.6947	-0.0165	-3.6782
Tas	Vic	-3.6947	-0.1589	-3.5358
Tas	Qld	-3.6947	0.1293	-3.8240
Tas	SA	-3.6947	-0.2625	-3.4322
Tas	WA	-3.6947	0.0628	-3.7575

but revert in the long-run to the situation they would have been in had they not engaged in the contest in the first place. This is clear from the presence of negative signs in the final column of the table.[9]

The third conclusion is that *all* states have an incentive to engage in competitive-bidding location contests; every state has at least one contest from which it gains a permanent reduction in its unemployment rate both when it wins and when it loses. This conclusion reflects the fact that each state has at least one row in Table 4 with a negative entry in both the "Deduction" column and the

[9] The gains are, of course, *potential* gains; this will be clear from earlier discussions.

"Net" column.

The fourth conclusion is that two states (Queensland and South Australia) have an incentive to engage in competitive-bidding location contests against *all* other states. This follows from the fact that *all* of the Queensland and South Australia rows in Table 4 have negative signs in *both* the "Deduction" and "Net" columns.

Finally, it can be concluded that the smaller states gain more from winning a competitive-bidding location contest with a given "new-jobs" prize than the larger. For example, if it wins, Tasmania can achieve a permanent unemployment-rate deduction of at least 3.43 percentage points. If South Australia wins, it gains a reduction of at least 0.78 percentage points. On the other hand, if New South Wales wins it can achieve no more than a reduction of 0.48 points, while if Victoria wins the maximum reduction is 0.26 points.

The reason for this conclusion is twofold. In the first place, for a given number of new jobs being contested, the smaller the state the larger will be the negative unemployment-rate shock associated with victory, i.e. the larger will be the reduction in the unemployment rate, below its steady-state value, which is associated with month 0. For example, when Tasmania wins in the 10,000 new-jobs case, the month-0 value is -4.98 percentage points whereas when New South Wales wins the month-0 value is -0.36 points.

Secondly, the nature of the dynamic inter-relationships which exist between the unemployment rates of the six states and which are captured by the VAR model are such that the smaller states are able to retain a significant part of their initial gains from a win. For example, in the 10,000 new-jobs case when Tasmania wins against South Australia, the value associated with month 24 is 3.69 points - only 1.29 points less than the month-0 value.

Table 5 shows, for each of the thirty possible competitive-bidding contests, the long-run effects of the outcome of the contest on the unemployment rates of each of the states including the winning state and the losing state. It will be seen that the figures which appear in this table for the winning state are those which appear in Table 4. Like the figures in Table 4, all of the figures in this table are "net" in character, i.e. each figure takes account of the fact that there would have been some change to the long-run unemployment rate of the state concerned if the roles of the two contestants had been reversed.

Several further conclusions about competitive-bidding location contests can be drawn from this table. The first is that the state which loses in a competitive-bidding location contest may nevertheless gain from the victory of the winning state in terms of a long-run reduction of its unemployment rate. Examples are the contests in which South Australia and Western Australia lose to Tasmania.

Secondly, in cases where the losing state *is* adversely affected by the outcome of the contest, it may be the *only* state of which this is true. Examples are the contest between Western Australia and Queensland and Tasmania and Queensland.

Table 5. Effects of Competitive-bidding Location Contests on the Individual States

State		Net Change in Steady-State Unemployment Rate (Percentage Points)						Change in Steady-state Employment Rate (Percentage Points)
Winning	Losing	NSW	Vic	Qld	SA	WA	Tas	Aus
NSW	Vic	-0.3114	0.2619	-0.0681	-0.0611	-0.0943	0.1424	0.0643
NSW	Qld	-0.4750	0.0127	0.4152	-0.0050	-0.0138	-0.1458	0.0876
NSW	SA	-0.2263	0.0094	0.0046	0.9010	-0.0157	0.2459	-0.0022
NSW	WA	-0.3494	0.0454	0.0247	0.0796	0.7381	-0.0793	0.0223
NSW	Tas	0.2908	0.4940	0.2709	0.1249	0.3561	3.6782	-0.4200
Vic	NSW	0.3114	-0.2619	0.0681	0.0611	0.0943	-0.1423	-0.0643
Vic	Qld	-0.1636	-0.2492	0.4833	0.0562	-0.0103	-0.2882	0.0233
Vic	SA	0.0851	-0.2525	0.0727	0.9620	0.0786	0.1036	-0.0665
Vic	WA	-0.0380	-0.2165	0.0928	0.1406	0.8324	-0.2217	-0.0420
Vic	Tas	0.6022	0.2320	0.3390	0.1860	0.4505	3.5358	-0.4843
Qld	NSW	0.4750	-0.0127	-0.4152	0.0050	0.0138	0.1458	-0.0876
Qld	Vic	0.1636	0.2492	-0.4833	-0.0561	-0.0805	0.2882	-0.0233
Qld	SA	0.2487	-0.0033	-0.4107	0.9059	-0.0019	0.3918	-0.0898
Qld	WA	0.1256	0.0327	-0.3906	0.0845	0.7519	0.0665	-0.0653
Qld	Tas	0.7658	0.4813	-0.1443	0.1299	0.3699	3.8240	-0.5076
SA	NSW	0.2263	-0.0094	-0.0046	-0.9010	0.0157	-0.2459	0.0022
SA	Vic	-0.0851	0.2525	-0.0727	-0.9620	-0.0786	-0.1036	0.0665
SA	Qld	-0.2487	0.0033	0.4107	0.9059	0.0019	-0.3918	0.0898
SA	WA	-0.1231	0.0360	0.0201	-0.8214	0.7538	-0.3253	0.0245
SA	Tas	0.5171	0.4846	0.2664	-0.7761	0.3719	3.4322	-0.4178
WA	NSW	0.3494	-0.0454	-0.0247	-0.0796	-0.7381	0.0793	-0.0223
WA	Vic	0.0380	0.2165	-0.0928	-0.1406	-0.8324	0.2217	0.0420
WA	Qld	-0.1256	-0.0327	0.3906	-0.0845	-0.7519	-0.0665	0.0653
WA	SA	0.1230	-0.0361	-0.0203	0.8205	-0.7542	0.3264	-0.0243
WA	Tas	0.6402	0.4486	0.2462	0.0453	-0.3820	3.7575	-0.4423
Tas	NSW	-0.2908	-0.4940	-0.2709	0.1249	-0.3561	-3.6782	0.4200
Tas	Vic	-0.6022	-0.2320	-0.3390	-0.1860	-0.4505	-3.5358	0.4843
Tas	Qld	-0.7658	-0.4813	0.1443	-0.1299	-0.3699	-3.8240	0.5076
Tas	SA	-0.5171	-0.4846	-0.2664	0.7761	-0.3719	-3.4322	0.4178
Tas	WA	-0.6402	-0.4486	-0.2462	-0.0453	-0.3820	-3.7575	0.4423

Thirdly, it is possible for a contest to have beneficial long-run effects on all of the states, including the losing state. This is true, for example of the contest which Tasmania wins against South Australia and Western Australia.

Finally, it may well be that the outcome of a contest is favourable to the states *collectively* even though some individual states are adversely affected. Examples are the contest won by South Australia against New South Wales and against Victoria, and the contest won by South Australia against Queensland; in all of these contests the long-run change in the national employment rate is positive.[10] Moreover, jobs created in some states have greater national benefits than in others

It must be emphasised that *none* of conclusions which have been drawn from Tables 4 and 5 depends in any way on the 10,000-jobs figure used in the construction of these tables. *Every one* of the conclusions would hold if any other figure had been used since every entry in the new tables would be the same as the corresponding entry in the present tables except for a proportionality factor.

3.2 Model Results for Competitive-Bidding Re-location Contests

General Procedure for Generating Model Results

The situation in which competitive bidding takes the form of a *re*-location contest is similar, with one difference of detail to be mentioned in a moment, to the case of a location contest.

For example, assume Tasmania succeeds by offering financial incentives in persuading a firm or the organisers of a special event to re-locate from some other state, say South Australia. The VAR model can then be used to determine the long-run reduction in Tasmania's unemployment rate consequent on the re-location and the long-run change in the unemployment rate of the other five states including the state which has been "raided", South Australia.

This modelling exercise would then be repeated four times with Tasmania still as the "raiding" state but with NSW, Vic, Qld, and WA, replacing South Australia, in turn, as the raided state and then another five times with one of the other states, say Victoria, replacing Tasmania as the raiding state and each of the other five states (including Tasmania) taking their turn as the raided state. Continue in this way until each state has had its turn as the raiding state. This gives 30 model simulations and from the large body of results we could draw conclusions for the case of a competitive-bidding *re*-location contest.

The difference of detail referred to earlier relates to the shock pattern that would be used to activate the model. In the location case the aim of each contestant is to capture for their jurisdiction a certain number of *new* jobs, say 10,000, which are going to be located somewhere in the country. By contrast, in the re-location case the aim of one contestant is to capture for its jurisdiction 10,000 jobs which are already located in the jurisdiction of the other contestant, while the aim of the other contestant is to prevent this happening. Thus in the re-location case the contest is not about the destination of a given increment to the national job-total but rather about the distribution of a given national job-total.

This difference in the nature of the two contests would mean that the shock patterns which are appropriate would also be different. The analysis of a

---

[10] An increase in the national steady-state employment rate means a decrease in the national steady-state unemployment rate by virtue of the identity : unemployment rate = 1 - employment rate.

competitive-bidding location contest by means of the VAR model calls for a positive shock to the error term of the national employment equation, a negative shock to the error term of the unemployment equation of the winning state and zero shocks for the error terms of all remaining five unemployment equations. Analysing a competitive-bidding *re*-location contest, however, requires a positive shock to the error term of the unemployment equation of the "raided" state, a negative shock to the error term of the unemployment equation of the "raiding" state and zero shocks elsewhere. In particular the error term of the national employment equation would have a zero shock.

Surprising though it may be, however, the results that would be generated by the procedure just described are no different from those that already appear in Table 5. That this is so is essentially due to the linear structure of our VAR model. We may therefore use Table 5 as it stands, except for a change in headings from "Winning" and "Losing" to "Raiding" and "Raided", to draw conclusions about competitive-bidding contests of the re-location kind.

The first conclusion is that the raiding state does not always gain, in terms of a long-run unemployment-rate reduction from engaging in a competitive-bidding re-location contest.[11] In particular, neither New South Wales nor Victoria gain by raiding Tasmania.

A second conclusion is that, in cases where a raid "comes off" the benefit to the raiding state is not necessarily at the expense of the raided state. For example when Tasmania raids South Australia both states achieve a long-run reduction in their unemployment rate.

A third important conclusion is that, in cases where a raid comes off, the benefit to the raiding state is not necessarily at the expense of *any* other state - all may gain from the raid. This is the situation whenever a row contains all negatives. Examples are a Tasmanian raid on South Australia and a Tasmanian raid on Western Australia.

Finally, the table shows that the states may gain *collectively* from a raid which comes off, even when some states lose. This situation is indicated by a positive entry in the final column of a row[12] and a mixture of positive and negative entries in the other columns. Examples are a Western Australian raid on Queensland and a South Australian raid on Queensland.

Once again it must be emphasised that the conclusions which have just been drawn from Table 5 do not depend in the least on the 10,000 redistributed-jobs figure on which the table is based since if any other figure had been used all entries in the new table would be the same as those in the present table except for a proportionality factor.

While it may be tempting to conjecture about the economics underlying these results, the reader is reminded of the atheoretical nature of the VAR model. The

---

11 Throughout this section "gain" will be taken to mean *potential* gain; as explained earlier there is always doubt about *actual* gains even when potential gain can be established.

12 See footnote 8.

model itself, therefore, provides no basis for such theorising which must await the construction and analysis of a structural model.

4. CONCLUSION

The aim of this paper has been to undertake a numerical analysis of competitive-bidding contests which is regional in character in the sense that it focuses on the consequence of such contests for the individual states rather than for the country as a whole.

Two types of competitive-bidding contest can be distinguished. In the first, which have been called “location contests”, two states bid against each other by offering financial incentives of various kinds for the location of the new jobs associated with a new firm or a special event in their jurisdiction. In the second, called “re-location contests”, one state bids to have jobs which already exist in another state transferred to its jurisdiction while the second state makes a counter-bid to retain them. Numerical analysis of both types of contest has been undertaken in the paper.

For the purposes of the analysis, gains and losses have been interpreted in unemployment-rate terms. An individual state is regarded as having profited from engaging in a competitive-bidding contest if it achieves a permanent reduction in its unemployment rate. Similarly one of the states which is not engaged in the contest is regarded as having suffered if its unemployment rate is permanently higher than it would have been if the contest had not occurred.

The vehicle used to carry out the analysis is a seven-variable, seven-equation VAR model of the conventional kind. As is appropriate, having regard to the unemployment-rate interpretation of gains and losses, the variables are an unemployment variable for each of the six states and an employment variable for the country as a whole.

A large number of conclusions have been drawn from the numerical analysis in relation to both types of competitive-bidding contest. The major conclusions are that:

- *permanent* gains in unemployment terms can be achieved by the winners of competitive-bidding location contests;
- a state can achieve long run gains from a competitive-bidding location contest even if it loses the contest;
- it is possible for a competitive-bidding location contest to have beneficial long-run effects on all of the states, including the losing state;
- the outcome of a competitive-bidding location contest may be favourable to the states collectively even though some individual states may be adversely affected;
- the “raiding” state in a competitive-bidding re-location contest does not necessarily gain in terms of a long-run reduction of its unemployment rate;
- the states may gain collectively in unemployment terms from a competitive-bidding re-location contest even when some states lose.

These and other conclusions which emerge from the VAR analysis, are subject to two limitations which should be noted. In the first place, gains and losses are interpreted in unemployment-rate terms. This is a legitimate interpretation but it is by no means the only one which might have been adopted. Two other obvious possibilities are constant-price GDP and constant-price GDP per capita.

In the second place the conclusions about the unemployment gains which are achievable by the winners of competitive-bidding contests relate to *potential* gains only. Whether these potential gains are realised in any actual case will depend on the extent and nature of the financial incentives which had to be given by the winner - a careless bidder could find that the unemployment loss associated with the bid exceeds the unemployment gain flowing from victory.

The broad thrust of the conclusions is that the states stand to gain from playing the competitive-bidding game provided they play the game sensibly. They have, therefore, little incentive to respond to a call for an agreement aimed at putting the game beyond the law.

REFERENCES

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

Groenewold, N. and Hagger, A.J. (1995) Regional unemployment dynamics: the big neighbour effect. *Australasian Journal of Regional Studies*, 1, pp. 197-214.

Hamilton, J.D. (1994) *Time Series Analysis*. Princeton University Press: Princeton, N.J.

Industry Commission (1996) *State, Territory and Local Government Assistance to Industry (Draft Report)*. Industry Commission: Melbourne.

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

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

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

APPENDIX 1.

This appendix derives the expression for the appropriate shock to the Australian employment rate and a state's unemployment rate which corresponds to a location contest over 10,000 persons.

Take the Australian employment rate. Denote the employment rate by $e = E/L$ where E denotes the number of persons employed and L denotes the labour force. Recall that the model is specified in first differences:

$$\Delta e_t = e_t - e_{t-1}$$

Assume that the economy is in a steady state at $t = -1$ and that the increase in employment occurs at $t = 0$. Hence E_0 is 10,000 higher than E_0^*, the value that E_0 would have taken on if the steady state had persisted. Thus

$$E_0 = E_0^* + 10{,}000$$

It follows that

$$e_0 = \frac{E_0}{L_0} = \frac{E_0^* + 10{,}000}{L_0} \equiv e_0^* + \frac{10{,}000}{L_0}$$

Now

$$\Delta e_0 = e_0 - e_{-1}$$

and

$$\Delta e_0^* = e_0^* - e_{-1}$$

Hence the shock to Δe, (denoted by s) is given by:

$$\begin{aligned} s &= \Delta e_0 - \Delta e_0^* \\ &= (e_0 - e_0^*) \\ &= \frac{10{,}000}{L_0} \\ &= \frac{10{,}000}{L_{-1}(1 + \bar{l})} \end{aligned}$$

where $\bar{l}$ denotes the steady-state growth rate of the labour force. In the numerical applications of the model, take L_{-1} to be the labour force at the end of the sample period and $\bar{l}$ to be the sample average monthly growth rate in the labour force.

A similar expression for the shock to the unemployment rate of the winning state may be derived by replacing E_0 by U_0 (the number of persons unemployed) and noting that the increase in employment of 10,000 will reduce U by 10,000.

APPENDIX 2.

This appendix explains how the model output is transformed into deviations from steady-state unemployment-rate levels. The model reports the effects of a shock in terms of deviations of first differences from their steady-state values. Take a particular unemployment rate, u, with first difference in period t denoted by Δu_t. The model produces impulse responses at each period after the shock. The impulse response is:

$$IR_t = \Delta u_t - \Delta u_t^*$$

where Δu_t^* is the value that Δu_t would have taken on in the absence of the shock, i.e. if the steady had not been disturbed by the shock. Since the shock occurs at $t = 0$

$$\left.\begin{aligned} IR_t &= 0 \\ \text{and} \quad u_t &= u_t^* \end{aligned}\right\} \text{for } t = \ldots -3,\ -2,\ -1$$

Then the cumulative impulse response, CIR_t, is

$$\begin{aligned} CIR_t &= \sum_{j=-\infty}^{t} IR_j = IR_t + IR_{t-1} + \ldots + IR_0 \\ &= (\Delta u_t - \Delta u_t^*) + (\Delta u_{t-1} - \Delta u_{t-1}^*) + \ldots + (\Delta u_0 - \Delta u_0^*) \\ &= (u_t - u_{t-1}) - (u_t^* - u_{t-1}^*) + (u_{t-1} - u_{t-2}) - (u_{t-1}^* - u_{t-2}^*) + \ldots + (u_0 - u_{-1}) - (u_0^* - u_{-1}^*) \\ &= (u_t - u_t^*) \end{aligned}$$

Hence the cumulative impulse response function gives the deviation of the unemployment rate from its steady-state level.